14th NATIONAL CERTIFICATION EXAMINATION FOR ENERGY MANAGERS & ENERGY AUDITORS – August, 2013

PAPER – 1: General Aspects of Energy Management & Energy Audit

Date: 24.08.2013 Timings: 09:30-12:30 HRS Duration: 3 HRS Max. Marks: 150

Section - I: OBJECTIVE TYPE **Marks: 50 x 1 = 50**

a) Answer all **50** questions
b) Each question carries **one** mark
c) Please hatch the appropriate oval in the OMR answer sheet with Black Pen or HB pencil, as per instructions

	As per Energy Conservation Act, 2001, a BEE Certified Energy Manger is required to be appointed/designated by the a) state designated agencies b) all industrial consumers c) **<u>designated consumers</u>** d) electrical distribution licensees
	The type of energy possessed by a charged capacitor is a) kinetic energy b) **<u>electrostatic</u>** c) potential d) magnetic
	The process of capturing CO_2 from point sources and storing them is called _____. a) **<u>carbon sequestration</u>** b) carbon sink c) carbon capture d) carbon adsorption
	What is the heat content of 200 liters of water at 5°C in terms of the basic unit of energy in kilojoules ? a) 3000 b) 2388 c) 1000 **d) <u>4187</u>**
	Nameplate kW rating of a motor indicates a) input to the motor **b) <u>rated output of the motor</u>** c) no-load input to the motor d) rated input to the motor
	Which of the following has the highest specific heat? a) lead b) mercury **c) <u>water</u>** d) alcohol
	What is the average conversion efficiency of a solar photo voltaic cell? a) 22% **b)<u>15%</u>** c) 98% d)50%

	An indication of sensible heat content in air-water vapour mixture is a) wet bulb temperature b) dew point temperature c) density of air **d) <u>dry bulb temperature</u>**
	Which of the following statements with respect to Reserve / Production (R/P) ratio is true? a) is a constant once established b) varies every year with changes in production c) varies every year with changes in reserves **d) <u>varies every year with changes in production and reserves</u>**
	Which issue is not addressed by Integrated Energy Policy of India? a) consistency in pricing of energy b) scope for improving supply of energy from varied sources c) energy conservation, research and development **d) <u>removal of subsidies for energy across all sectors</u>**
	In inductive and resistive combination circuit, the resultant power factor under AC supply will be **a) <u>less than unity</u>** b) more than unity c) zero d) unity
	Which of the following statement is not true regarding energy security? a) impaired energy security can even reduce agricultural output b) energy security is strengthened by minimising dependence on imported energy **c) <u>diversifying energy supply from different countries weaken energy security</u>** d) increasing exploration to find oil and gas reserves improves energy security
	An energy policy at the plant level is to be preferably signed by **a) <u>chief executive</u>** b) energy Manager c) energy auditor d) chief executive with approval of state designated agency
	The energy benchmarking parameter for air conditioning equipment is **a) <u>kW/Ton of Refrigeration</u>** b) kW/ kg of refrigerant handled c) kW/m^3 of chilled water d) kW/EER
	How much carbon dioxide emission will be reduced annually by replacing 60 Watt incandescent lamp with a 15 Watt CFL Lamp, if emission per unit is 1 kg CO_2 per kWh and annual burning is 3000 hours? a) 45 ton b) 3 ton **c) <u>0.135 ton</u>** d) 183 ton
	Which of the following statement is not correct regarding Demand Side Management (DSM)? a) agriculture and municipalities are potential areas for DSM activities b) **<u>savings accrued through DSM cannot be treated as avoided capacity on supply side</u>**

