بسم الله الرحمن الرحيم

Mansoura University   **JanuaryTerm, 2013**
Faculty of Engineering   **Third year , Exam .**
Mechanical power Depart.   **Time: 3hrs.**

- *STEAM TECHNOLOGY [M90]*

Attempt all Questions. Tables & charts are allowed. Assume any missing data.

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QUESTION NO. One: [M40]

Objective Type Questions

Pick up the most appropriate statement of the multiple-choice answers by writing down the correct answers.

1. If a steam sample is nearly in dry condition, then its dryness fraction can be most accurately determined by:
(a) throttling calorimeter   (b) separating calorimeter (c) bucket calorimeter
(d) combined separating and throttling calorimeter   (e) none of the above.

2 If x_1 and x_2 be the dryness fractions obtained in separating calorimeter and throttling calorimeter respectively, then the actual dryness fraction of steam will be
(a) $x_1 . x_2$ (b) $x_1 + x_2$ (c) $(x_1 + x_2)/2$ (d) $1/(x_1 + x_2)$

3. In a throttling process -
(a) heat transfer takes place   (b) work is done by the expanding steam
(c) internal energy of steam changes   (d) all of the above   (e) none of the above.

4. The pressure at which latent heat of vaporisation of water is zero, is
(a) below atmospheric pressure   (b) 1 kg/cm^2
(c) 100 kg/cm^3 (d) 170 bar   (e) 221 bar

5. Latent heat of dry steam at atmospheric pressure is equal to
(a) 2256 kj/kg   (b) 539 Btu/lb   (c) 2000 kj/g   (d) 100 kcal/kg   (e) 471 kj/g.

6. The latent heat of steam with increase of pressure
(a) remains same   (b) increases   (c) decreases
 (d) behaves unpredictably   (e) none of the above.

13.At critical point. p=221bar, the latent enthalpy of vporisation is:
(a) maximum   (b) minimum   (c) zero
(d) depends on temperature also   (e) none of the above.

7. At which pressure the properties of water and steam become identical
(a) below atmospheric pressure   (b) 1 bar (c) 100 kg/cm^3 (d) 221 bar
 (e) it is never possible.

8. Which of the following is a water tube boiler
(a) Locomotive boiler   (b) Cochran boiler
(c) Cornish boiler   (d) Babcock and Wilcox boiler
(e) Lancashire boiler.

9. In actual practice, reheat improves the cycle efficiency by about:
(a) 10%   (b) 5%   (c) 15%   (d) 20%

10. In Rankin cycle reheating should be done at optimum pressure which equal to percentage of operating pressure of:
 (a) 10%   (b) 5%   (c) 15%   (d) 20%

11. The reheating reduces fuel consumption with a corresponding reduction in fuel handling in the range of:
(a) 6 to 10%   (b) 2 to 3%   (c) 4 to 5%   (d) 4 to 15%

12. A reduction in steam volume and heat to the condenser is reduced Therefore, the condenser size and cooling water requirement are also reduced by the same percentages in the range of:.
(a) By 17 to 18%.   (b) By 7 to 8%.   (c) By 2 to 4%.   (d) By 4 to5%.

13. The size of the L.P turbine blades is reduced because specific volume is reduced in the range of:
(a) By 17 to 18%.   (b) By 7 to 8%.   (c) By 2 to 4%.   (d) By 4 to5%.

14. The percentage gain in economy of reheat over non-reheat
(a) Is 5%, the reduction in steam flow and 16.5% at full load and heat load on condenser is reduced by 8.7%,
(b) Is 10%, the reduction in steam flow and 20.5% at full load and heat load on condenser is reduced by 12%,
(c) Is 8%, the reduction in steam flow and 10.5% at full load and heat load on condenser is reduced by 15%,
(d) Is10%, the reduction in steam flow and 10.5% at full load and heat load on condenser is reduced by 15%,

15. Which of the following is/are super critical Boiler?
(a) Cochran Boiler   (b) Benson Boiler (a) Locomotive Boiler   (a) Lamont Boiler

16. If all the steam states during expansion are found to be dry saturated then the expansion curve is called:
(a) Boiling curve (b) Saturation curve   (c) Missing curve (d) Isentropic curve

17. Boiler efficiency is given by the the ratio of heat used in steam generation and
(a) Heat recovered using artificial draught (b) Heat lost due to use of natural draught
(c) Heat available due to fuel burning   (d) None of these

18. Mean temperature of heat addition gets increased and shows increase in cycle thermal efficiency. This cycle is called.
(a) Regenerative cycle (b) Reheat cycle   (c) Carnot cycle   (d) None of these

19. Water level indicator has how many vertical tubes?
(a) One   (b) Two   (c) Three   (d) Four

20. Condensation can be prevented in steam engine by:
(a) Supplying superheated steam (b) Providing steam jacket around cylinder wall
(c) Increasing speed of engine for certain output (d) all of the above

21. Fusible plug has plug made of copper and the body is made of
(a) Gun metal   (b) Aluminum   (c) Iron   (d) Bronze

21. Feed pump in boilers may be of
  (a) Reciprocating pump type   (b) Centrifugal pump type
  (c) Injector type   (d) All of these

22. Regenerative cycle thermal efficiency
(a) is always greater than simple Rankine thermal efficiency
(b) is greater than simple Rankine cycle thermal efficiency only when steam is bled at particular pressure
(c) is same as simple Rankine cycle thermal efficiency
(d) is always less than simple Rankine cycle thermal efficiency.

