

II B.Tech II Semester Supplementary Examinations, Apr/May 2008
THERMAL ENGINEERING-I

(Common to Mechanical Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Why do you need lubrication in i.c. engines and name the types of lubrication.
(b) Explain the principle of working of a battery ignition system with a neat sketch. [16]
2. Discuss the effects of the following operating variables on detonation
(a) compression ratio.
(b) Inlet temperature of mixture.
(c) Spark timing.
(d) Engine speed.
(e) Size of bore. [16]
3. (a) With the aid of neat diagram explain how squish is develop in a combustion chamber.
(b) Give a clear comparison of compression and induction turbulane. [8+8]
4. (a) Why testing of engine is necessary? Describe the various methods for determination of indicated power of an engine.
(b) A single cylinder internal combustion engine gave the following results when put to a trial test.
Area of the indicator diagram = 12 cm^2
Length of the indicator diagram = 8 cm
Spring scale = 2.8
Diameter of the piston = 21 cm
Stroke length = 28 cm
Speed of the engine = 370 RPM
Determine IP of the engine when
i. working on 4 stroke cycle and
ii. working on two stroke cycles. [16]
5. (a) State the uses of compressed air in engineering.
(b) Working from first principles, derive an expression for work done on air in a reciprocating compressor in terms of the pressure ratio. [6+10]
6. (a) What is “slip factor”? What is its effect on the flow and the pressure ratio in the stage? [5+5]

- (b) Compare the merits and demerits of axial flow compressors and centrifugal compressor. [6]
7. In a Bell Coleman refrigeration cycle, 10450 kJ of heat is extracted from the brine per minute, which is circulated around the cold chamber at 0°C and 1 bar. The air coming out from the cold chamber is compressed to 2 bar isentropically by the compressor. The compressed air is cooled to 40°C without pressure loss in the inter cooler. The cooler air expands isentropically in an air expander to the cold chamber pressure of 1 bar and again taken to the chamber. Find
- (a) COP and
- (b) power required to run the compressor. [16]
8. (a) Discuss the essential properties of an ideal refrigerant?
- (b) Name various psychrometric processes and show each of them on psychrometric chart? Which of these properties is most suitable in summer? [8+8]

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1. (a) What are the differences between air standard cycle and fuel-air cycle? Explain the significance of fuel-air cycle?
(b) Why the actual cycle efficiency is much lower than the air standard cycle efficiency? The major losses in the actual engine. [16]
2. (a) What two rates enter into the normal flame front propagation? How does each of these rates advance the flame front?
(b) Why is flame important in S.I. engine combustion. Explain.
(c) How does flame speed vary with engine speed and A/F ratio. [6+4+6]
3. (a) What are the types of combustion chambers used on C.I. engines and explain their role in generating turbulence.
(b) Compare air swirl in C.I. engines with turbulence in S.I. engines. [10+6]
4. (a) Explain the various methods of determining the Brake power of an engine.
(b) A compression ignition engine has a compression ratio 14:1 and the fuel supply is cut off at 0.07 of the stroke. The relative efficiency of this engine is 0.62. Determine the consumption of fuel having a calorific value of 43960 kJ / kg for this engine to develop 3.75 kW per hour. [16]
5. (a) What is the principle of operation of the reciprocating compressor valves?
(b) An air compressor has a piston displacement of 2200 cm with a clearance of 5% . It receives air at 110kPa. There is a pressure drop of 3.5kPa through the suction valves. The discharge valves also leaks and a drop of 5% occurs in delivery pressure. Using $n=1.35$, calculate and plot the volumetric efficiency for the discharge pressures of 350, 700 ,1000, 1500,2000 and 2500kPa. [4+12]
6. (a) List the various types of rotary compressors? [5+5]
(b) Explain with a neat sketch, the working of a roots blower. [6]
7. (a) Write the differences between refrigerator and heat pump? Derive the COP for both of them?
(b) Calculate the power required to run a refrigerator producing 500 kg/hr of ice at -5°C when the water is supplied at 15°C . Take $C_p = 2.0 \text{ kJ/kg K}$ for the ice and latent heat of freezing as 315 kJ/kg. [8+8]
8. (a) Explain the working of year round air conditioning system with a neat diagram.

