STUDY MATERIAL

SUBJECT : BASIC MECHANICAL ENGG.(BME)

MODULE-II

SEMESTER :1ST /2ND

(ALL BRANCHES)

CONTENTS :

- OBJECTIVE TYPE QUESTIONS AND ANSWERS
- SHORT TYPE QUESTIONS AND ANSWERS
- LONG TYPE QUESTIONS AND ANSWERS

DEPARTMENT OF MECHANICAL ENGINEERING

MULTIPLE CHOICE QUESTIONS

1. Device used to generate and supply steam at a high pressure and temperature is known as
   (a) steam injector (b) steam boiler
   (c) steam turbine (d) steam condenser
2. Fire tube boilers are
   (a) internally fired (b) externally fired
   (c) both (d) none of the above
3. Fire tube boilers are
   (a) Lanchashire boiler
   (b) Cochran boiler
   (c) locomotive boiler
   (d) all of the above
4. Number of fire tubes in Lanchashire boiler are
   (a) 1 (b) 2
   (b) 3 (d) 4
5. In a Lancashire boiler, the economiser is located
   (a) before air preheater
   (b) after air preheater
   (c) between feed pump and drum
   (d) all of the above
6. Locomotive boiler is
   (a) vertical, multitubular, fire-tube type
   (b) horizontal, multitubular, fire-tube type
   (c) horizontal, multitubular, water-tube type
   (d) none of the above
7. Water tube boiler is
   (a) Babcock and Wilcox boiler
   (b) Stirling boiler
   (c) Benson boiler
   (d) all of the above
8. Babcock and Wilcox boiler has water tubes
   (a) vertical (b) horizontal
   (c) inclined (d) none of the above
9. If circulation of water takes place by convection currents, set up during the heating of water, the boiler is known as
   (a) natural circulation boiler
   (b) forced circulation boiler
   (c) internally fired boiler
   (d) externally fired boiler
10. If circulation in boiler made by pump, then it is known as
    (a) natural circulation boiler
    (b) forced circulation boiler
    (c) internally fired boiler
    (d) externally fired boiler
11. If combustion takes place outside the boil water region, the boiler is known as
    (a) natural circulation boiler
    (b) forced circulation boiler
    (c) internally fired boiler
    (d) externally fired boiler
12. If combustion takes place inside the boi water region, the boiler is known as
    (a) natural circulation boiler
    (b) forced circulation boiler
    (c) internally fired boiler
    (d) externally fired boiler
13. In forced circulation boiler, force is applied t
    (a) draw water
    (b) drain off the water
    (c) circulate water
    (d) all of the above
14. Forced circulation boiler is
    (a) La-Mont boiler
    (b) Benson boiler
    (b) Loeffler boiler
    (d) all of the above
15. Safety valve used in locomotive boilers is
    (a) lever safety valve
    (b) dead weight safety valve
    (c) high steam and low water safety valve
    (d) spring loaded safety valve
16. A device used to empty the boiler, v required and to discharge the mud, scale or ments collected at the bottom of the boil known as
    (a) safety valve (b) stop valve
    (b) fusible plug (d) blow off cock
17. An accessory of boiler is
    (a) feed pump
    (b) feed check valve
    (c) stop valve
    (d) blow off cock
18. A device used for recovery of waste heat o gas to heat the air before it passes into th nace is known as
    (a) super heater (b) air preheater
    (c) injector (d) economiser
19. Boiler mounting is
    (a) economiser (b) injector
    (c) fusible plug (d) super heater

20. Ratio of heat used in steam generation and heat supplied to the boiler is known as
    (a) boiler efficiency
    (b) chimney efficiency
    (c) economizer efficiency
    (d) none of the above

21. At very low temperature at which melting and boiling point of water becomes equal is
    (a) 233 K (b) 273.16 K
    (c) 303 K (d) 0 K

22. The critical pressure at which latent heat of vaporization of water becomes zero is
    (a) 225.65 bar (b) 273 bar
    (c) 100 bar (d) 1 bar

23. For water, below the atmospheric pressure
    (a) melting point rises slowly and boiling point drops markedly
    (b) melting point drops slowly and boiling point rises markedly
    (c) melting point rises slowly and boiling point rises markedly
    (d) none of these

24. The latent heat of steam at pressure greater than atmospheric pressure is
    (a) less (b) more
    (c) equal (d) none of these