	c) under DSM, demand can be shifted from peak to off peak hours thereby avoiding imported power during peak hours d) DSM programs may result in demand as well as energy reduction
	_____ considers impact of cash flow even after payback period a) **net present value** b) return on investment b) sensitivity analysis d) simple payback period
	Consider two competitive projects entailing investment of Rs.85,000/- . Project A returns Rs.50,000 at the end of each year, but Project B returns Rs.115,000 at the end of year 2. Which project is superior? a) Project A since it starts earning by end of first year itself and recovers cost before end of two years b) Project B since it offers higher return in two years c) both projects are equal in rank d) **insufficient information**
	_____ determines the project viability in response to changes in input parameters. a) Life cycle analysis b) Financial analysis **c) Sensitivity analysis** d) Payback analysis
	Which of the following is false? **a) 1 calorie = 4.187 kJ** b) 1 calorie = 4.187J c) 1000 kWh = 1 MWh d) 860 kcal = 1 kWh
	The annual electricity bill for a plant is Rs 110 lakhs and accounts for 38% of the total energy bill. Furthermore the total energy bill increases by 5% each year. The plant's annual energy bill at the end of the third year will be about _____ **a) Rs 335 lakhs** b) Rs 268 lakhs c) Rs 386 lakhs d) Rs 418 lakhs
	The retrofitting of a variable speed drive in a plant costs Rs 2 lakh. The annual savings is Rs 0.5 lakh. The maintenance cost is Rs. 5,000/year. The return on investment is a) 25% **b) 22.5%** c) 24% d) 27.5%
	For a project to be financially attractive, ROI must always be ___ than interest rate. a) lower **b) higher** c) equal d) no relation
	A sum of Rs 100,000 is deposited in a bank at the beginning of a year. The bank pays 10% interest annually. How much money will be in the bank account at the end of the fifth year, if no money is withdrawn? **a) 161050** b) 150000 c) 155000 d) 160000
	The technique used for scheduling the tasks and tracking of the progress of energy management projects through a bar chart is called

	a) CPM **b) <u>Gantt chart</u>** c) CUSUM d) PERT
	_____is a statistical technique which determines and quantifies the relationship between variables and enables standard equations to be established for energy consumption. a) **<u>linear regression analysis</u>** b) time-dependent energy analysis c) moving annual total d) CUSUM
	Which of the following is not an environmental issue of global significance? a) ozone layer depletion b) global Warning c) loss of Biodiversity **d) <u>suspended particulate Matter</u>**
	The power generation potential in mini hydro power plant for a water flow of 3 m^3/sec with a head of 14 meters with system efficiency of 55% is a) **<u>226.6 kW</u>** b) 76.4 kW c) 23.1 kW d) none of the above
	If the wind speed doubles, energy output from a wind turbine will be: a) 2 times higher b) 4 times higher c) 6 times higher **d) <u>8 times higher</u>**
	Which of the following two statements are true regarding application of Kaizen for energy conservation? i) Kaizen events are structured for reduction of only energy wastes ii) Kaizen events engage workers in such a way so that they get involved in energy conservation efforts iii) Implementation of kaizen events takes place after review and approval of top management iv) In a Kaizen event, it may happen that small change in one area may result in significant savings in overall energy use **a) <u>ii & iv</u>** b) i & iv c) iii & iv d) i & iv
	The electrical power unit Giga Watt (GW) may be written as a) 1,000,000 MW b) **<u>1,000 MW</u>** c) 1,000 kW d) 1,000,000 W
	Which of the following statements regarding TOD tariff is true? a) an incentive to induce user to draw more power during peak period b) discourages user from drawing more power during off peak period c) both a and b are true **d) <u>encourages user to shift load from peak period to off peak period</u>**
	The producer gas basically consists of a) Only CH_4 b) CO & CH_4 **c) <u>CO, H_2 & CH_4</u>** d) Only CO & H_2
	The ozone layer in the stratosphere acts as an efficient filter for ____

	a) UV- B rays b) X-rays c) Gamma rays d) beta rays
	Which of the following macro factors is used in the sensitivity analysis of project finance? **a) Change in tax rates** b) Changes in maintenance cost c) Changes in debt: equity ratio d) Change in forms of financing
	Which among the following has the lowest Global Warming Potential? a) Perflurocarbon b) chloroflurocarbons c) **methane** d) nitrous oxide
	Which of the following statements is correct regarding 'float' for an activity? a) Time between its earliest start time and earliest finish time b) Time between its latest start time and latest finish time c) Time between latest start time and earliest finish time **d) Time between earliest finish time and latest finish time**
	In a cumulative sum (CUSUM) chart, if the graph is going up, then a) nothing can be said b) actual and calculated energy consumption are the same c) energy consumption is reduced **d) specific energy consumption is going up**
	CO_2 measurement in a Fyrite kit is based on a) Weight basis (dry) b) **Volume basis (dry)** c) Weight basis (wet) d) Volume basis (wet)
	The depletion of Ozone layer is caused mainly by _____ a) nitrous oxide b) carbon dioxide c) **choloroflourocarbons** d) methane gas
	Portable combustion analyzers may have in-built chemical cells for measurement of stack gas components. Which combination of chemical cells for measurement of stack gas components is not possible? a) CO, SO_x, O_2 b) **CO_2, O_2** c) O_2, NO_r, SO_x, CO d) O_2, CO
	The Energy Conservation Act,2001 requires that all designated consumers should get energy audits conducted periodically by a) certified energy manager b) certified energy auditor c) **accredited energy auditor** d) state Designated Agencies
	The term missing in the following equation $(kVA)^2 = (kVA \cos phi)^2 + (?)^2$ is a) cos phi b) sin phi c) **kVA sin phi** d) kVArh
	The weight (kg) of the water vapour in each kg of dry air(kg/kg) is termed as : a) **Specific Humidity** b) relative humidity c) humidity d) saturation ratio

