Appendix A

	High-Performance Building Design Professional Certification Examination Content Outline Guideline 36: Best of Class HVAC Control Sequences	Submit to ALI Complexity Level and Number of Items Recall	Application	Analysis	TOTALS
	I. BACKGROUND INFORMATION	***6***	***10***	***2***	***18***
	A. Sustainability Concepts	***3***	***3***	***0***	***6***
X	1. Define energy efficiency concepts.				
	2. Explain the following:				
	a. commissioning (e.g., owner's-project requirements, commissioning process, measurement and verification, retrocommissioning).				
	b. the design process (e.g., integration, team formation, team dynamics, documentation requirements, building information modeling).				
	c. water usage efficiency.				
	d. environmental impact (e.g., emissions, solid and fluid waste disposal).				
	3. Demonstrate indoor environmental quality elements (e.g., thermal comfort parameters, ventilation, acoustics, chemical and human pollutants, lighting, biological contaminants).				
	4. Analyze the building envelope.				
	5. Consider capital equipment options.				
	6. Define net-zero energy building concepts.				
	7. Understand the definition of life cycle analysis:				
	a. explain life cycle.				
	b. identify benefits and limitations of analysis methods.				
	B. HVAC Processes	***3***	***2***	***0***	***5***
	1. Obtain the owner's project requirements (OPR).				
	2. Identify and evaluate alternative systems:				
	a. selection.				
	b. optimization.				
	c. operability.				
	d. maintainability.				
	3. Comply with codes and standards in the design and construction documents.				
	4. Utilize incentives offered, as applicable.				
	5. Design hydronic and air distribution systems to minimize energy consumption.				

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	Recall	Application	Analysis	TOTALS
B. Sustainable Processes	***0***	***4***	***2***	***6***
1. Utilization of natural resources.				
2. Analyze alternative/renewable energy sources:				
a. solar assisted DHW heating.				
b. photovoltaic.				
c. air to water heat pumps.				
d. air to air heat pumps.				
e. ground source heat pumps.				
3. Evaluate feasibility/options for a net-zero energy building.				
4. Explain implications of siting.				
C. Environmental Improvement Programs and Rating Systems	***0***	***1***	***0***	***1***
1. Advise customers on available programs and systems.				
2. Distinguish among programs and systems (pros, cons, costs).				
II. ENERGY ANALYSIS	***6***	***8***	***8***	***22***
A. Envelope / Massing / Orientation Optimization	***0***	***2***	***2***	***4***
1. Perform tradeoffs on the cost/benefit of alternatives.				
2. Determine the impact of climate on design.				
3. Analyze thermal mass effect.				
4. Analyze effect of envelope decisions on building pressurization.				
B. Initial Assessment	***2***	***2***	***2***	***6***
1. Identify facility parameters.				
2. Calculate preliminary building loads.				
3. Determine alternative system concepts.				
4. Identify interrelated processes and systems, and perform synergy analysis.				
5. Analyze energy consumption for different options (e.g., modeling).				
6. Compare alternative systems.				
C. Ventilation	***2***	***2***	***4***	***8***
1. Natural:				
a. analyze benefits and consequences of alternatives.				
b. apply thermal gradient theories (e.g., stack effect, buoyancy).				

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	2. Mechanical:				
	a. analyze benefits and consequences of alternatives.				
	b. optimize zone loading with the mechanical system.				
	3. Integrate natural and mechanical ventilation into hybrid systems.				
	4. Identify key reference documents.				
	5. Determine appropriate energy recovery methods.				
	6. Assess cross contamination risk.				
	C. Energy Compliance Modeling	***2***	***2***	***0***	***4***
	1. Apply modeling techniques to predict the following with respect to established targets:				
	a. code compliance.				
	b. energy consumption.				
	c. emissions impact.				
	2. Distinguish among modeling techniques.				
	3. Define energy modeling limitations and alternative calculation methods.				
	III. INDOOR and SITE ENVIRONMENT	***6***	***7***	***4***	***17***
	A. Thermal Comfort	***1***	***4***	***2***	***7***
	1. Identify:				
	a. comfort variables that affect the occupant (e.g., operative temperature, clo value, metabolic rate).				
	b. key reference documents.				
	c. thermal comfort requirements of individuals and groups.				
	2. Zone the building and determine building pressurization requirements to optimize comfort and energy efficiency.				
	3. Plan individual control and zoning strategies.				
	B. Air Quality	***3***	***2***	***1***	***6***
	1. Control indoor air contaminants/pollutants.				
X	2. Identify outdoor air ventilation requirements.				
	3. Analyze air quality strategies.				
	4. Recognize applications requiring governmental and regulatory codes.				
	5. Recognize impact of external environment.				

