TR/TES/M-II/V(B)/13

MECHANICAL ENGINEERING

Paper : II

Grade : V(B)

Full Marks – 200

Time – Three hours

The figures in the margin indicate full marks for the questions.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A 15×6=90

Answer *all* questions.

Each question carries 6 (six) marks.

1. (a) Explain liquid-suction heat exchanger.

   (b) Why is this incorporated in vapour compression refrigeration system ? 3+3=6

2. (a) How does the increase in condenser temperature affect COP of vapour compression refrigeration system ? Also explain the influence of evaporator temperature on COP.

[Turn over

13. (a) What is the life-time of a typical solar power plant ?

(b) What is the hydraulic balance of the solar field ? 3+3=6

14. (a) How much electricity can one wind turbine generate ?

(b) What are the economic benefits of wind-generated energy ? 3+3=6

15. (a) What is latent heat ? Where is it absorbed and where is it released ?

(b) What percentage of incoming solar radiation is absorbed by the earth's surface ? 4+2=6

GROUP – B 40×2=80

Answer *all* questions.

Each question is having four options. Select the correct option and write in your answer script.

16. The earth's atmosphere consists largely which of the following gases ?

(a) Oxygen and carbon-dioxide

(b) Nitrogen and carbon-dioxide

(c) Nitrogen and oxygen

(d) Oxygen and water vapour

17. The earth experiences 12 hours of daylight and 12 hours of night on

(a) Summer solstice

(b) Winter solstice

(c) Either equinox

(d) Both aphelion and perihelion

18. The earth, maintaining a significantly cooler surface temperature than the sun emits

(a) Ultraviolet radiation

(b) Shortwave infrared radiation

(c) Longwave radiation

(d) Visible light

19. Scattered radiation moving in all directions through the atmosphere is known as

(a) diffuse radiation

(b) diffuse reflection

(c) direct radiation

(d) refracted radiation

20. Which of the following is the example of high altitude cloud ?

(a) Cirrus

(b) Cumulus

(c) Stratus

(d) Stratocumulus

21. Wind speed is measured using an instrument called

(a) Barometer

(b) Wind vane

(c) Speedometer

(d) Anemometer

22. Liquid-suction heat exchanger is used in vapour compression refrigeration system to

(a) improve COP of the cycle

(b) avoid useless superheating in pipes

(c) to reduce heat rejection in condenser

(d) None of the above

23. Sub-cooling is a process of cooling the refrigerant in vapour compression refrigeration system

(a) after compression

(b) before compression

(c) before throttling

(d) None of the above

24. In vapour compression refrigeration system the following data is available. Enthalpy of refrigerant at suction to compressor = 585 kJ/kg at discharge from compressor = 610 kJ/kg and heat rejected to cooling water = 5 kJ/kg. The work of compressor per kg is

(a) 25 kJ/kg

(b) 20 kJ/kg

(c) 30 kJ/kg

(d) None of the above

25. For high speed planes cruising at Mach number of 2·5 and above. The aircraft refrigeration system recommended is

(a) Simple evaporative type

(b) Boot-strap type

(c) Regenerative type

(d) Boot-strap evaporative type

26. The dense air system as compared to open air system for same range of temperature using Bell-Colemann system gives

(a) higher power / ton of refrigeration

(b) lower power / ton of refrigeration

(c) same power / ton of refrigeration

(d) unpredictable results.