	Which of the following tool is made use of to assess the input, conversion efficiency, output, losses, quantification of all material, energy and waste streams in a process or system? a) material balance b) energy balance **c) material and energy balance** **d)** Sankey diagram
	If feed of 100 tonnes per hour at 10% concentration is fed to an evaporator, the product obtained at 25% concentration is equal to ____ tonnes per hour. a) 25 **b) 40** c) 50 d) 62.5
	2000 kJ of heat is supplied to 500 kg of ice at 0°C. If the latent heat of fusion of ice is 335 kJ/kg then the amount of ice in kg melted will be a) 1.49 b) 83.75 **c) 5.97** d) None of the above
	An electric heater draws 5 kW of power for continuous hot water generation in an industry. How much quantity of water in litres per min can be heated from 30°C to 85°C ignoring losses?. **a) 1.3** b) 78.18 c) 275 d) none of the above
	The fixed energy consumption of a company is 2000 kWh per month. The line slope of the energy (y) versus production (x) chart is 0.3. The energy consumed in kWh per month for a production level of 80,000 tons/month is a) 24,000 kWh b) 24,200 kWh **c) 26,000 kWh** d) 38,000 kWh
	The major constituent of natural gas is **a) Methane** b) Ethane c) Propane d) Hydrogen

……. End of Section – I …….

Section – II: SHORT DESCRIPTIVE QUESTIONS **Marks: 8 x 5 = 40**

(i) Answer all **Eight** questions
(ii) Each question carries **Five** marks

S-1	**The rating of a single phase electric geyser is 2000 Watts, at 230 Volt.** **Calculate:** **a) Rated current** **b) Resistance of the geyser in Ohms**

	c) Actual power drawn when the measured supply voltage is 210 Volts
Answer:	a)Rated Current of the Geyser, I = P/V= 2000/230 = 8.7 Ampere b)Resistance Value , R = V/I = 230/8.7= 26.4 Ohms c)Actual Power drawn at 210 Volts = (V/R)*V = (210/26.4) x210 = 1670 Watts OR $(210/230)^2$ x 2000 = 1667 Watts
S-2	**A Diesel Generator performance trial gives specific generation of 3.5 kWh per liter of diesel. The cooling water loss and exhaust flue gas loss as percentage of fuel input are 28% and 32% respectively. The calorific value of diesel is 10,200 kcal/kg. The specific gravity of Diesel is 0.85. Calculate unaccounted loss as percentage of input energy.**
Ans	CV of Diesel = 10,200 kcal/kg Heat in input diesel = 10,200 x 0.85 = 8670 kcal/litre Heat in kWh energy output = 3.5 x 860 = 3010 kcal/litre % of heat used for kWh output = 3010/8670 = 34.72 % Unaccounted loss = 100 – (34.72+28+32) = 5.28 %
S-3	**A renovation and modernization (R&M) program of a 110 MW coal-fired thermal power plant was carried out to enhance the operating efficiency from 28% to 32%. The specific coal consumption was 0.7 kg/kWh before R&M. For 7000 hours of operation per year and assuming the coal quality remains the same, calculate** **a) the coal savings per year and** **b) the expected avoidance of CO_2 into the atmosphere in Tons/year if the emission factor is 1.53 kg CO_2/kg coal**
Ans	a) Specific coal consumption after modernization = 28 x 0.7/32 = 0.6125 kg/kwh Annual savings = (0.7 – 0.6125) x110 x 1000 x 7000/1000 = 67,375 Tonnes per year b) CO2 emission reduction =67,375 x 1.53 = 103083.75 Tonnes of per year
S-4	**Briefly compare NPV and IRR method of financial analysis.**
Ans	In NPV method, NPV is determined by assuming the discount rate (cost of capital). In IRR calculations, we set the NPV as zero and determine the discount rate (internal rate of return) which satisfies this condition.

