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AU – 2849

Seventh Semester B. E. (Mechanical Engineering) Examination

ENERGY CONVERSION – II

Paper – 7 ME 02

(USC – 10871)

P. Pages : 5

Time : Three Hours] [Max. Marks : 80

Note : (1) Separate answer book must be used for each section in the subject Geology, Engineering material of Civil branch and separate answer book must be used for Section A and B in pharmacy and Cosmetic Tech.
(2) Answer **Three** questions from Section A and **Three** questions from Section B.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Illustrate your answer wherever necessary with the help of neat sketches.
(6) Use of slide rule, logarithmic table, steam tables, Molliers chart, drawing instrument, Thermodynamic Table for moist air, psychrometric chart, and refrigeration charts is permitted.
(7) Use pen of Blue / Black ink / refill only for writing book.

SECTION A

1. (a) Air is to be compressed in a single stage reciprocating compressor from 1.013 bar and 15^0C upto 7 bar. Calculate the indicated power required for a free air delivering of $0.3\,m^3/min$ when compression process is

(i) Isentropic (ii) Isothermal (iii) Polytropic with n = 1.25. 7

(b) Following data relate to a performance test of single acting (14 cm x 10 cm) reciprocating compressor :—
Suction pressure = 1 bar ; Temp. = 20 ^{0}C
Discharge pressure = 6 bar ; Discharge Temp. = 180 ^{0}C
Speed of compressor = 1200 rpm
Shaft power = 6.25 kW
Mass of air delivered = 1.7 kg/min

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Calculate the following :—

(i) Volumetric Efficiency

(ii) Indicated Power

(iii) Isothermal Efficiency

(iv) Mechanical Efficiency.

(v) Overall isothermal Efficiency. 7

OR

2. (a) What is clearance volume in reciprocating compressor ? What is effect of clearance volume on volumetric efficiency and work of compressor ? 7

(b) Single stage double acting air compressor is required to deliver 14 m^3 of air per min. measured at 1.013 bar and 15 ^{0}C. Delivery pressure is 7 bar and speed is 300 rpm. Clearance volume is 5% of swept volume. Index of compression and expansion is 1.3.
Calculate :—

(i) Swept volume of cylinder (ii) Delivery Temperature

(iii) Indicated Power. 7

3. (a) Explain with neat sketch construction and working of Roots Blower. 6

(b) Compare the work inputs required for a Roots Blower and Vane type compressor having same induced volume of 0.03 m^3 / rev, the inlet pressure being 1.013 bar and pressure ratio 1.5 to 1. For vane type assume that internal compression takes place through half the pressure range. 7

OR

4. (a) Explain with neat sketch construction and working of vane type blower. 6

(b) Free air of 30 m^3/ min. is compressed from 1.013 bar to 2.23 bar. Calculate power required if :—

(i) Compression is carried out in Roots Blower.

(ii) Compression is carried out in Vane Blower.

Assume that there is 25% reduction in volume before back flow occurs. 7

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5. (a) What is under cooling or subcooling of liquid refrigerant ? What is its effect on C. O. P. of refrigeration system ? 6

(b) A simple vapor compression plant produces 5 tonnes of refrigeration. The enthalpy volues at the inlet to compressor, at the exit of compressor, and at the exit from condenser are 183.19 kJ/kg ; 209.41 kJ/kg and 74.59 kJ/kg respectively. Find :—

(i) Mass Flow Rate of Refrigerant

(ii) C. O. P.

(iii) Power required to drive compressor

(iv) Rate of Heat rejection in condenser. 7

OR

6. (a) What is superheating of Refrigerant ? What is the effect of super heating on C. O. P. of refrigeration system ? Explain with the help of P–h and T–s diagram. http://www.sgbauonline.com 6

(b) 28 Tonnes of ice formed at 0^0C is produced per day in an ammonia refrigerator. Temperature range in compressor is from 25^0C to – 15^0C. Vapor is dry and saturated at the end of compression. Assuming a coefficient of performance 62% of therotical ; calculate power required to drive compressor. Use following table for properties of NH_3.

Temp. ^{0}C	Enthalpy (kJ/kg)		Entropy of Liquid	Entropy of Vapour
	liquid	Vapour		
25	100.04	1319	0.3473	4.48
– 15	– 54.56	1304	– 2.13	5.05

Take latent Heat of ice = 335 kJ/kg. 7

SECTION B

7. (a) What is Regeneration in gas turbine plant ? Explain effect of Regeneration with the help of T–S diagram on performance of Gas Turbines. 7

(b) In an air standard Regenerative gas turbine cycle, the pressure ratio is 5. Air enters the compressor at 1 bar, 300 K and leaves at 490 K. The max. temp.

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in the cycle is 1000 K. Calculate thermal efficiency of cycle. Efficiency of regenerator is 80%. Also assume that isentropic efficiency of turbine is 80% and efficiency of compressor is 85%. For air take ratio of spe. heat = 1.4. 7

OR

8. (a) What is intercooling in gas turbine ? What is effect of intercooling on performance of gas turbine ? Represent the same on T – S diagram. 7

(b) Air enters compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temp. 20^0C. Pressure of air after compression is 4 bar. The isentropic efficiences of compressor and turbine are 80% and 85% respectively. The air fuel ratio is 90%. If mass flow rate of air is 3kg/s. Find :—

(i) Power developed

(ii) Thermal Efficiency of cycle

Assume Cp = 1 kJ/kgK ν = 1.4 calorific value of fuel = 41800 kJ/kg. 7

9. (a) Explain with neat sketch construction and working of Boiling Water Reactor. 7

(b) Explain nuclear chain reaction with the help of neat sketch. 6

OR

10. (a) Explain with neat sketch construction and working of Pressurised Water Reactor. 7

(b) What are the factors to be considered while erecting nuclear power plant ? Discuss advantages and disadvantages of nuclear power plant over thermal power plant. 6

11. (a) What is the use of solar drier ? Explain Solar Dryer with the help of neat sketch. 6

(b) Explain with neat sketch construction and working of floating drum type Bio gas plant. 7

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OR

12. (a) What are the types of collectors ? Explain central tower receiver collector with heliostats. 7

(b) How light energy can be converted into electricity ? Explain working and construction of solar P – V cell. 6

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