Uka Tarsadia University (Diwaliba Polytechnic)
Diploma in Mechanical Engineering
Assignment (Thermal Engineering 2 – 020040501)

Unit-1 Boilers

1. Define boiler as per IBR.
2. Define natural and artificial draft.
3. List various mountings required as per IBR.
4. List the minimum accessories required as per IBR.
5. State industrial application of steam.
6. Define high and low pressure boiler.
7. Give the advantages and disadvantages of artificial draft system.
8. Draw the neat sketch of 1.Lancashore boiler 2.Babcock and Wilcox boiler3.Cochran Boiler.
9. Explain in brief packaged boiler.
10. A boiler is generating 9.5 kg of steam/kg of coal. The calorific value of coal is 35,200 kJ/kg. the heat content of steam is 2835 kJ/kg. feed water temperature is 45 ^{o}C. Calculate boiler efficiency and equivalent evaporation.
11. Classify the boilers.
12. The following data is available during boiler trail run:
    Coal used = 450 kg/hr
    Mass of dry flue gas = 21 kg/kg of coal
    Calorific value of coal = 31,000 kJ/kg
    Flue gas temperature = 320 ^{o}C
    C_p of flue gas = 1.008 kJ/kg K
    C_p of steam = 1.89 kJ/kg K
    Feed water temperature = 80 ^{o}C
    Dry saturated steam generated = 4700 kg/hr
    Steam pressure = 12 bar
    Atmospheric pressure = 1 bar
    Prepare heat balance sheet.
13. State the purpose of chimney, Induced draft fan and forced draft fan in steam power plant.
14. Explain the main safety precautions to be taken in boiler house as per IBR.
15. Give the difference between boiler mountings & boiler accessories.
16. Explain important terms related to boilers.
17. Draw the neat sketch of 1.spring loaded safety valve 2.Pressure gauge 3.Fusible plug 4.Feed check valve 5.Economiser 6.Superheater 7.Air Preheater.

Unit-2 Steam Prime-Movers, Condensers and Cooling Towers

1. Explain types of steam Nozzle with diagrams.
2. Apply steady flow energy equation to nozzle and derive equation of extreme velocity.

3. State applications of steam nozzle.
4. Differentiate between steam engine and steam turbine.
5. Give classification of cooling tower.
6. Write down factor affecting cooling tower performance.
7. Discuss principle of steam turbine.
8. Why compounding is required in steam turbine?
9. Write the functions of steam turbine.
10. Explain velocity and pressure compounding with neat sketch.
11. Discuss principle of impulse and reaction turbine.
12. Discuss principle of impulse and reaction turbine.
13. Give comparison between natural and mechanical draft cooling tower.
14. What are the objectives of using condensers in steam power plant?
15. Write down the short note on condensers.
16. Explain main parts of Steam turbine.
17. Explain simple impulse turbine.

Unit-3 Internal Combustion (I. C.) Engines

1. Why petrol engines are called S.I. engine and why diesel engines are called C.I. engine?
2. Write the disadvantages of two stroke engines.
3. Write the application of I.C engine.
4. Differentiate between I.C engine and E.C engine.
5. State the advantages of two stroke engines over four stroke engines.
6. Draw block diagram of fuel supply system for 4 stroke petrol engine.
7. List various system used in IC engine.
8. Give classification of IC engine.
2. Explain the essential elements of IC Engine with neat Sketch.
3. Explain working of 4- stroke S.I. engine.
4. What is the function of fuel injector? Explain working of 4-stroke C.I. engine.
5. Working of 2-stroke S.I. (petrol) engine
9. Draw block diagram of fuel supply system for 4 stroke diesel engine.
10. List thermodynamic cycle employed in IC engine.
11. Classify IC engine based on thermodynamic cycle used and method of ignition.
12. State various function of lubrication system in IC engine.
13. Define prime movers and heat engine.
14. Define indicated power and brake power.
15. Give function of carburetor and fuel pump.
16. Explain multi point fuel injection system.
17. Differentiate between Petrol engine and Diesel Engine.
18. Differentiate between 2-stroke and 4-stroke engine.
19. List various cooling system in IC engine and explain any one of them.
20. Explain fuel supply system for four stroke petrol engine.