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	D. Lighting	***2***	***1***	***1***	***4***
	1. Integrate the occupant's mission with lighting requirements.				
	2. Analyze visual quality of the lighted space.				
	3. Integrate daylighting and lighting.				
	4. Assess site lighting goals.				
	IV. CONTROLS and MONITORING	***5***	***7***	***2***	***14***
	A. Control Hardware	***2***	***1***	***0***	***3***
	1. Establish sensors, instrumentation, and calibration requirements.				
x	2. Define the control functions of the equipment.				
	3. Determine the need for central monitoring and control such as:				
	a. trending (logging intervals, storage capacity).				
	b. alarms.				
	c. remote access.				
	B. Control Strategies	***3***	***6***	***2***	***11***
x	1. Establish control sequences that meet the owner's objectives.				
x	2. Integrate controls with equipment and systems.				
x	3. Instruct building operators in system functions.				
	4. Establish:				
	a. operator training requirements.				
	b. operating and maintenance procedures.				
	c. reporting requirements.				
	5. Incorporate energy reporting capabilities.				
x	6. Optimize control sequences for energy conservation.				
	V. BENCHMARKING WITH PERFORMANCE METRICS	***1***	***4***	***2***	***7***
	B. Project Performance Measurement	***0***	***1***	***0***	***1***
	1. Assess the efficiency of information transfer on high-performance requirements.				
	2. Assess financial and time impact of implementing sustainable principles.				
	C. Energy Performance Verification	***1***	***2***	***1***	***4***
	1. Measure the performance of a building.				
	2. Normalize performance data and trends.				
	3. Compare the performance of a building against:				
	a. projections.				
	b. similar buildings.				

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D. Environmental Performance Measurement	***0***	***1***	***1***	***2***
1. Compare emissions measures to goals.				
2. Compare utility consumption to goals.				
3. Compare occupant satisfaction measures to goals.				
VI. WATER CONSERVATION	***3***	***4***	***1***	***8***
E. Storm Water Management	***1***	***2***	***0***	***3***
1. Analyze feasibility of harvesting options and uses.				
2. Define:				
a. storage methods and quantities.				
b. treatment options.				
3. Calculate optimum capacity and use.				
4. Apply best management practices.				
F. Domestic Water Management	***1***	***2***	***1***	***4***
1. Analyze fixture selection impact.				
2. Determine irrigation reductions.				
3. Develop strategies to reduce potable water consumption for:				
a. reclaimed water.				
b. non-potable water harvesting.				
c. irrigation optimization.				
d. types of vegetation and planting.				
G. Process / Wastewater Management	***1***	***0***	***0***	***1***
1. Condition and reuse processed and wastewater.				
2. Comply with federal regulations.				
VII. COMMISSIONING IN SUSTAINABLE CONSTRUCTION	***3***	***3***	***1***	***7***
H. Documentation	***2***	***1***	***0***	***3***
1. Identify unique requirements for sustainable construction.				
2. Determine the owner's objectives and criteria.				
3. Define commissioning scope.				
4. Specify systems and operations.				
X 5. Identify the sequence of operations.				

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I. Commissioning Process	***1***	***2***	***1***	***4***
1. Integrate quality control into design and construction.				
2. Verify quality assurance in design and construction.				
3. Evaluate post-occupancy performance.				
4. Develop a feedback/corrective action methodology.				
5. Implement corrective actions (e.g., recommissioning, retrocommissioning).				
I. ENERGY and MATERIALS USE and MANAGEMENT	***4***	***3***	***0***	***7***
1. Encourage the owner to hire an energy manager.				
2. Identify needed competencies of staff who will service a building.				
3. Implement a maintenance plan.				
4. Recommend sustainable practices for:				
a. housekeeping and site management.				
b. renovation projects.				
Totals	***34***	***46***	***20***	***100***

Appendix B

Acceptable Professional Development Activities and PDHs Earned

Activity	PDHs
Completion of short courses, workshops and seminars in a related field	1 PDH for each hour of documented attendance
Attendance at meetings and conferences (e.g. National, Annual, Regional) or special conferences in a related field	1 PDH for each hour of documented attendance
Successful completion of a course in a related field from an accredited institution of higher learning **Note:** *To qualify for this credit, a course must be offered regularly and must conclude with a test that sets a passing grade.*	15 PDHs per credit hour (semester system) OR 10 PDHs (quarter system)
Patent in a related field **Note:** *PDHs can be claimed after a patent is issued and the inventor submits details to the board. The invention must be related to engineering.*	10 PDHs per patent
Publication of article/paper/book in a recognized, peer reviewed journal in a related field (max. 3 per year). **Note:** *A "news" article in a technical or professional bulletin is not considered a published paper.*	10 PDHs per published item
Active participation in a professional or technical society in a related field **Note:** *The certificant must serve as an officer and/or must actively participate in a committee of the organization. PDHs are earned at the end of each year of service.*	2 PDHs per year per organization
Write ASHRAE certification exam items in a related field	5 PDHs per 10 acceptable exam questions, annually
Pass ASHRAE certification exam (E.g. HBDP should pass HBDP exam)	45 PDHs
Accreditation Visit Evaluator	3 PDHs, annually
Professional awards	2 PDHs per award
Teach courses and workshops in a related field. Faculty performing regular duties may earn PDHs	2 PDHs per hour taught for the first presentation, then 1 per hour for subsequent equivalent presentations.

Certificants are not required to submit a report of Professional Development activities as part of the recertification application; however, a percentage of Certificants are randomly chosen for audit each year. If audited, a report of continuing professional development with documentation must be submitted to the Certification Coordinator for review.

For questions about any of the information about ASHRAE certification renewal requirements, including clarification of acceptable and reportable qualifying activities, please contact ASHRAE Certification Coordinator at certification@ASHRAE.org.