	The *net present value* method calculates the *present value* of all the yearly cash flows (i.e. capital costs and net savings) incurred or accrued throughout the life of a project and summates them. Costs are represented as negative value and savings as a positive value. The higher the *net present value*, the more attractive the proposed project. The calculation procedure for determining IRR is tedious (iterative) and usually requires a computer spreadsheet. The exact internal rate of return can be found by interpolation or plotting the net present value on a graph. If this discount rate is greater than current interest rate, the investment is sound. NPV is essentially a tool which enables number of different projects to be compared while IRR method is designed to assess whether a single project will achieve a target rate of return. The project is accepted if the net present value is positive and rejected if the net present value is negative. A negative net present value indicates that the project is not achieving the return standard and thus will cause an economic loss if implemented. A zero NPV is value neutral. In IRR, the criterion for selection among alternatives is to choose the investment with the highest rate of return. The internal rate of return figure cannot distinguish between lending and borrowing and hence a high internal rate of return need not necessarily be a desirable feature. Both the NPV and IRR takes into account the time value of money and it considers the cash flow stream in entire project life.
S-5	**When the same quantity of heat is added to equal masses of iron and copper pieces, the temperature of iron piece rises by 15 ^{O}C. Calculate the rise in temperature of copper piece, if the specific heat of iron is 470 J / kg / ^{O}C and that of copper is 390 J / kg / ^{O}C.**
Ans	**Mass of Iron x Sp. Heat Iron x 15 ^{O}C = Mass of Copper x Sp. Heat Copper x (Rise in Temp of Copper ^{O}C)** **Since mass of Iron = Mass of Copper** Sp. Heat Iron x 15 ^{O}C = Sp. Heat Copper x (Rise in Temp of Copper ^{O}C) Sp. Heat of Iron = 470 J / kg / ^{O}C Sp. Heat of Copper = 390 J / kg / ^{O}C Hence, Rise in Temp. of Copper piece = (470 x 15) / 390 **= 18.08 ^{O}C**

S-6	**Write down the parameters, which can be measured by following instruments:** **a) Stroboscope** **b) Sling Psychrometer** **c) Fyrite** **d) Tachometer** **e) Pitot tube**
Ans	a) Stroboscope : Speed (Non Contact) b) Sling Psychrometer : Dry & Wet Bulb Temperatures c) Fyrite : O2 or CO2 in Flue Gases d) Tachometer : Speed (Contact type) e) Pitot tube : Velocity pressure of moving gases
S-7	**An industrial plant is consuming 400 kW of power with a maximum demand of 520 kVA. The demand charge is Rs. 150/-per kVA. Determine the savings possible by improving power factor to 0.95 and payback period if investment on capacitor bank is Rs 1,50,000/-.**
Ans	Present Power Factor : 400 / 520 = 0.77 Present Demand Charges Rs. : 520 * 150 = 78000/- Future Demand with higher PF : 400 / 0.95 =421 kVA Modified Demand Charges : 421 * 150 = Rs. 63150/- Savings =78000 – 63150 = Rs. 14850/- per Month Capacitor Investment =Rs. 1.50,000/- Simple Payback Period =1,50,000 / 14850 =10.1 Months
S-8	**A 100 tonnes per day capacity chlor-alkali plant produced 30,000 tonnes per annum (TPA) of caustic soda with annual energy consumption of 90 million kWh in the reference year 2009-10. During the year 2011-12, the annual production was 25,000 TPA, with an annual energy consumption of 80 million kWh. Calculate the Plant Energy Performance.**
Ans	Production Factor = 25000 / 30000 = 0.833 Reference year energy equivalent = Reference year energy use x Production factor = 90 x 0.833 = 75 million kWh