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Set No. 2

- (b) What are the psychrometric properties? Give the different applications of psychrometrics? [8+8]

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1. (a) Why the lubrication and cooling systems in an I.C. engine?
(b) Explain the principle operation of an I.C. Engine with neat sketch? [16]
2. (a) Explain ignition lag. Discuss the influence of operating variables on ignition lag.
(b) What is meant by rate of pressure rise? What is the important factor determining this rate?
(c) Explain the desirable point in the cycle where to obtain the peak pressure and discuss its importance. [16]
3. Discuss about various factors that influence knocking in C.I. Engines. [16]
4. (a) Explain the various methods of determining the Brake power of an engine.
(b) A compression ignition engine has a compression ratio 14:1 and the fuel supply is cut off at 0.07 of the stroke. The relative efficiency of this engine is 0.62. Determine the consumption of fuel having a calorific value of 43960 kJ / kg for this engine to develop 3.75 kW per hour. [16]
5. (a) State the uses of compressed air in engineering.
(b) Working from first principles, derive an expression for work done on air in a reciprocating compressor in terms of the pressure ratio. [6+10]
6. (a) List the various types of rotary compressors? [5+5]
(b) Explain with a neat sketch, the working of a roots blower. [6]
7. A vapour compression refrigerator circulates 4.5 kg of NH_3 per hour condensation takes place at $30^\circ C$ and evaporation at $-15^\circ C$. The temperature after isentropic compression is $75^\circ C$ and the specific heat of the superheated vapour is 2.82 kJ/kg K. Determine (i) COP, (ii) ice produced in kg/hr from water at $20^\circ C$ and ice at $0^\circ C$. Take enthalpy of fusion of ice = 336 kJ/kg and specific heat of water is 4.187 kJ/kg K. [16]

Saturation temp $^\circ C$	Enthalpy, kJ/kg		Entropy, kJ/kg K	
	h_f	h_g	s_f	s_g
-15	112.3	1426	0.457	5.549
30	323.1	1469	1.204	4.984

8. (a) Define wet bulb and dry bulb temperature and illustrate its application with respect to air conditioning applications?

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Set No. 3

- (b) How the refrigerants are named according their composition? Discuss the important properties of refrigerants? [8+8]

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1. (a) Name the lubrication systems available and which one uses splash lubrication in i.c .engines.
(b) Explain cylinder wise classification of i.c. engines. [16]
2. (a) Explain the phenomenon of pre-ignition? How pre-ignition leads to detonation and vice Versa? What are the dangers of pre-ignition?
(b) How can pre-ignition be detected? What are pre-ignition inhibitors? [16]
3. (a) What are the types of combustion chambers used on C.I. engines and explain their role in generating turbulence.
(b) Compare air swirl in C.I. engines with turbulence in S.I. engines. [10+6]
4. (a) Explain the various methods of determining the Brake power of an engine.
(b) A compression ignition engine has a compression ratio 14:1 and the fuel supply is cut off at 0.07 of the stroke. The relative efficiency of this engine is 0.62. Determine the consumption of fuel having a calorific value of 43960 kJ / kg for this engine to develop 3.75 kW per hour. [16]
5. (a) State the uses of compressed air in engineering.
(b) Working from first principles, derive an expression for work done on air in a reciprocating compressor in terms of the pressure ratio. [6+10]
6. (a) How does the working of centrifugal compressor differ from the axial flow compressor. Explain.
(b) For a degree of reaction of 50% , draw the velocity diagrams for the rotor. [16]
7. The pressure limits of an air refrigeration system working on Bell Coleman cycle is 4.3 bar and 1 bar. The temperature of air entering into the compressor and expander are -1⁰C and 27⁰C respectively. Find
 - (a) COP of the cycle if the compression and expansion are isentropic,
 - (b) the ice making capacity in tones of ice per day if the air circulation through the system is 13 kg/min and water is supplied at 0⁰C and ice is formed at 0⁰C and
 - (c) piston displacement per minute for the compression and expansion. [16]
8. (a) Discuss the essential properties of an ideal refrigerant?

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Set No. 4

- (b) Name various psychrometric processes and show each of them on psychrometric chart? Which of these properties is most suitable in summer? [8+8]

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