Code No: 114DU

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, April - 2018

THERMAL ENGINEERING – I

(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Name the processes and piston displacement in 4 stroke petrol engine. [2]
b) What are the advantages of liquid cooling system? [3]
c) Define abnormal combustion. [2]
d) What is cetane and octane number? [3]
e) Define specific fuel consumption and supercharging. [2]
f) Write the effects of engine overheating and engine under cooling. [3]
g) Define slip and slip factor and pressure coefficient. [2]
h) Write the losses in axial flow compressor. [3]
i) What is the difference between refrigerator and a heat pump? [2]
j) What is ozone depletion and global warming? [3]

PART-B

(50 Marks)

2.a) What are the desirable properties of lubricating oil?
b) Compare Spark Ignition Engines with Compression Ignition Engines. [5+5]

OR

3.a) What is firing order? Which one is most preferred?
b) Explain the battery ignition system with a neat sketch. [4+6]

4.a) Bring out clearly the process of combustion in CI engines.
b) Explain the various stages of combustion in SI engines. [5+5]

OR

5.a) Explain the phenomenon of knock in CI engines and compare it with SI engine knock.
b) Explain the various factors that influence the flame speed. [6+4]

6. A full load test was conducted on a 2 stroke engine and the following results were obtained:
Speed = 500 rpm
Brake load = 500N
imep = 3 bar
Oil consumption = 5kg/h
Jacket water temperature rise =35^{0}C
Jacket water flow rate = 7 kg/min
A/F ratio by mass = 30
Exhaust gas temperature = 350^0 C
Room temperature = 25^0 C
Atmospheric pressure = 1 bar
Cylinder diameter = 22 cm
Stroke = 28 cm
Brake diameter = 1.6 m
CV of fuels = 42000 kJ/kg
Proportion of H_2 by mass in fuel = 15%
Specific heat of exhaust gas = 1.0 kJ/kgK
Specific heat of dry stream = 2.0kJ/kgK
Calculate:
a) Indicated thermal efficiency
b) Specific fuel consumption
c) Volumetric efficiency based on atmospheric conditions
Draw up a heat balance sheet for test. [10]

OR

7. A three-stage, double acting, reciprocating air compressor operating at 300 rpm, receives air at 1bar and 27^{0}C. The bore of LP cylinder is 360 mm and its stroke is 400 mm. Intermediate cylinder and HP cylinder have same stroke as LP cylinder. The clearance volume in each cylinder is 4% of the stroke volume. The LP cylinder discharges air at a pressure of 5 bar, the intermediate cylinder discharges at 20 bar and air is finally discharged by the HP cylinder at 75 bar. The air is cooled in intercoolers to initial temperature after each stage of compression. A pressure drop of 0.2 bar takes place in intercooler after each stage. The index of compression and expansion for an LP cylinder is 1.3, for intermediate cylinder is 1.32 and for HP cylinder is 1.35. Neglect the effect of piston rod and assume C_p=1.005 kJ/kgK, and R= 0.287kJ/kgK. Calculate a)Heat rejected in each stages in intercooler and during compression, b) Heat rejected in after cooler, if delivered air is cooled to initial temperature, c) Diameter of intermediate and HP cylinders, d) Power required to drive compressor, if its mechanical efficiency is 85%. [10]

8.a) Describe the principle of operation, construction and working of centrifugal compressor.
b) Explain the phenomena of surging and its effects in the centrifugal compressor. [6+4]

OR

9.a) Derive an expression for indicated work of a reciprocating air compressor by neglecting clearance.

b) A single-stage, single acting reciprocating air compressor has a bore of 20 cm and a stroke of 30 cm. The compressor runs at 600 rpm. The clearance volume is 4% of the swept volume and index of expansion and compression is 1.3. The suction conditions are at 0.97 bar and 27^0C and delivery pressure is 5.6 bar. The atm conditions are at 1.01 bar and 17^0C. Determine:

i) The free air delivered in m^3/min,

ii) The volumetric efficiency referred to the free air conditions,

iii) The indicated power. [5+5]

10.a) With the help of a P-h diagram, discuss the effects of sub cooling and superheating on the performance of standard vapour compression system.

b) What is Air refrigeration system? Where it is used and why? [6+4]

OR

11. A refrigerator operates between temperature limits of 30^0C and -5^0C. The refrigerant is 0.97 dry before leaving the evaporator coil. Find the condition of refrigerant entering the evaporator and cop of system. If the temperature rise of water circulating through the condenser is limited to 20^0C, calculate mass flow rate of the coolant.
Use properties of refrigerant from table given below:

Temp-°C	Enthalpy kJ/kg		Entropy kJ/kg.K		Specific heat kJ/kg.K	
	h_f	h_g	s_f	s_g	$C_{p,L}$	$C_{p,g}$
30	323.22	1465.38	1.2037	4.9839	5.024	3.35
-5	158.26	1431.89	0.63	5.4072	--	--

Take C_p for superheated vapour as 3.35kJ/kgK. [10]

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