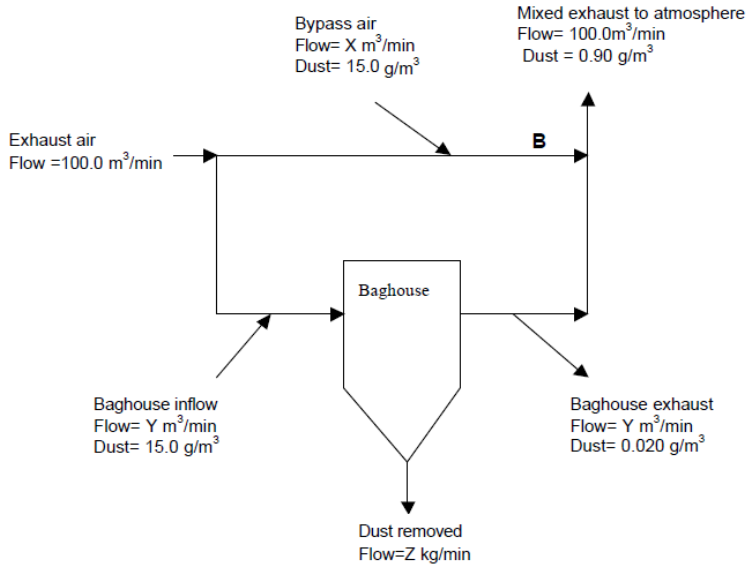
	Excess Energy Consumption in 2011-2012 = 80 – 75 = 5 million kWh Plant Energy Performance (PEP) = [(75 - 80) / 75] x 100 **= (-) 6.67 %** **The performance in the year 2011 – 2012 is poor as compared to the reference year**

------- End of Section - II ---------

Section – III: LONG DESCRIPTIVE QUESTIONS **Marks: 6 x 10 = 60**

(i) Answer all **Six** questions
(ii) Each question carries **Ten** marks

L1	**A bag house is being used to remove dust from an air exhaust stream flowing at 100 m^3/min. The dirty air contains 15 g/m^3 of particles, while the cleaned air from the bag house contains 0.02 g/m^3. The industry's operating permit allows the exhaust stream to contain as much as 0.9 g/m^3.** **For various operating reasons, the industry wishes to bypass some of the dirty air around the bag house and blend it back into the cleaned air so that the total exhaust stream meets the permissible limit. Assume no air leakage and negligible change in pressure or temperature of the air throughout the process.** **Draw a schematic diagram and calculate the flow rate of air through the bag house and the mass of dust collected per day in kg.**
ANS	Draw a flow diagram of the process as shown in Figure 1. In this problem two balances can be made, namely, flow rate of dust in g/m^3 and flow rate of air in m^3/min. Balancing of flow rate of air in m^3/min is possible because the temperature and pressure of air remains constant in the system.



Write a balance for dust around the total system:

Input = Output from bag house +Output in the mixed exhaust

Or

Dust removed from bag house (Z) = 100m^3/min. x 15 g/m^3 —100m^3/min. x 0.90 g/m^3 =1410 g/min.

Or

Daily dust Output = 1410g/min x 24h/1d x 60min/1h x 1kg/1000g= 2030 kg

Write a balance for airflow
100 = X+Y, where X and Yare bypass stream and flow through bag house, respectively.

Write a balance for dust around B:
15X + 0.02Y = 0.9x100

Solving the last two equations
X, the bypass stream = 5.9 m^3/ min.
Y, the flow through bag house = 94.1 m^3/min.

L2

a. Explain the difference between GCV and NCV.

b. A gas fired water heater heats water flowing at the rate of 1.2 M^3 / hour from 20°C to 65°C. If the GCV of the gas is 4x10^7 J/kg, what is the rate of combustion gas in kg/hr. The efficiency of water heater as 80%,

