

II B.Tech II Semester Regular Examinations, Apr/May 2006**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) What are the merits and demerits of two stroke i.c. engines over the four stroke i.c. engines.
(b) Explain the methods of governing in i.c. engines naming which engines adopt quantitative governing. [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) what causes the knock in a CI engine? In which part of the combustion process (beginning or the end) does it occur?
(b) Explain and discuss the phenomenon of diesel knock in C.I engines and compare the same with detonation in S.I engines.
(c) How do the injection timing and the fuel quality affect the engine knock? [4+8+4]
4. (a) A four cylinder two stroke petrol engine, 75 mm bore by 90 mm stroke, operates on the constant volume cycle and has a compression ratio 6:1, the efficiency ratio being 55% .Calculatethe thermal efficiency. When it runs at 40 RPS, it develops a bmep of 360 kpa and uses 9.2 kg of fuel per hour of CV 44000 kJ/kg. Calculate the brake thermal efficiency, the mechanical efficiency and the indicated specific fuel consumption in kg/kWh.
(b) Explain the various engine performance parameters in detail. [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) Explain the working of air refrigeration system with a neat diagram? Also derive the COP of the Bell Coleman cycle?

- (b) Derive an expression for the COP of Bell-edeman code. [8+8]
8. (a) Explain the working of year round air conditioning system with a neat diagram.
- (b) What are the psychrometric properties? Give the different applications of psychrometrics? [8+8]

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1. (a) Name the type of i.c. engines generally having valves and ports. How are these valves or ports operated.
(b) Explain the working principle of wet sump lubrication with a sketch. [16]
2. (a) Describe with suitable sketches the combustion phenomenon in S.I engines and explain the two phases of combustion.
(b) What are the basic parameters that influence the flame speed? Discuss the influence of engine variables of the flame speed. [10+6]
3. (a) What is meant by ignition delay or injection lag? It is usually divided into two parts. Name and describe them.
(b) "C.I engines can accept very lean over all mixture ratios but S.I engines cannot". Explain and discuss. [8+8]
4. In a test with a four cylinder four stroke petrol engine, the following results are obtained for a particular setting and speed
BP with all cylinders working =24.0 kW
BP with No.1 cylinder cutoff =16.2 kW
BP with No.2 cylinder cutoff =16.7 kW
BP with No.3 cylinder cutoff =16.8 kW
BP with No.4 cylinder cutoff =17.3 kW
Estimate the IP of the engine and its mechanical efficiency. [16]
5. (a) What are the effects of clearance on the performance of reciprocating air compressors? [6+4]
(b) What is meant by brake power and indicated power of an air compressor? [6]
6. (a) Explain the terms slip factor and power input factor in centrifugal compressors.
(b) A centrifugal compressor operating at a pressure ratio of 4:1 has inlet temperature of 15°C. Calculate the overall diameter of impeller given that speed of operation 15000 rpm.
Slip factor 0.9
Power input factor 1.03
Isentropic efficiency 0.85 [16]
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) Differentiate between the actual and ideal cycles and the factors responsible.
(b) Name the various fuels used in i.c. engines and the type of ignition with each one of them. [16]
2. (a) Discuss the desirable principles of combustion chamber design for S.I engines.
(b) How does preignition lead to detonation and vice versa. [8+8]
3. (a) Explain and discuss the stages of combustion in CI engines.
(b) Discuss the basic difference in the combustion process of S.I and C.I engines. [8+8]
4. A six cylinder, four stroke cycle marine oil engine has cylinder diameters of 610 mm and a piston stroke of 1250 mm. When the engine speed is 120 rpm it uses 340 kg of fuel oil of calorific value 44.2 MJ / kg in one hour. The cooling water amounts to 19200 kg / h, entering at 15°C and leaving at 63°C. The torque transmitted at the engine couplings is 108 k N-m and the indicated mean effective pressure is 775 kPa. Determine
 - (a) the ip,
 - (b) the bp,
 - (c) the mechanical efficiency,
 - (d) bmep
 - (e) brake thermal efficiency
 - (f) the percentage of energy supplied per kg of fuel lost to the cooling water,
 - (g) the fuel used per kWh on a brake power basis. [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) Under what circumstances would you recommend the use of multistage compressor. [5+6]
(b) Explain with a neat sketch, the working of a vane blower? [5]

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.
- (b) What are the psychrometric properties? Give the different applications of psychrometrics? [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) Explain the phenomenon of knock in a S.I. engine with $p-\theta$ diagram.
(b) How does detonation affect engine performance in S.I. engines. [8+8]
3. (a) How does the type of combustion chamber in C.I. engine influence the Fuel system design. Explain.
(b) With the aid of a neat sketch, explain squish in C.I. engines. [8+8]
4. In a full load test on a two cylinder, four stroke oil engine, the following readings were taken: mean effective pressure = 775 kPa, net brake load 2000N, effective brake diameter = 1.5 m, mean speed = 300 rpm, fuel consumption = 14.4 kg per hour, quantity of cylinder cooling water = 12 kg per min; cylinder cooling water inlet temperature = 16°C cylinder cooling water outlet temperature = 70°C; quantity of exhaust calorimeter cooling water = 20kg/min exhaust cooling water inlet temperature = 16°C; exhaust cooling water outlet temperature 55°C; temperature of gases leaving calorimeter = 86°C air / fuel ratio by mass = 20 ; engine room temperature 18°C.
The calorific value of the fuel oil was 43000 kJ / kg and the mean specific heat of the exhaust gases was 1.004 kJ / kg K. The stroke volume per cylinder was 15 liters and each cylinder may be assumed to have contributed equally towards the work done. Find the mechanical and brake thermal efficiencies. Draw up a heat balance for the test expressed in kJ / min. [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 dense air refrigerating system works between pressure of 20 bar and 4 bar to produce 25 tons of refrigeration. The air temperature leaving the refrigerating coil is -8°C and the air temperature leaving the air cooler is 16°C. Calculate

- (a) power required,
 - (b) mass of air circulated per minute,
 - (c) COP and
 - (d) piston displacement of compressor and expander. [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]