23. *In a regenerative feed heating cycle, the optimum value of the fraction of steam extracted for feed heating*
(a) Decreases with increase in Rankine cycle efficiency
(b) Increases with increase in Rankine cycle efficiency
(c) Is unaffected by increase in Rankine cycle efficiency   (d) none of the above.

24. *Deaerator is feed water heater of which type*
   (a) Closed type feed water heater
   (b) Surface type feed water heater
   (c) Open type feed water heater   (d) None of these

25. *Fig. (2.8) shows modified Rankine engine on (p-v)&(T-s) charts*
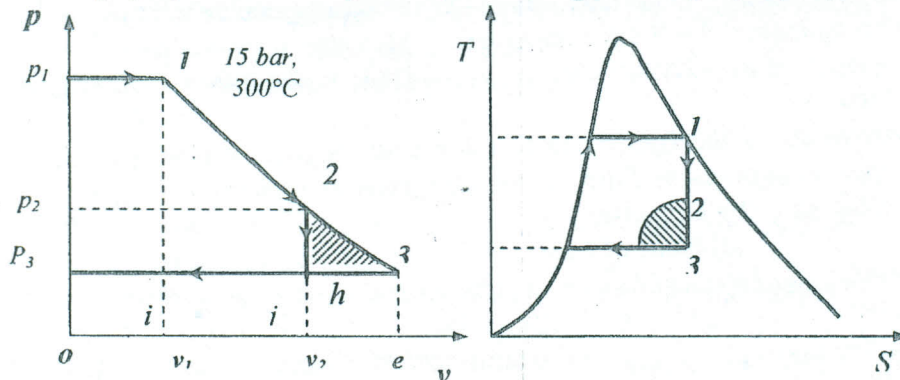

Fig 2.8 Modified Rankine

Ideal work or the modified Rankine engine work per kg may be:

 (a) $W = (h_1 - h_3) + (p_2 - p_3) v_2$ (b) $W = (h_1 - h_2) + (p_2 - p_3) v_2$

(c) $W = (h_1 - h_2) + (v_2 - v_3) p_2$ (d) $W = (h_2 - h_3) + (p_1 - p_3) v_2$

26. *Efficiency of the modified Rankine engine or ideal thermal efficiency in fig.2.8 will be:*

(a) $\{(h_1 - h_3) + (p_2 - p_3) v_2\} / (h_1 - h_{f3})$ (b) $(h_1 - h_2) + (v_2 - v_3) p_2 / (h_1 - h_{f3})$

(c) $(h_1 - h_2) + (p_2 - p_3) v_2 / (h_1 - h_{f3})$ (d) $(h_2 - h_3) + (p_1 - p_3) v_2 / (h_1 - h_{f3})$

27. *A performance test gave the result of the specific steam consumption of 12.8 kg / kW.h. The indicated work per kg may be;*
(a)281.25 kj/kg   (b) 218.55 kj/kg   (c) 218.55 kj/kg   (d) 182.55 kj/kg

28. *A performance test gave the result of the specific steam consumption of 12.8 kg /kW.h and a mechanical efficiency of 80%. Brake work per kg may be;*

(a) 255 kj/kg   (b) 212 kj/kg   (c) 225 kj/kg   (d) 252 kj/kg

29. *The maximum discharge through a natural draught chimney can be given as function of m (mass of air supplied per kg of fuel), T_a (atmospheric temperature) and T_g (hot gas temperature).*

(a)$T_g = T_a \dfrac{2(m+1)}{m}$ (b) $T_g = T_a \dfrac{2m}{(m+1)}$ (c) $T_g = T_a \dfrac{(m+1)}{2m}$ (d) None of these

 30. *The power requirement in forced draught and induced draught shall be related as,*

(a)$P_{induced} = P_{forced}$ (b) $P_{induced} \prec P_{forced}$ (c) $P_{induced} \succ P_{forced}$ (d) None of these

31. **State which of the following is/are incorrect?**
(a) Combustion is better in forced draught
(b) Fan size of induced draught is larger than forced draught fan
(c) Maintenance in F.D. fan is easy as compared to ID fan
(d) None of these

32. **Steam jet draught is not of following type**
   (a) Natural draught   (b) Induced draught
   (c) Forced draught   (d) Artificial draught

33. **Stagnation temperature can be related to the static temperature and dynamic temperature as under**
(a) Stagnation temperature = Static temperature - Dynamic temperature
(b) Stagnation temperature = Static temperature + Dynamic temperature
(c) Stagnation temperature = Dynamic temperature - Static temperature
(d) None of these

34. **A combustion has all the oxygen supplied with air to the reactants being used and no free oxygen appears in products. Such air supplied is called as**
(a) Stoichiometric air   (b) Excess air
(c) Dry air   (d) None of these

35. **The fusible plug in small boilers is located**
(a) in the drum   (b) in the flute tube
(c) above steam dome   (d) over the combustion chamber
(e) at the inlet of chimney.

