Code No: RR220303 **Set No.1**

II B.Tech. II Semester Regular Examinations, April/May -2005
THERMAL ENGINEERING-I
(Mechanical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain how an i.c. engine qualifies to be a heat engine?
   (b) Why is ignition required in an i.c. engine and how does it take place in a diesel engine.
2. (a) How can be the possibility of detonation be reduced at the design stage in S.I. engines.
   (b) Explain the desirable point in the cycle to obtain the peak pressure and discuss its importance.
3. (a) How does the mixture of air and fuel in the combustion chamber of C.I engine differ from that of S.I engines? What are the reason for operating a C.I engines at considerably higher A:F ratio compared to the chemically correct mixture?
   (b) What is the range of overall A/F ratios m a C.I engine combustion chamber?
   (c) Does the flame front exist in a C.I engines? Why
4. (a) What is the significance of conducting the MORSE test? Explain the same in detail.
   (b) During the trail of a four stroke diesel engine the following observations were recorded:
   Area of the indicator diagram = 475 mm^2
   Length of indicator diagram = 62 mm
   Spring number = 1.1 bar / mm
   Diameter of piston = 100 mm
   Length of the stroke = 150 mm
   Engine RPM = 375
   Determine
      i. indicated mean effective pressure
      ii. indicated power in kW.
5. (a) Explain the terms free air delivery and clearance ratio.
   (b) Compute the work required to compress 1kg of air at 25°C and 100kPa to 10MPa pressure if the compression process is
      i. isotheral
      ii. adiabatic and
      iii. polytropic with n=1.35.

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^oC. 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

7. (a) What are the basic components of a vapour compression refrigeration system and discuss their properties?
   (b) Why is an expansion valve preferred to expansion cylinder in vapour compression refrigeration cycle.

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?

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1. (a) Give complete classification of i.c. engines.
   (b) Explain with a neat sketch the construction details of i.c. engine mechanism and name the principal components.
2. (a) Discuss the methods for improving the anti-knock quality of an S.I. Engine fuel.
   (b) Name any two chemicals that can be used as additives in s.i. engine fuels.
   (c) What are the detrimental effects of the additives used in s.i engine fuels?
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.
4. (a) A diesel engine has a compression ratio of 14 to 1 and the fuel supply is cut off at 0.08 of the stroke. If the mass of the fuel is 0.2685 kg/kWh, having calorific value of 43700 kj/ kg. Determine the relative efficiency of the engine.
   (b) Define volumetric efficiency for a four stroke cycle engine.
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. (a) Define mechanical efficiency of a compressor.
   (b) A centrifugal compressor receives air at the rate of $1400m^3$/min at 100kPa and 35^oC and delivers at 350kPa. It has an isentropic efficiency of 82% . Mechanical losses amounts to 2.5% of the shaft power. Determine the power required and exit air temperature.
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 -1^0C and 27^0Crespectively. 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 0^0C and ice is formed at 0^0C and 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.

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?

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1. (a) Explain how an i.c. engine qualifies to be a heat engine?
   (b) Why is ignition required in an i.c. engine and how does it take place in a diesel engine.

2. (a) How are the SI fuels rated? What do you understand by octane number - 100 ?
   (b) How does the compression ratio affect engine's performance ? What is meant by HU.C.R
   (c) Explain the difference between
      i. Pre-ignition
      ii. Auto ignition
      iii. Detonation

3. Explain the term delay period as referred to C.I engines. Explain the effect of the following operating parameters on delay period in C.I engines
   (a) Speed
   (b) Fuel / air ratio
   (c) Injection advance
   (d) Cetane number of fuel

4. The output of a single cylinder four stroke IC engine is measured by a rope brake dynamometer. The diameter of the brake pulley is 750 mm and rope diameter 50mm. The dead load on the tight side of the rope is 400 N and the spring balance reading is 50 N. The bore is 150 mm and stroke is 190 mm. The engine consumes 4 kg / h of fuel at rated speed of 1000 rpm. The calorific value of the fuel is 44 MJ / kg. Calculate the brake specific fuel consumption, bmep and the brake thermal efficiency. If the mechanical efficiency is 80% , calculate the IP, imep indicated specific fuel consumption and indicated thermal efficiency.

5. (a) Is it essential to have a receiver in reciprocating compressors? Give reasons.
   (b) Air enters the low pressure stage of a two stage compressor at 1atm and 25^{o}C. The LP cylinder diameter is 30cm and stroke is 37.5cm, while the HP cylinder has these values as 15cm and 37.5cm respectively. Air enters HP cylinder at 30^{o}C. Neglect clearance and determine the pressure of air entering HP cylinder.

6. (a) List the various types of rotary compressors?

(b) Explain with a neat sketch, the working of a roots blower.

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 -1^{0}C and 27^{0}Crespectively. 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 0^{0}C and ice is formed at 0^{0}C and 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.

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?

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Code No: RR220303 **Set No.4**

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THERMAL ENGINEERING-I
(Mechanical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Give complete classification of i.c. engines.
   (b) Explain with a neat sketch the construction details of i.c. engine mechanism and name the principal components.
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
3. (a) Why turbulent combustion chambers cause higher heat transfer rate than the non-turbulent type? Explain.
   (b) List out the advantages and disadvantages of turbulent combustion chambers over non-turbulent type.
4. (a) A diesel engine has a compression ratio of 14 to 1 and the fuel supply is cut off at 0.08 of the stroke. If the mass of the fuel is 0.2685 kg/kWh, having calorific value of 43700 kj/ kg. Determine the relative efficiency of the engine.
   (b) Define volumetric efficiency for a four stroke cycle engine.
5. (a) Derive an expression for the isothermal efficiency of a compressor in terms of the pressure ratio.
   (b) A double acting compressor takes in air at 100kPa and delivers it to the receiver at 1000kPa. The speed is 200rpm, diameter is 150mm and stroke length is 220mm. Calculate the capacity of the motor required.
6. (a) Under what circumstances would you recommend the use of multistage compressor
   (b) Explain with a neat sketch, the working of a vane blower?
7. (a) Draw the flow diagram of vapour compression refrigeration system and analyse the thermodynamic cycle applied for it?
   (b) Explain the difference between the Bell Coleman and Joule cycle of refrigeration.

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

   (b) How the refrigerants are named according their composition? Discuss the important properties of refrigerants?

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