

Seat No.: _____

Enrolment No. _____

(E-1)

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. all Sem-I Examination December 08/January 09

Elements of Mechanical Engineering (110006)

DATE: 15-12-2008, Monday

TIME: 12.00 to 2.30 p.m.

MAX. MARKS: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Steam Tables and Mollier's Chart is permissible.**

- Q: 1**
- (a) What are the various forms of energy? List the non conventional sources of energy. **03**
 - (b) Derive characteristics equation of a perfect gas. **04**
 - (c) A cylinder contains 0.6 m³ of gas at a pressure of 1.0 bar and 90⁰ C. The gas is compressed to a volume of 0.18 m³ according to law $pv^n = C$. The final pressure is 5.0 bar. Assuming $R=0.287$ kJ/kg K and $\gamma = 1.4$ **07**
 Calculate:
 - (i) The mass of gas
 - (ii) The value of index 'n' for compression
 - (iii) The change of internal energy of gas
- Q: 2**
- (a) Differentiate between four stroke and two stroke i.c. engine. **03**
 - (b) A sample of wet steam at a pressure of 25 bar absolute has dryness fraction 0.80. Determine its enthalpy and internal energy. **04**
 - (c) Combined separating and throttling calorimeter is used to find out dryness fraction of steam. **07**
 Following readings were taken:

Main pressure	= 12 bar ab.
Mass of water collected in separating calorimeter	= 2 kg
Mass of steam condensed in throttling calorimeter	= 20 kg
Temperature of steam after throttling	= 110 ⁰ C
Pressure of steam after throttling	= 1 bar ab.
Assume Cp of steam	= 2.1 kJ/kg K

 Calculate dryness fraction of steam.
- OR**
- (c) The following results refer to a test on i.c. engine. **07**

Indicated Power	= 42 kW
Frictional power	= 7 kW
Engine speed	= 1800 r.p.m.
Specific fuel consumption per b.p.	= 0.30 kg/kWh
Calorific Value of fuel used	= 43000 kJ/kg

 Calculate:
 - (i) Mechanical Efficiency
 - (ii) Brake thermal efficiency
 - (iii) Indicated thermal efficiency

- Q: 3** (a) Derive an expression for efficiency of Carnot cycle. **03**
(b) In an Otto cycle the compression ratio is 8. The temperatures at the beginning of compression and at the end of heat supply are 310 K and 1600 K respectively. Assume $\gamma = 1.4$ and $C_v = 0.717$ kJ/kg K. Find : **04**
(i) Heat Supplied
(ii) Efficiency of the cycle.
(c) The compression ratio of an oil engine working on Diesel Cycle is 15. Cut off takes place at 12 % of the working stroke. The air is drawn in to cylinder at 100 kPa and 27°C. Assume $C_p = 1.006$ kJ/kg K and $C_v = 0.717$ kJ/kg K. Calculate: **07**
(i) Temperature at the end of compression
(ii) Pressure at the end of compression
(iii) Air std. efficiency of the cycle.
- OR**
- Q: 3** (a) Differentiate between fire tube and water tube boiler. **03**
(b) List various mountings and accessories and explain fusible plug. **04**
(c) A steam generator evaporates 18000 kg of water per hour at 10 bar absolute pressure. The steam is 97 % dry. Feed water temperature is 40°C. Coal is fired at a rate of 2050 kg per hour, having calorific value 28000 kJ/kg. Calculate: **07**
(i) Thermal efficiency
(ii) Equivalent evaporation per kg of coal.
- Q: 4** (a) Explain working of Watt governor with sketch. **03**
(b) Explain working of single acting reciprocating pump with air vessels. **04**
(c) Define volumetric efficiency with p-v diagram and usual notations. **07**
Prove that volumetric efficiency of reciprocating compressor is $1 - C [(p_2/p_1)^{1/n} - 1]$
- OR**
- Q: 4** (a) What is split air conditioner? State its advantages over window air conditioner. **03**
(b) What is refrigeration? What is refrigerating effect? What is one ton refrigeration? **04**
(c) A single stage, single cylinder reciprocating air compressor with negligible clearance takes 1 m³ of air per minute at 1.013 bar and 15°C. The delivery pressure is 7 bar. Assuming law of compression $p v^{1.35} = C$, $R = 0.287$ kJ/kg K. Calculate: **07**
(i) Mass of air delivered per minute
(ii) Delivery temperature
(iii) Indicated Power
(iv) Isothermal efficiency
- Q: 5** (a) Differentiate between clutch and coupling. Describe Disc clutch. **04**
(b) Compare belt drive, chain drive and gear drive. **04**
(c) Explain the function of Flywheel with turning moment diagram. **06**
- OR**
- Q: 5** (a) Define Ductility, Elasticity, Plasticity and Weldability **04**
(b) State the first law of thermodynamics. State its limitations. **04**
(c) List the various liquid fuels. State its advantages over solid fuels. **06**