25. The saturation temperature of steam with increasing pressure increases
    (a) linearly
    (b) first rapidly then slowly
    (c) inversely
    (d) none of these

26. Heating of dry steam above saturation temperature is known as
    (a) enthalpy
    (b) superheating
    (c) supersaturating
    (d) none of these

27. Superheating of steam is done at
    (a) constant volume
    (b) constant pressure
    (c) constant enthalpy
    (d) constant entropy

28. The specific volume of steam with increase in pressure decreases
    (a) linearly
    (b) slowly first and then rapidly
    (c) rapidly first and then slowly
    (d) inversely

29. 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_1x_2 (b) $x_1 + x_2$
    (c) $(x_1 + x_2)/2$ (d) x_1/x_2

30. The specific heat of superheated steam in kcal/kg is generally of the order of
    (a) 0.1 (b) 0.3
    (c) 0.5 (d) 0.8

31. A wet steam can be completely specified by
    (a) pressure only
    (b) temperature only
    (c) dryness fraction only
    (d) pressure and dryness fraction

32. On Mollier chart, the constant pressure lines
    (a) diverge from left to right
    (b) diverge from right to left
    (c) first rise up and then fall
    (d) none of these

33. On Mollier diagram, free expansion, or throttling process from high pressure to atmosphere is represented by
    (a) horizontal straight line
    (b) vertical straight line
    (c) curved line
    (d) none of these

34. Latent heat of dry steam at atmospheric pressure is equal to
    (a) 539 kcal/kg (b) 539 kJ/kg
    (c) 539 BTU/lb (d) none of these

35. In throttling process
    (a) entropy remains constant
    (b) enthalpy remains constant
    (c) pressure remains constant
    (d) none of these

Answers

1. (b), 2. (c), 3. (d), 4. (b), 5. (b), 6. (b), 7. (d), 8. (c), 9. (a), 10. (b), 11. (d), 12. (c), 13. (c), 14. (d), 15. (d), 16. (d), 17. (a), 18. (b), 19. (c), 20. (a), 21. (b), 22. (a), 23. (a), 24. (a),2 5(b), 26. (b), 27. (b), 28. (c), 29. (a), 30. (c), 31. (d), 32. (a), 33, (a), 34, (a), 35, (b)

FILL IN THE BLANKS

1. Water tube boilers produce steam at a _____ pressure than that of fire tube boilers.
2. For same dimensions and thickness of the tube, a water tube boiler has _____ heating surface than fire tube boiler.
3. A _____ in a boiler is used to put off fire in the furnace when the level of water falls to the unsafe limit.
4. An equivalent evaporation of a boiler is defined as _____.
5. The draught in locomotive boiler is produced by _____.

Answers

1. Higher, 2. More, 3. Fusible plug, 4. The amount of water evaporated from and at 100°C to dry and saturated steam, 5. Passing the steam through the furnace.

REVIEW QUESTIONS (Imp. Questions)

1. Define dryness fraction and degree of superheat and show their applications in steam power plant.
2. Explain the use of steam table and Mollier diagram.
3. Draw a neat sketch of throttling calorimeter and explain how dryness faction of steam is determined. Wha are its limitations?
4. What are the requirements for a good boiler?
5. Differentiate between
   (a) Natural circulation and forced circulation in boilers.
   (b) Internal fired and external fired boilers.
   (c) Fire tube and water tube boilers.
   (d) High pressure and low pressure boilers.
6. Explain very briefly the function of following mountings:
   (a) Steam stop valve (b) Feed check valve
   (c) Blow-off cock (d) Water level indicator
   (e) Pressure gauge (f) Safety valve
7. State the advantages of high pressure boilers. Explain the construction and working of Babcock ar Wilcox boiler with a neat sketch.
8. Explain the construction and working of pressure gauge with a neat sketch.
9. Explain the working of Cochran boiler and fusible plug with neat sketches.