27. A reverse Carnot cycle has a COP of 4. The ratio of higher temperature to lower temperature will be

(a) 1·5 (b) 2 (c) 1·25 (d) 2·5

28. Reversed Carnot cycle assumes that all processes in the cycle are

(a) Non-flow only

(b) Steady flow only

(c) Non-flow or steady flow

(d) Transient flow

29. A Carnot refrigerator operates between 300·3°K and 273°K. The fraction of cooling effect required as work input is

(a) 20% (b) 10%

(c) 50% (d) None of these

30. The refrigerant R-22 stands for

(a) $CFCL_3$ (b) CF_2CL_2

(c) CF_3CL (d) CHF_3CL

31. For fixed pressure ratio, the isentropic compressor work is the highest for

(a) R – 717 (b) R – 11

(c) R – 22 (d) R – 12

32. High boiling point refrigerants are preferably suited for

(a) Reciprocating compressors

(b) Centrifugal compressors

(c) Small screw type compressors

(d) For all the above

33. In vapour compression refrigeration cycle the following data are available :

Heat rejected in condenser = 65 KW, work-done in compressor = 10 KW, then COP is

(a) 6·5 (b) 5·5

(c) 4·5 (d) None of these

34. In a domestic vapour compression refrigerator, the refrigerant used is

(a) CO_2 (b) Freon - 12

(c) Ammonia (d) All the above

35. A domestic window type air conditioner capacity may be approximately

(a) 1 ton (b) 0·1 ton

(c) 5 ton (d) 10 ton

36. The specific fuel consumption of diesel engine as compared to that for petrol engine is

(a) higher

(b) lower

(c) same for same output

(d) same for same speed

37. In four stroke cycle diesel engine, during suction stroke

(a) only air is sucked in

(b) only fuel is sucked in

(c) mixture of fuel and air is sucked in

(d) None of the above

38. Relative fuel-air ratio for maximum thermal efficiency of spark ignition engine may be

(a) 0·8 (b) 0·6

(c) 1·2 (d) 1·5

39. Standard firing order for 4 cylinder petrol engine is

(a) 1– 2 – 3 – 4 (b) 1– 4 – 3 – 2

(c) 1 – 3 – 2 – 4 (d) 1– 3 – 4 – 2

40. In petrol engine the knocking tendency will increase when

(a) speed is increased

(b) speed is decreased

(c) fuel-air ratio is made rich

(d) fuel-air ratio is made lean

41. The knocking tendency in compression ignition engines increase with

(a) increase of compression ratio

(b) decrease of compression ratio

(c) increasing the temperature of inlet air

(d) increasing the cooling water temperature

42. Cetane number of the fuel used commercially for diesel engines in India is in the range

(a) 40 to 45 (b) 60 to 70

(c) 60 to 80 (d) 80 to 90

43. The maximum pressure of air fuel mixture at the end of compression in petrol engines varies from

(a) 10 – 30 kg/cm^2 (b) 30 – 100 kg/cm^2

(c) 6 – 10 kg/cm^2 (d) 100 – 1000 kg/cm^2

44. The type of friction generally present in an automotive engine is

(a) Viscous friction

(b) Greasy friction

(c) Dry friction

(d) None of the above

45. The combustion process in diesel engine is

(a) Constant pressure process

(b) Isothermal process

(c) Constant volume process

(d) Adiabatic process

46. Two stroke engine is preferred for small vehicles because

(a) fuel consumption is low

(b) shock and vibration are less

(c) its size is small

(d) it is easy to control

47. The air volume in the cylinder with the piston at B.D.C divided by the clearance volume is called

(a) compression ratio

(b) piston displacement

(c) cylinder ratio

(d) None of the above

48. Piston compression rings are manufactured by

(a) Aluminium (b) Cast iron

(c) Steel (d) Bronze

49. The synchronizing device used in the transmission system uses

(a) cone braking surfaces

(b) flat braking surfaces

(c) synchronizing pins

(d) None of these

50. The device that produces different gear ratios in the power train is called

(a) Differential

(b) Transmission

(c) Speed Changer

(d) None of these

51. The number of planetary gear sets in a hydromatic transmission system is

(a) Two (b) Three

(c) Four (d) Five

52. The most widely used brakes are operated

(a) Electrically

(b) Hydraulically

(c) By air pressure

(d) By vacuum

53. In the air brake, the air pressure is supplied by

(a) Engine manifold

(b) A compressor

(c) The diaphragm valve

(d) None of these

54. The crankshafts are usually forged to get

(a) Minimum friction effort

(b) A good mechanical design

(c) Good grain structure

(d) Improved corrosion structure

55. The device for smoothing out the power impulses from the engine is called the

(a) Flywheel

(b) Camshaft

(c) Crankshaft

(d) Clutch

GROUP – C 5×6=30

Answer *all* questions.

Each question carries 6 (six) marks.

56. In a Bell-Coleman refrigeration plant, the air is drawn from cold chamber at 1 bar and 10°C and compressed to 5 bar. The same is cooled to 25°C in the cooler before expanding in the expansion cylinder to cold chamber pressure of 1 bar.

Determine the theoretical COP of the plant and the theoretical refrigeration effect/kg of air. The compression and expansion be assumed isentropic.

57. Compare the quantity of cooling water required for a 100 KW petrol and diesel engine in which the water is raised in temperature by 30°C in passing through the jackets. In petrol engine the percentage of energy going to coolant is 30% and in diesel engine 26%. The efficiency of petrol engine is 26% and diesel engine 31%.

58. A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 40°C and the lower temperature is –20°C. The capacity is to be 10 TR. Determine COP and power required of the system.

59. In an absorption type refrigeration system heating in generator, refrigeration in evaporator and cooling by cooling water in condenser take place at 95°C, –5°C and 30°C. Determine the maximum COP of the system.

60. A reversed Carnot cycle working on heat pump is delivering 40000 kJ/min to heat the conditioned space and maintaining it at 25°C when the outside atmospheric air temperature is 15°C.
Determine the heat drawn in or pumped into the conditioned space from atmospheric air and the power required to operate the cycle.