	a. The calorific value is the measurement of heat or energy produced, and is measured either as gross calorific value or net calorific value. **The difference being the *latent heat of condensation of the water vapour* produced during the combustion process.** Gross calorific value (GCV) assumes all vapour produced during the combustion process is fully condensed. Net calorific value (NCV) assumes the water leaves with the combustion products without fully being condensed. b) **Mass of water heated = 1.20 M^3 /hr** **= 1.2 x 1000 / 60 = 20 kg/min** **Heat required by Water = m x Cp x ($t_2 - t_1$)** **= 20 kg/min x 4.187 x 10^3 J/kg/^{0}C x (65-20) °C** **= 3.77 x 10^6 J/min** **Mass of Gas kg/min = 3.77 x 10^6 / 0.8 /(4 x 10^7)** **Mass 0f Gas Required = 0.1178 kg / min** **= 7.068 kg / Hr**
L-3	**Answer any two of the following** **a) Benefits of Monitoring and Targeting system** **b) Duties and responsibilities of energy manager** **c) Energy substitution need not save energy: Explain with an example**
ANS	**a) Benefits of Monitoring and Targeting system** The ultimate goal is to reduce energy costs through improved energy efficiency and management control measures. Other benefits include ✓ Identify and explain an increase or decrease in energy use ✓ Draw energy consumption trends (weekly, seasonal, operational) ✓ Improve energy budgeting corresponding to production plans ✓ Observe how the organization reacted to changes in the past ✓ Determine future energy use when planning changes in operations ✓ Diagnose specific areas of wasted energy ✓ Develop performance targets for energy management programs / energy action plans ✓ Manage energy consumption rather than accept it as a fixed cost that cannot be controlled. **b) Duties and responsibilities of energy manager** **Responsibilities:**

1. Prepare an annual activity plan and present to management concerning financially attractive investments to reduce energy costs.
2. Establish an energy conservation cell within the firm and agree with management about the mandate and task of the cell.
3. Initiate activities to improve monitoring and process control to reduce energy costs.
4. Analyze equipment performance with respect to energy efficiency.
5. Ensure proper functioning and calibration of instrumentation required to assess level of energy consumption directly or indirectly.
6. Prepare information material and conduct internal workshops about the topic for other staff.
7. Improve disseminating of energy consumption data down to shop level or profit center of a firm.
8. Establish a methodology to accurately calculate the specific energy consumption of various products/services or activity of the firm.
9. Develop and manage training programme for energy efficiency at operating levels.
10. Co-ordinate nomination of management personnel to external programs.
11. Create knowledge bank on sectorial, national and international development on energy efficiency technology and management system and information denomination.
12. Develop integrated system of energy efficiency and environmental up gradation.
13. Wide internal and external networking
14. Co-ordinate implementation of energy audit/efficiency improvement projects through external agencies.
15. Establish and / or participate in information exchange with other energy managers of the same sector through association.

Duties of Energy Manager:

1. Report to BEE and State level Designated Agency once a year. The information with regard to energy consumed and action taken in the recommendation of the accredited energy auditor, as per BEE – Format.
2. Establish an improved data recording, collection and analysis system to keep track of energy consumption.
3. Provide support to Accredited Energy Audit Firm retained by the company for the conduct of energy audit.
4. Provide information to BEE as demanded in the Act, and with respect to the tasks given by the mandate, and the job description.
5. Prepare a scheme for efficient use of energy and its conservation and implement such scheme keeping in view the economic stability of the investment in such firm and manner as may be provided in the regulations of the Energy Conservation Act.

c) Energy substitution need not save energy: Explain with an example

The objective of energy substitution may be to reduce the use of costlier energy source to maximize the profit and to improve the efficiency of the process.

Example: Replacement of conventional energy by renewable energy.

The efficiency of fuel oil fired systems will be higher than rice husk fired systems. Hence the total energy input to the systems will increase for rice husk fired systems. Even though material handling cost, specific fuel (energy) consumption increases for rice husk, this is a cheap locally available renewable form of energy which will bring down the fuel cost and transport cost compared to fuel oil.

Hence Energy substitution need not save energy.

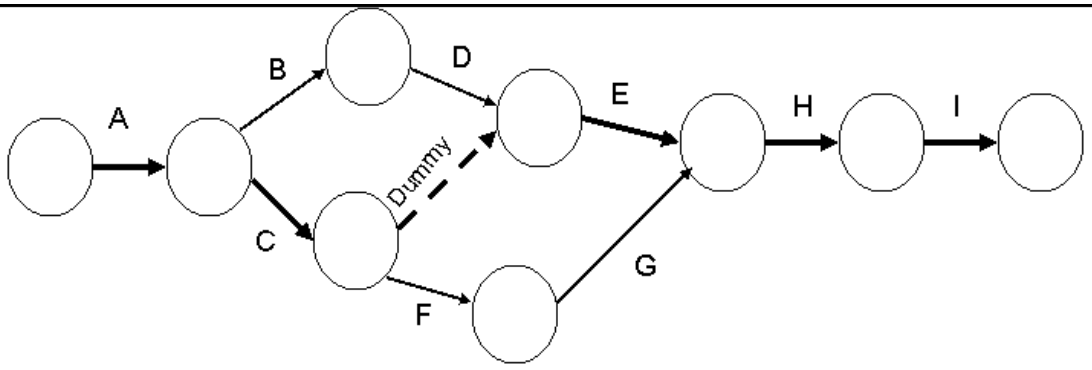
Any other similar example.