21. Explain battery ignition system of spark ignition engine with line diagram.
22. Explain magneto ignition system of spark ignition engine with neat sketch.
23. Draw actual valve timing diagram for four stroke IC engine and compare with ideal valve timing diagram.
24. Write down purpose and requirement of lubricant.
25. Classify lubrication system and explain dry sump lubrication system.
26. Explain wet sump lubrication system.
27. List various cooling system and explain thermo siphon cooling system
28. Explain multipoint fuel injection system.
29. Write short note on common rail direct injection system.
30. The following data refers to a single cylinder 4 stroke petrol engine. Cylinder diameter = 25 cm, stroke length = 40 cm, engine speed = 1400 rpm, indicated mean effective pressure = 4 bar, fuel consumption = 20 lit/hr, Calorific value of fuel = 45000kj/kg.
31. A 6 cylinder 4 stroke IC engine is to produced 95 kw brake power at 800 rpm. The stroke to bore ratio is 1.25, mean effective pressure is 7 bar. Determine bore and stroke of engine. Assume mechanical efficiency is 80%.
32. A two stroke IC engine has a stroke length of 140 mm and cylinder bore length 90 mm. its mean effective pressure is 5.4 bar and speed of engine is 1000 rpm. Determine brake power of engine. Assume mechanical efficiency 85%.
33. Indicated power of 6 cylinder 4 stroke CI engine is 150 kw at average piston speed 320 m/min. stroke to bore ratio is 1.2, If mean effective pressure 650 kN/m^2. Determine shaft speed.
34. A four stroke engine having 270 mm cylinder diameter and 380 mm stroke length. Mean effective pressure = 6 bar, engine speed = 250 rpm, mass of fuel consumption = 10 kg/hr, calorific value = 44400 kJ/kg and torque developed = 750 N/m^2. Determine indicated power, brake power, brake thermal efficiency and indicated thermal efficiency.
35. Cylinder, 4 stroke CI engine develops 30 KW at 2500 RPM. The indicated mean pressure of each is 800 KPa and mechanical efficiency 75%. Calculated the diameter and stroke of each of the cylinder if l/d =1.25. Also calculated Friction power and break thermal efficiency if break specific fuel consumption is 0.3 kg/Kwh. Calorific value of fuel is 43980 kj/ kg.
36. The following observation were recorded during the trial run of single cylinder, Two stroke engine.Engine torque = 650 N m, Engine speed = 400 rpm, cylinder diameter = 20 cm, stroke length = 30 cm, fuel consumption = 8. 5 kg/hr, mean effective pressure = 5.5 bar, calorific value = 42500 kJ/kg. Calculate mechanical efficiency, indicated thermal efficiency, brake thermal efficiency, and specific fuel consumption in kg/Kw hr.
37. Four stroke single cylinder engine, load on brake = 50 kg. diameter of brake drum = 1250 mm. spring balance reading = 7 kg, engine speed = 450 rpm, fuel consumption = 4 kg/hr, CV = 43000 kJ/kg. Find indicated thermal efficiency, brake thermal efficiency. Assume mechanical efficiency = 70 %.

Unit-4 Gas Turbines

1. State difference between Open and closed gas turbine plants.
2. Give applications of gas turbines.
3. Describe merits of gas turbines.

4. State demerits of closed cycle gas turbines.
5. Draw layout diagram of gas turbine with intercooler and reheat method.
6. Draw h-s diagram for open gas turbine cycle and closed gas turbine cycle.
7. State merits of closed cycle gas turbines.
8. Name different components used in gas turbine plant and state their function.
9. Difference between gas turbines and steam turbines.
10. State and classify different gas turbines.
11. Write note on gas turbine fuels.
12. Draw layout diagram of gas turbine with reheat and regeneration method.
13. State demerits of gas turbines.
14. Classify gas turbines and explain them.
15. Write note on regeneration method used to improve the efficiency of simple gas turbine cycle with diagram.
16. Explain intercooling method used to improve the output of simple gas turbine cycle with necessary diagram.
17. The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1bar and temperature of 20°C.The pressure of the air after compression is 4 bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The air-fuel ratio used is 90:1. If the flow rate of air is 3 kg/s, find :Power developed,Thermal efficiency of the cycle
    Assume Cp = 1 kJ/kg.K and γ = 1.4 of air and gases, Calorific value of fuel = 41800 kJ/kg
18. Give different types of gas turbine plants and explain them.
19. Explain briefly regeneration method used to improve the efficiency of simple gas turbine cycle with diagram.
20. Explain reheat method used to improve the performance of simple gas turbine cycle with diagram.
21. Explain intercooling method used to improve the work output of simple gas turbine cycle with diagram.
22. Write note on reheat method used to improve the performance of simple gas turbine cycle with diagram.
23. A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 530°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatt of an electric generator geared to turbine when the air enters the compressor at 15°C at rate of 16 kg/s. Take Cp= 1.005 kJ/kg K and γ=1.4 for compression process and take Cp=1.11kJ/kg K and γ=1.333 for the expansion process.
24. Write down advantages and disadvantages of Gas turbines.
25. Give brief note of different types of gas turbines.
26. State two methods used to improve the performance of simple gas turbine cycle in detail with necessary diagram.
27. Write note on working of gas turbine plant with necessary diagram
28. A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 700°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatt of an electric generator geared to turbine when the air enters the compressor at 15°C at rate of 16 kg/s. Take Cp= 1.005 kJ/kg K and γ=1.4 for compression process and take Cp=1.11kJ/kg K and γ=1.333 for the expansion process.

29. Explain different methods used to improve the performance of simple gas turbine cycle in detail with necessary diagram.
30. Give advantages and disadvantages of Gas turbines over steam turbines.