MULTIPLE CHOICE QUESTIONS (Steam Turbines & Gas Turbines)

Steam Turbine

1. In an impulse turbine, steam expands
   (a) fully in nozzle
   (b) fully in blades
   (c) partly in nozzle and partly in blades
   (d) none of the above

2. In an impulse turbine, steam expands
   (a) fully in nozzle
   (b) fully in blades
   (c) partly in nozzle and partly in blades
   (d) none of the above

3. In impulse turbines, pressure on the two sides of the moving blades
   (a) increases (b) decreases
   (c) remains same (d) none of the above

4. In impulse turbine, when steam flows over the moving blades,
   (a) velocity decreases
   (b) velocity increases
   (c) pressure decreases
   (d) none of the above

5. In a reaction steam turbine, steam expands
   (a) in nozzle only
   (b) in moving blades only
   (c) partly in nozzle partly in blades
   (d) both in fixed and moving blades

6. De-Laval turbine is a
   (a) simple impulse turbine
   (b) simple reaction turbine
   (c) pressure compounded turbine
   (d) velocity compounded turbine

7. Parson's turbine is a
   (a) simple impulse turbine
   (b) simple reaction turbine
   (c) pressure compounded turbine
   (d) velocity compounded turbine

8. Curtis turbine is
   (a) simple impulse turbine
   (b) simple reaction turbine
   (c) pressure compounded turbine
   (d) velocity compounded turbine

9. Reteau turbine is
   (a) simple impulse turbine
   (b) simple reaction turbine
   (c) pressure compounded turbine
   (d) velocity compounded turbine

10. The turbine having identical fixed and moving blades is
    (a) de-laval turbine
    (b) parson's reaction turbine
    (c) rateau turbine
    (d) zoelly turbine

11. In reaction turbine, stage is represented by
    (a) each row of blades
    (b) number of casting
    (c) number of steam exits
    (d) none of the above

12. Blade efficiency is the ratio of
    (a) work done on blades and energy supplied to the blades
    (b) work done on blade and energy supplied to each stage

(c) energy supplied per stage and work done on the blades
(d) energy supplied to blades and work done on blades.

13. Maximum efficiency of Parson's reaction turbine is equal to

(a) $\frac{\cos^2\alpha}{1+2\cos^2\alpha}$ (b) $\frac{2\cos^2\alpha}{1+\cos^2\alpha}$

(c) $\frac{1+2\cos^2\alpha}{\cos^2\alpha}$ (d) $\frac{1+\cos^2\alpha}{2\cos^2\alpha}$

14. For maximum efficiency of a Parson's reaction turbine, the speed ratio is equal to

(a) $\frac{\cos\alpha}{2}$ (b) $\cos\alpha$

(c) $\cos^2\alpha$ (d) $\frac{\cos^2\alpha}{2}$

15. For maximum blade efficiency of a single stage impulse turbine, the blade speed is equal to

(a) $\frac{\cos\alpha}{2}$ (b) $\cos\alpha$

(c) $\cos^2\alpha$ (d) $\frac{\cos^2\alpha}{2}$

16. The compounding of turbine
(a) increases efficiency
(b) decreases rotor speed
(c) decreases exit loss
(d) all of the above

Gas Turbine

17. A gas turbine works on
(a) Rankine cycle (b) Carnot cycle
(c) Joule cycle (d) Ericsson cycle

18. When working fluid in a plant doesn't come in contact with the atmospheric air, and is used again, turbine is said to work on
(a) open cycle (b) closed cycle
(c) semi-closed cycle (d) none of these

19. When the entire fluid is taken from the atm sphere and is returned back to the atmosphe the gas turbine is said to work on
(a) open cycle
(b) closed cycle
(c) semi-closed cycle
(d) none of these

20. Efficiency of closed cycle gas turbine as co pared to open cycle gas turbine is
(a) more (b) less
(c) same (d) none of the abov

21. Regenerator in gas turbine
(a) increases thermal efficiency
(b) decreases heat loss in exhaust
(c) allows use of higher compression ratio
(d) all of the above

22. Compressors used in turbine are
(a) reciprocating type
(b) centrifugal type
(c) axial flow type
(d) none of the above

23. Intercooling in gas turbine
(a) increases thermal efficiency
(b) decreases compression work
(c) increases turbine work
(d) none of the above

24. Reheating in turbine
(a) increases thermal efficiency
(b) decreases compression work
(c) increases turbine work
(d) none of the above

25. The air–fuel ratio in gas turbine is
(a) 15:1 (b) 30:1
(c) 45:1 (d) 50:1

26. The pressure ratio in gas turbine is of the orc of
(a) 2:1 (b) 4:1
(c) 6:1 (d) 8:1

Answers

1. (a) 2. (c) 3. (a) 4. (c) 5. (a) 6. (b) 7. (d) 8. (c) 9. (b) 10. (a) 11. (a) 12. (b) 13. (b) 14. (a) 15. (d) 16. (c) 17. (18. (a) 19. (a) 20. (d) 21. (c) 22. (b) 23. (c) 24. (d) 25. (c)

FILL IN THE BLANKS

1. The ratio of useful heat drop to isentropic heat drop is called ____.
2. De-Laval turbine is normally used for ____ pressure and ____ speed.

