CBCS SCHEME

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18MR45

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Marine Heat Engine and Air Conditioning

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Steam table and HMT data hand book is permitted.***

Module-1

1 a. With the help of indicator diagram, with clearance derive an expression for work done per cycle. **(06 Marks)**

b. Derive an expression for volumetric efficiency of reciprocating air compressor. **(08 Marks)**

c. A single cylinder single acting air compressor has a swept volume of $0.035m^3$ and a clearance volume of $0.0012m^3$, and runs at 400rpm. The air is compressed from 1 bar and 27°C to 5.5bar. The index of compression and expansion is 1.28. Calculate :
i) Volumetric efficiency
ii) The mass of air delivered per second. **(06 Marks)**

OR

2 a. With the help of P-V and line diagram explain two stage reciprocating air compressor. **(10 Marks)**

b. In a single acting, two stage air compressor the mass compressed is 7.5kg of air per minute from 1.013 bar and 15°C through a pressure ratio of 12.25:1. The stage pressure ratios are equal and the index of compression and expansion is 1.28. Inter cooling is perfect, and the bode of each cylinder is 220mm. The clearance volume of each stage is 4% of the respective swept volume and the speed of rotation is 320rpm. Determine:
i) Indicated Power
ii) The volumetric efficiency of each stage
iii) The stroke of each stage. **(10 Marks)**

Module-2

3 a. What do you mean by Refrigeration? Write the basic cycle of vapour compression cycle. **(10 Marks)**

b. Define the following with respect to Refrigeration :
i) Refrigerating effect
ii) Cooling load
iii) Compressor work
iv) Capacity of refrigerant
v) Co-efficient of performance. **(10 Marks)**

OR

4 a. Briefly write down the desirable properties of a refrigerant. **(10 Marks)**

b. In an Ammonia refrigerator operating on the vapour compression cycle, the ammonia leaves the evaporator and enters the compressor as dry saturated vapour at 2.68 bar, it leaves the compressor and enters the condenser at 8.57 bar with 50°C of superheat. It is condensed at constant pressure and leaves the condenser as saturated liquid. If the rate of flow of the refrigerant through the circuit is 0.45 Kg/min calculate : i) compressor power ii) the heat rejected to the condenser cooling water in kJ/sec and iii) the refrigerating effect in kJ/sec. **(10 Marks)**

Module-3

5 a. Sketch a thermostatic expansion control valve as fitted in a refrigeration system, label the part. (10 Marks)

b. Explain the functions of the following with reference to the refrigeration system. (10 Marks)

i) Solenoid valve
ii) H.P safety cutout
iii) Oil pressure safety cutout.

OR

6 a. Write short notes on maintenance of the following refrigeration system equipments

i) Condensers
i) Oil separators
ii) Filters and driers. (10 Marks)

b. State how each of the following faults identified for a vapour compression refrigeration machine.

i) Air in the system
ii) Moisture in the system
iii) Undercharge
iv) Overcharged. (10 Marks)

Module-4

7 a. Write and explain the basic principle of air conditioning. (08 Marks)

b. Draw a block diagram of an automatic accommodation air conditioning unit and label the parts and indicate the directions of air flow. (12 Marks)

OR

8 a. What safety precaution will you take when working with a refrigerated compressor during troubleshooting or repairs? (08 Marks)

b. Enumerate the standard maintenance carried out in air condition system. (08 Marks)

c. What are the properties of air for an effective air conditioning system? (04 Marks)

Module-5

9 a. Classify heat exchanger. Briefly explain with a neat sketch shell and tube heat exchanger. (10 Marks)

b. Derive an expression for LMTD of counter flow heat exchanger. (10 Marks)

OR

10 a. Define effectiveness of a heat exchanger and write the effectiveness equation for parallel and counter flow. (08 Marks)

b. Write a note on duct insulation. (04 Marks)

c. Exhaust gases flowing through a tubular heat exchanger at the rate of 0.3 kg/s are cooled from 400 to 120°C by water initially at 10°C. The specific heat capacities of exhaust gases and water may be taken as 1.13 and 4.19kJ/kgK respectively, and the overall H.T.C from gases to water $140 W/m^2K$. Calculate the surface area required when the cooling water flow is 0.4Kg/s

i) for parallel flow
ii) for counter flow. (08 Marks)

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