Work Session 2

1. Define the following terms:

   Cost Escalation: _____

   SIR Method: _____

   IRR Method: _____

   LCC Method: _____

   NS Method: _____

2. Define Return on Investment (ROI) in simple terms:

   _____

   _____

3. Define *Simple Payback* in simple terms:

   _____

4. Given a $3,500 annual investment amount (annuity) and a 2.5 percent annual rate of inflation (escalation) with a discount rate of 8 percent for twenty-five years, calculate the present value (PV).

   _____

   _____

5. An engineer is trying to decide between using a heat pump or a gas-fired HVAC system. Assume the interest rate is 10 percent. The table below lists the associated costs and useful lives of both alternatives. Using the Annual Cost Method determine which alternative is best (show your work).

Alternative	A (heat pump)	B (gas heating)
Useful life	15 years	18 years
Installed Cost	$10,000	$12,500
Annual Operating Cost (energy + maintenance)	$3,000	$2,500

6. An engineer is trying to decide if an airside economizer on a packaged rooftop unit (RTU) is cost-effective. The economizer provides free cooling when the outdoor conditions are favorable. If the economizer is not used the compressor must run many more hours per year resulting in an earlier failure and subsequent replacement of the compressor in year 8. Assume the interest (discount) rate is 10 percent and the escalation rate for annual operating and maintenance costs is 4 percent. Neglect the costs for water and assume a zero salvage value for both alternatives. The table below lists all required data for both alternatives. Using the LCC method, determine the most favorable alternative (show your work).

Alternative	Base Case (No Economizer)	A (With Economizer)
Useful life	15 years	15 years
Installed Cost	$15,000	$16,500
Annual Operating Cost (energy)	$3,500	$2,625
Annual Maintenance Cost	$1,500	$1,500
Capital Replacement Cost (replace compressor at end of year 8)	$2,000	N/A
Salvage Value	N/A	N/A

7. A building owner is considering adding a variable frequency drive (VFD) to a chilled-water pump to save energy. From a previously conducted energy analysis estimate, the following cost data has been collected:

Year	Annual Energy Cost w/o VFD	Annual Energy Cost with VFD	Annual Energy Savings with VFD
1	$1050	$840	$210
2	$1103	$882	$221
3	$1158	$926	$232
4	$1216	$973	$243
5	$1276	$1021	$255
Total	$5803	$4642	$1161

Assume that the total cost to purchase and install the VFD is $3,500, and that the building owner can borrow money from the bank at an interest rate of 8.5 percent, compounded annually. Using the IRR method, calculate the IRR for each alternative and decide which alternative is preferred (show your work).

6. Referring to question 5, calculate the Net Savings (NS).

Can the NS method be used in lieu of the LCC method? If so why, if not why not?

_____

_____

_____

_____

_____

8. An architect is trying to determine the optimal glass type for a new building. Various types of glass are available; single pane, double-pane clear and double-pane, tinted. The associated installed and energy costs present values are summarized in the table below. Using the incremental SIR method, determine which alternatives are economically justified and determine which alternative is most cost-effective (show your work).

Design Alternative	Glass Type	Initial Cost $ (PV)	Energy Cost (life) $ (PV)
A	Single-Pane	$50,250	$150,750
B	Double-Pane	$65,850	$115,200
C	Double-Pane Tinted	$70,500	$100,750

9. A 20-year old piping system leaks water. Repairs must be made frequently to keep the system in operation. Annual OM&R costs average $15,000. The annual cost of the wasted water is $1,000. The cost to replace the entire piping system is $175,000. The typical life of a water piping system is approximately 30 years. Assume an escalation rate of 4 percent for all annual, recurring costs and a discount rate of 8 percent. Should the piping system be replaced immediately or should we wait 10 more years to replace it and incur the annual OM&R expenses? Select an appropriate economic analysis method and show your work below.

10. Three possible efficiency levels are being considered for a replacement packaged rooftop unit (RTU). Given the following cost data, decide on an appropriate economic analysis method and justify which system is most cost-effective (show your work). If required, use an escalation rate of 4 percent for all recurring costs and a discount rate of 6 percent.

Alternative	RTU-A	RTU-B	RTU-C
EER	9.5	10.5	12.0
Installed Cost	$17,965	$19,870	$21,050
Annual Energy Cost	$2,250	$2,000	$1,750
Annual OM&R Cost	$1,000	$1,000	$1,000