Unit-5 Refrigeration and Air-Conditioning

1. Explain Reverse Carnot cycle. Which refrigerant is used in Reverse Carnot cycle?
2. What are the disadvantage of using air as a refrigerant?
3. Write down function of following in refrigeration cycle.
   1.Compressor
   2.Condenser
   3.Liquid reservoir
4. What do you mean by dry compression and wet compression?
5. Draw general layout of vapour absorption refrigeration cycle and explain function of each component.
6. Draw general layout of vapour compression refrigeration cycle and explain function of each component.
7. What is primary refrigerant? Classify in different way to primary refrigerant?
8. Give difference between dry compression and wet compression?
9. What do you mean by dry compression and wet compression?
10. Differentiate between primary and secondary refrigerant.
11. What is refrigeration? What do you mean by 1 tonnage of refrigeration?
12. Define Coefficient of performance and 1 tonnage of refrigeration.
13. Compare primary and secondary refrigerant.
14. Write down function of following in refrigeration cycle.

a. Expansion valve
b. Evaporator
c. Liquid reservoir

15. Write down desirable properties of good refrigerant.
16. A refrigeration system operates on the reverse Carnot cycle. The higher temperature of the refrigerant system is $35^{O}C$ and the lower temperature is $-15^{o}C$. The capacity is to be 12 tonnes. Determine 1. Coefficient of Performance 2. Heat rejected from the system per hour 3. Power required.
17. Write note on simple vapour compression cycle with neat diagram.
18. Briefly describe vapour absorption refrigeration cycle.
19. Give required characteristics of good refrigerant?
20. A Carnot refrigerator requires 1.3Kw per tonne of refrigerant to maintain a region at low temperature of $-38^{o}c$. Determine 1. COP of Carnot refrigerator 2. Higher temperature of cycle.
21. What do you mean by simple vapour compression cycle? Explain in brief.
22. State working of vapour absorption refrigeration cycle with appropriate diagram.
23. State different types of refrigerants and its characteristics.
24. A refrigeration system operates on the reverse Carnot cycle. The higher temperature of the refrigerant system is $30^{O}C$ and the lower temperature is $-15^{o}C$. The capacity is to be 9 tonnes.

Determine 1. Coefficient of Performance 2. Heat rejected from the system per hour 3. Power required.

25. Write note on vapour absorption refrigeration cycle with neat diagram.
26. State desired characteristics of refrigerant for cooling purpose.
27. A Carnot refrigerator requires 1Kw per tonne of refrigerant to maintain a region at low temperature of -30^{o}c. Determine 1. COP of Carnot refrigerator 2. Higher temperature of cycle.
28. State working of simple vapour compression cycle with appropriate diagram.
29. Explain vapour absorption refrigeration cycle. With P – h and T – S diagram.
30. Classify refrigerants with examples
31. A refrigeration system operates on the reverse Carnot cycle. The higher temperature of the refrigerant system is 45^{O}C and the lower temperature is -15^{o}C. The capacity is to be 10 tonnes. Determine 1. Coefficient of Performance 2. Heat rejected from the system per hour 3. Power required.
32. Explain Coefficient of performance of reverse heat pump.
33. Explain heat pump and refrigerator using neat sketch.
34. Give various application of refrigeration.
35. Write down usage of refrigeration and its significance.
36. Explain reverse Carnot cycle.

Unit-6 Heat Transfer

1. State different modes of heat transfer with examples.
2. Explain Fourier's Law of Conduction.
3. Give physical significance of Thermal Conductivity.
4. Derive equation of heat transfer through a plane wall.
5. Explain Newton's Law of Convection.
6. Write a short note on Convective heat transfer coefficient.
7. Differentiate Conduction and Convection process.
8. Explain Thermal resistance.
9. Explain absorptivity, reflectivity and transmissivity.
10. Write short note on black body.
11. For same heat transfer rate, which arrangement out of parallel or counter flow will produce compact heat exchanger? Justify your answer.
12. The flow rates of hot and cold water streams running through a parallel flow heat exchangers are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperature on the hot and cold sides are 75^{o}C and 20^{o}C respectively. The exit temperature of hot water is 45^{o}C,If the individual heat transfer coefficients on the both sides are 650 W/m^{2o}C, calculate the area of the heat exchangers.
13. Out of natural and forced convection process which one has higher value of heat transfer coefficient? Justify your answer.
14. Explain Stefan Boltzmann law.

15. Give classification of heat exchanger and explain double pipe
16. Derive LMTD for parallel flow and counterflow heat exchanger.
17. Write short note on Plate type heat exchanger.
18. A counter flow double pipe heat exchanger using superheated steam is used to hot water at the rate of 10000 kg/h. The steam enters the heat exchanger at 200^{o}C and leaves at 160^{o}C. The inlet and exit temperatures of water are 30^{o}C and 80^{o}C respectively. If the overall heat transfer coefficient from steam to water is 804 W/m^{2o}C, calculate the heat transfer area. What would be the increase in area if the fluid were parallel?
19. Derive Overall heat transfer coefficient for composite material
20. Distinguish between forced convection and free convection.
21. Draw temperature diagram for evaporator and condenser during heat transfer process.
22. Explain Recuperator type heat exchanger.