36. **The function of injector used in small capacity boilers is to**
(a) create vacuum   (b) inject chemical solution in feed water
(c) pump water, similar to boiler feed pump
(d) add make up water in the system   (e) none of choices.

37. **The safety valve at superheater as compared to drum safety valve setting is set at**
(a) higher value   (b) lower value
(c) same value   (d) irrespective of (e) none of choices.

38. **The fitting mounted on the boiler, whose function is to control the flow of steam from boiler to the main steam pipe and to shutt off steam completely when required, is called**
(a) safety valve   (b) stop valve
(c) fusible valve   (d) blow off cock.

39. **The fitting mounted on the boiler, whose function is to empty the boiler when required and to discharge mud and scale which are accumulated at the bottom of boiler is called**
(a) safety valve   (b) stop valve
(c) fusible valve   (d) blow off cock.

40. **The velocity of steam in a nozzle can be increased above sonic velocity by expanding steam below critical pressure by using**
(a) parallel section   (b) tapered section
(c) abruptly changing cross section
(d) divergent portion   (e) ring diffusers.

QUESTION NO. Two: [M18]

(a) In a steam power plant the high pressure turbine is fed with steam at 60 bar, 450°C and enter low pressure turbine at 3 bar with a portion of steam bled out for feed heating at this intermediate pressure. Steam finally leaves low pressure turbine at 0.05 bar for inlet to condenser. Closed feed heater raises the condensate temperature to 115"C. Bled steam leaving closed feed heater is passed through trap to mix with condensate leaving condenser. Consider actual alternator output to be 30 MW, boiler efficiencey as 90% and alternator efficiency of 98%. Determine;
(a) The mass of steam bled for feed heating,   (b) The capacity of boiler in kg/hr.
(c) The overall thermal efficiency of plant
Also give layout with (T-s) and (h-s) diagrams.

(b) From the Techenology view:
  1- Design requirements of an Economiser.?
  2-Why economizers are essentially used irrespective of the fuel used
     in boile rfurnace?
  3- Economizers are located after or before feed pump, comment?.

(c) A steam injector delivers 150 kg of water per minute to the boiler. The level of the water tank is 4 meters below the level of the injector and the level of boiler is 1 meter above the center line of the injector. The pressure in the boiler is 15bar-ab. The steam of the boiler pressure and 0.95 dryness is supplied to the steam injector. Assume the steam flow through the steam nozzle, is. Frictionless adiabatic, find,:
(a) Mass of steam supplied per hour.
(b) Diameter of the throat of mixing nozzle.

QUESTION NO. THREE: [M17]

(a) A Steam power plant operates on Reheat cycle , the pressure limits of 5 Mpa and 5Kpa with steam mass flow rateof 1500 kg/min . Steam enters both stages of the turbine at 500 °C.If the moisture content of the steam at the exit of turbine not to exceed 5%, and the efficiency of high pressure turbine is 0.85% while the pressure losses in the reheat is 0.5 bar, the efficiency of low pressure turbine is causes entropoy change of 0.3 kj/kg .K . Determine the efficiency of low pressure turbine; the net power output and the thermal efficiency of the cycle. Show the cycle on (T-s) and (h-s) diagrammes

(b)What are the different factores necessary for ideal boiler includes?. Give an outline sketch showing the arrangment of Water tubes boiler in a diagrammatic view of a Loeffler boiler.

(c)A convergent nozzle is supplied with steam at 10 bar and 270°C.   The diverging portion of the nozzle is 32mm. long and throat diameter is 6 mm. Find the semi cone angle of the divergent section so that the steam may leave the nozzle at 1.2 bar. The loss in the nozzle due to friction is 15% of the total enthalpy drop Assume that the loss takes place only in the divergent part of the nozzle.

QUESTION NO. FOUR: [M15]

(a) As a mechanicel Engineer explain in details the following;

   1- How are Boilers classified?

   2- Explain the stepes of Hydrostatics test?

   3- What are the factors should be considered While selecting a boiler?

(b) Explain with the help of drawing operation of balanced draft control. What advantages has mechanical draft over natural draft?

(c). Find the mass of flue gases flowing through the chimney when the draught produced is equal to 20 mm of water. Temperature of the flue gases is 297°C and ambient temperature is 27°C. The flue gases formed per kg of fuel burned are 20 kg. Diameter of the chimney is 2 meters. Neglect the losses.

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مع أطيب التمنيات بالتوفيق
Dr ALY ELBOUZ