3. The pressure–velocity compounded steam turbine allows a ____ pressure drop and hence____ number o stages are required.
4. In impulse-reaction turbine, the pressure drops gradually and continuously over____ blades.
5. The parson's reaction turbine has ____ and____ blades.
6. In reaction turbine, the degree of reaction is zero. This implies ____ heat drops in moving blades.

Answers

1. Reheat factor, 2. Low, High, 3. High, Less, 4. Fixed and Moving, 5. Identical fixed and moving, 6. Zero.

REVIEW QUESTIONS (Practice following Questions)

1. With a neat sketch explain the construction and working of a single stage impulse steam turbine.
2. What is compounding of impulse turbine? With a neat sketch explain the working of velocity compounding
3. With a neat sketch explain the working of pressure–velocity compounding of impulse steam turbine.
4. Differentiate impulse and reaction type steam turbines.
5. Write short notes on: (i) degree of reaction, (ii) reheat factor, (iii) diagram efficiency, and (iv) condition line
6. Explain the methods of governing of steam turbine.
7. Explain the working of closed cycle gas turbine.
8. Explain the working principle of open cycle as turbine.
9. What is a gas turbine? What are the essential components of a gas turbine plant? How it differs from steam turbine?
10. What are the purposes of regeneration, intercooling, and reheating in a gas turbine?

PROBLEMS FOR PRACTICE (Imp. for Semester Exam)

1. In a single row impulse turbine, the blade speed is 200 m/s, nozzle angle is 18°. If the steam enters with absolute velocity of 300 m/s. Find
   (i) Inlet and outlet angles of moving blade so that there is no axial thrust.
   (ii) Power developed for a steam flow of 1 kg/s.
   (iii) Kinetic energy of steam leaving the stage.
2. A reaction turbine has degree of reaction 50% (i.e., Parson's reaction turbine) and running at 500 rpm develops 8 MW using 10 kg/kWh of steam flow rate. The exit angle of the blades is 18° and the velocity of steam relative to the blade at exit is two times the mean peripheral speed. At a particular stage in the expansion, the pressure is 1.2 bar and the steam quality is 90%.
   Calculate for the stage: (i) Blade height assuming the ratio of D_m/h_b as 12, and (ii) Diagram power.
3. In a four-stage turbine steam is supplied at 300 N/cm² and 380°C. The exhaust pressure is 0.05 N/cm² and the overall turbine efficiency is 0.7. Assuming that work is shared equally between stages and the condition line is a straight line, find (i) stage pressure, (ii) efficiency of each stage, and (c) reheat factor.
4. The enthalpy drop in the nozzle of an impulse turbine is 50 kJ/kg. The nozzle is inclined at 16° to the wheel tangent. The average diameter of the wheel is 0.25 m. Wheel runs at 11,000 rpm. Determine the blade inlet angle for sockless entry. If the blade exit angle is equal to the blade inlet angle, determine the work done/kg, and also the axial thrust for flow of 1 kg/s.

Imp. Notes

- The compression ratio of SI engines varies from 6 to 10 whereas in CI engines it ranges from 16 to 20.
- In a four stroke SI engine, there is one power stroke in two revolutions of crankshaft and two strokes, viz., suction and exhausts are non-productive.
- In two strokes of a spark ignition engine, the cycle of operations is completed in two strokes of the piston or one revolution of the crankshaft.
- SI engine is based on Otto cycle or constant volume heat addition and rejection cycle.
- CI engine is based on diesel cycle or constant pressure heat addition and constant volume heat rejection cycle.
- In Otto cycle, heat is added and rejected at constant volume.
- In diesel cycle, heat is added at constant pressure and is rejected at constant volume.
- Valve timing diagram is a graphical representation of valves opening and closing time with ignition time in terms of angle of crank revolution.
- For same compression ratio Otto cycle is more efficient but delivers less power than the diesel cycle. Therefore, in duel cycle partly heat is added at constant volume and partly at constant pressure.
- Indicated thermal efficiency is ratio of energy in the indicated diagram (I_p) to the input fuel energy.
- Brake thermal efficiency is ratio of energy in brake power (B_p) to the input fuel energy. Brake power is obtained by subtraction of friction losses from indicated power.
- Mechanical efficiency is ratio of the brake power to the indicated power.
- Volumetric efficiency is ratio of the volume of air inducted at ambient conditions to the swept volume of the engine.
- Relative efficiency or efficiency ratio is ratio of the thermal efficiency of actual cycle and the ideal cycle.
- Mean effective pressure is the average pressure inside the cylinder of an IC engine on the measured power output.