L-4 **For the following tasks, durations, and predecessor relationships in the following activity table,**

Activity Description	Immediate Predecessor(s)	Optimistic (Weeks)	Most Likely (Weeks)	Pessimistic (Weeks)
A	---	4	7	10
B	A	2	8	20
C	A	8	12	16
D	B	1	2	3
E	D, C	6	8	22
F	C	2	3	4
G	F	2	2	2
H	E, G	4	8	12
I	H	1	2	3

a) Draw the network
b) **Calculate expected time for all tasks**
c) **Calculate variance for all tasks**
d) **Determine all possible paths and their estimated durations**
e) Identify the critical path

Network diagram is shown below:



Formulas used for filling the above table:

$T_e = (T_o + 4\ T_m + T_p)/6$

? $= (T_p - T_o)/6$

$V = ((T_p - T_o)/6)^2$

Activity Description	Immediate Predecessor(s)	Optimistic (Weeks)	Most Likely (Weeks)	Pessimistic (Weeks)	T_e	Variance
A	---	4	7	10	7	1.00
B	A	2	8	20	9	9.00
C	A	8	12	16	12	1.78
D	B	1	2	3	2	0.11
E	D, C	6	8	22	10	7.11
F	C	2	3	4	3	0.11
G	F	2	2	2	2	0.00
H	E, G	4	8	12	8	1.78
I	H	1	2	3	2	0.11

The critical path is A – C – E – H – I
Duration of critical path is 39 days
.

A - B – D – E – H –I	7+9+2+10+8+2 = 38
A – C – E – H – I	**7+12+10+8+2 = 39**
A – C – F – G – H – I	7+12+3+2+8+2 = 34

The critical path is A – C – E – H – I
Duration of critical path is 39 weeks.

L-5 **Write short notes on any two of the following:**

	a) Advantages of Demand Side Management (DSM) for end user and utility b) **ISO 50001 Energy Management System** **c) Distinction between energy conservation and energy efficiency**
ANS	**a) Advantages of DSM** **End user:** End use demand can be shifted from peak to off peak hours thereby reducing the need for buying expensive energy during peak hours Helps better manage the load curve and thus reduce the demand improve the profitability **Utility:** Energy saving through DSM is treated same as new additions in supply side Can reduce the capital needs for power capacity expansion Improved loading of utility power plants and hence improved efficiency and profitability **b) ISO 50001 features** ISO 5001involves the following features: Goal outlined in Energy policy Objectives to achieve the goal Targets which are more specific than objectives which outlines actual energy conservation measures to be implemented. An objective may have one or more targets. Action plans to implement the targets which outline actions, time frame, responsibility and resources for implementation. All the above with other related documents are audited during internal and external audits. **c) Energy conservation and Energy efficiency** Energy conservation is achieved when energy consumption is reduced in physical terms as a result of productivity increase or technology change. On the other hand, energy efficiency is achieved when energy intensity is reduced in a specific product, process or area of production without affecting the output, consumption or comfort levels. Energy efficiency means using less energy to perform the same function. Energy efficiency promotion will contribute to energy conservation and therefore a part of energy conservation policies.

L-6 **It is proposed to install a heat recovery device in a process industry. The capital cost of installing the device is Rs.2,00,000 and after 5 years its salvage value is envisaged at Rs.15,000. The savings accrued by the heat recovery device are as shown below. Determine the net present value after 5 years for a discount rate of 8%.**

Year	**1**	**2**	**3**	**4**	**5**
Savings (Rs.)	**70,000**	**60,000**	**60,000**	**50,000**	**50,000**

Ans

Year	Discount factor for 8%	Capital Investment (Rs.)	Net savings (Rs.)	Present value (Rs.)
0	1.00	-200000		-200000
1	0.926		70000	+64820
2	0.857		60000	+51420
3	0.794		60000	+47640
4	0.735		50000	+36750
5	0.681		50000 +15000	+44265
				NPV=+44895
It is evident that over a 5-year life-span the net present value of the project is 44895.				

-------- End of Section - III ---------