MULTIPLE CHOICE QUESTIONS

1. In I. C. engines, power developed inside the cylinder is known as
   (a) brake horse power
   (b) indicated horse power
   (c) pumping power
   (d) none of the above
2. The power spent in suction and exhaust strokes is known as
   (a) brake horse power
   (b) indicated horse power
   (c) pumping power
   (d) none of the above
3. The difference of total power produced and pumping power is known as
   (a) brake horse power
   (b) indicated horse power
   (c) net indicated horse power
   (d) none of the above
4. The power available at the shaft of an IC engine is known as
   (a) brake horse power
   (b) indicated horse power
   (c) net indicated horse power
   (d) none of the above
5. In a four stroke engine, the number of revolutions of the crankshaft for completion of working cycle is
   (a) one (b) two
   (c) three (d) four
6. In a two stroke engine, the number of revolutions of the crankshaft for completion of working cycle is
   (a) one (b) two
   (c) three (d) four
7. Theoretically, four stroke engine should develop power as compared to two stroke engine is
   (a) half (b) same
   (c) double (d) four times
8. At the same speed, the number of power strokes given by a two stroke engine as compared to a four stroke engine is
   (a) half (b) same
   (c) double (d) four times
9. Thermal efficiency of two stroke engine in comparison to four stroke engine is
   (a) more (b) same
   (c) less (d) none of the above

10. Mechanical efficiency of two stroke engine in comparison to four stroke engine is
    (a) more (b) same
    (c) less (d) none of the above
11. In a petrol engine, charge is ignited with
    (a) spark plug (b) compression
    (b) both (d) none of the above
12. In four stroke petrol engine,
    (a) intake valve closes after top dead centre
    (b) intake valve closed after bottom dead centre
    (c) exhaust valve closes after top dead centre
    (d) exhaust valve closes after bottom dead centre
13. Compression ratio in petrol engine ranges from
    (a) 6 to 10 (b) 10 to 15
    (c) 15 to 25 (d) 25 to 40
14. Compression ratio in diesel engine ranges from
    (a) 6 to 10 (b) 10 to 15
    (c) 14 to 22 (d) 25 to 40
15. If compression ratio in petrol engines is kept higher than that is in diesel engines, then
    (a) pre-ignition of fuel will occur
    (b) ignition of fuel will be delayed
    (c) detonation will occur
    (d) none of the above
16. In CI engines, the combustion is
    (a) homogeneous (b) heterogeneous
    (c) both (d) none of the above
17. Which of the following is not related to CI engine?
    (a) fuel pump (b) fuel injector
    (c) carburettor (d) flywheel
18. Indicator on an engine is used to determine
    (a) B.H.P (b) speed
    (c) temperature (d) I.H.P and m.e.p
19. Morse test is conducted on
    (a) vertical engines
    (b) horizontal engines
    (c) single cylinder engines
    (d) multi-cylinder engines
20. The m.e.p of a diesel engine with fixed compression ration can be improved by
    (a) increasing cut-off ratio
    (b) increasing back pressure
    (c) increasing operating pressure
    (d) reducing charge density

Answers

1. (b) 2. (c) 3. (c) 4. (a) 5. (b) 6. (a) 7. (a) 8. (c) 9. (c) 10. (a) 11. (a) 12. (b) 13. (a) 14. (c) 15. (a) 16. (b) 17. (c) 18. (d) 19. (d) 20. (a)

FILL IN THE BLANKS

1. An engine is said to be square if cylinder bores equal to _____
2. The period during both inlet and exhaust valve remain open is known as _____
3. A two stroke engine employs _____ cut in the wall of cylinder instead of _____
4. In four stroke petrol engine, size of intake valve is _____ than that of exhaust valve.
5. Carburetion is the process of _____ and _____

Answers

1. Stroke length, 2. Valve overlap, 3. Ports, valves, 4. Smaller, 5. Mixing, vaporization of fuel.