

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- 1st / 2nd EXAMINATION (New Syllabus) – WINTER 2013

Subject Code: 2110006

Date: 21/12/2013

Subject Name: Elements of Mechanical Engineering

Time: 10:30 am to 1:00 pm

Total Marks: 70

Instructions:

1. Question No. 1 is compulsory. Attempt any four out of remaining Six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) Objective Questions:

07

1. Pump is a
(a) power producing machine (b) power consuming machine (c) universal machine
(d) all of above
2. Spark plug is used in
(a) petrol engine (b) diesel engine (c) steam engine (d) boiler
3. Cochran boiler is
(a) fire tube (b) water tube (c) single tube (d) none of these
4. Wind velocity is measured by
(a) manometer (b) tachometer (c) anemometer (d) thermometer
5. If load on the bearing acts perpendicular to the axis of the shaft then bearing is known as
(a) journal bearing (b) thrust bearing (c) bushed bearing (d) radial bearing
6. When rotary motion is to be converted into linear motion following gear arrangement is used
(a) spur gear (b) spiral gear (c) rack and pinion gear (d) none of these
7. Which power transmission element is used in motor cycle?
(a) rope (b) flat belt (c) chain (d) V belt

(b) Objective Questions:

07

1. The first law of thermodynamic is the law of
(a) energy conservation (b) heat transfer (c) work transfer (d) all of these
2. Gauge pressure is measured with respect to
(a) absolute zero pressure (b) atmospheric pressure (c) vacuum pressure (d) all of these
3. The phase change from solid to vapour is called
(a) sublimation (b) vaporization (c) pressurization (d) temperature
4. Which coal is having the highest calorific value?
(a) bituminous coal (b) lignite coal (c) anthracite coal (d) coke
5. Internal energy of a gas is a function of
(a) enthalpy (b) pressure (c) pressure and volume (d) temperature
6. Following is not a component of Rankine Cycle
(a) boiler (b) turbine (c) condenser (d) compressor
7. In a domestic vapour compression refrigerator the refrigerant commonly used is
(a) ammonia (b) air (c) CO₂ (d) Freon-12

- Q.2** (a) What is an adiabatic process? For adiabatic process with the usual notation prove $PV^\gamma = \text{constant}$. **07**
- (b) Determine enthalpy and internal energy of 1 kg of steam at a pressure of 12 bar when (i) the dryness fraction of steam is 0.8 (ii) steam is dry and saturated (iii) steam is superheated to 280°C . Take $C_{ps} = 2.1 \text{ kJ/kg K}$. **07**
- Q.3** (a) Give detailed classification of fuel. Write short note on wind energy. **07**
- (b) An air at 15°C and 1 bar is compressed adiabatically to 15 bar by an engine working on Otto cycle. The maximum pressure of the cycle is 40 bar. Calculate air standard efficiency, mean effective pressure. Take $C_v = 0.718 \text{ kJ/kg K}$ and $R = 0.287 \text{ kJ/kg K}$. **07**
- Q.4** (a) Differentiate between fire tube and water tube boiler. Explain Babcock and Wilcox boiler construction with neat sketch. **07**
- (b) Explain economiser and air-preheater with neat sketch. **07**
- Q.5** (a) What is throttling process? Explain throttling calorimeter with neat sketch. Derive equation for dryness fraction. **07**
- (b) During testing of single cylinder two stroke petrol engine following data were obtained. Brake torque 640Nm, cylinder diameter 21cm, speed 350 rpm, stroke length 28 cm, mean effective pressure 5.6 bar, oil consumption 8.16 kg/hr, CV 42705 kJ/kg. Determine (i) mechanical efficiency (ii) Indicated thermal efficiency (iii) Brake thermal efficiency (iv) brake specific fuel consumption. **07**
- Q.6** (a) What is compressor? Explain working of double acting reciprocating pump and bucket pump with neat sketch. **07**
- (b) What is refrigeration? What is refrigeration effect? Explain window air conditioner with neat sketch. **07**
- Q.7** (a) What is brake? Describe an internal expanding shoe brake with a neat sketch and state its applications. **07**
- (b) (1) Sketch and describe helical and bevel gear and state applications of each. **04**
- (2) Define elasticity, rigidity, hardness, fatigue, ductility, brittleness. **03**

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER- 1st / 2nd EXAMINATION – SUMMER 2014

Subject Code: 2110006

Date: 18-06-2014

Subject Name: Elements of Mechanical Engineering

Time: 02:30pm to 05:00 pm

Total Marks: 70

Instructions:

1. Question No. 1 is compulsory. Attempt any four out of remaining six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) Objective Questions

07

1. Which of the following is not a unit of distance?
(a) Light year (b) Angstrom (c) Mile (d) Carat
2. The specific heat at constant pressure (C_p) of an ideal gas is
(a) Equal to its specific heat at constant pressure
(b) $C_p < C_v$ (c) $C_p > C_v$ (d) $C_p = 2 C_v$
3. The process of sublimation is found to occur in
(a) Liquid N_2 (b) Solid CO_2 (c) Solid O_2 (d) Air
4. If x_1 and x_2 are the dryness fractions obtained in separating calorimeter and throttling calorimeter respectively, then actual dryness fraction of steam is _____
(a) $x_1 \cdot x_2$ (b) $x_1 + x_2 / 2$ (c) $x_1 + x_2$ (d) $x_1 - x_2$
5. The process of Carnot cycle are
(a) Two isothermal and two constant volume
(b) Two constant pressure and two constant volume
(c) Two isothermal and two isentropic
(d) Two isothermal and two adiabatic
6. A device which is used for pumping water into the boiler is called
(a) Economizer (b) Feed pump
(c) Injector (d) Air preheater
7. Which part used in I.C. Engine to convert reciprocating motion of piston to rotary motion of output shaft
(a) Connecting rod (b) Crank shaft (c) Cam shaft (d) Gudgeon pin

(b) Objective Questions

07

1. Which of the following is not a rotary pump?
(a) Gear pump (b) Vane pump (c) Screw pump (d) Axial pump
2. Which one of the externally fired boiler.
(a) Babcock and Wilcox (b) Lancashire
(c) Cochran (d) All of the above
3. The chemical formula of R-12 is
(a) CCl_2F (b) $CClF_3$ (c) CCl_2F_2 (d) $CHClF_2$
4. Which types of coupling used to connecting shafts, whose axis are parallel but not in one line?

(a)muff coupling (b)flexible coupling (c)Oldham's coupling (d) flange coupling

5. Compressor in which compression of air from suction pressure to delivery pressure takes place in more than one cylinder is called_____compressor.
 (a) Single acting (b) Double acting
 (c) Single stage (d) Multi stage
6. The ability of a material to resist fracture due to high impact loads is called
 (a)strength (b)stiffness (c) toughness (d) brittleness
7. Which property is called Intensive property?
 (a)Kinetic energy (b)viscosity (c)Internal energy (d)magnetization

- Q.2** (a) (I) Write a short-note on bio-fuels. **03**
 (II) Explain Specific heat. Give Statements of Zeroth Law and First law of thermodynamics. **04**
- (b) 1 kg of air at 9 bar pressure and 80° C temperature undergoes a non-flow work polytropic process. The law of expansion is $PV^{1.1} = C$. The pressure falls to 1.4 bar during process. Calculate (1) Final temperature (2) Work done (3) Change in internal energy (4) Heat exchange. Take $R=287 \text{ J/kg}$ and $\gamma = 1.4$ for air. **07**
- Q.3** (a) (I) state & Explain Charles's law. **03**
 (II) Prove the equation of work done for Isothermal process. **04**
- (b) Calculate the internal energy per kg of superheated steam at 10 bar and a temperature of 300°C. Find also change in internal energy if this steam is expanded to 1.4 bar and dryness fraction 0.8. **07**
- Q.4** (a) Explain Cochran boiler with neat sketch & give its advantages and disadvantages. **07**
 (b) Write a short note on Separating calorimeter with its limitations. **07**
- Q.5** (a) Explain working of four stroke petrol engine with neat sketch & P-V diagram. **07**
 (b) A four cylinder two stroke petrol engine with stroke to bore ratio 1.2 develops 35 kW brake power at 2200 rpm. The mean effective pressure in each cylinder is 9 bar and mechanical efficiency is 78 %. Determine (1) Diameter and stroke of each cylinder (2) Brake thermal efficiency (3) indicated thermal efficiency. If fuel consumption 8 kg / hr having C.V=43000 kJ/kg. **07**
- Q.6** (a) What do you mean by priming of centrifugal pump? Explain single acting reciprocating pump. **07**
 (b) An engine operates on the air standard diesel cycle. The conditions at the start of the compression stroke are 353 K and 100 kPa , while at the end of compression stroke the pressure is 4 MPa. The energy absorbed is 700 kJ/kg of air. Calculate (1) the compression ratio (2) the cut-off ratio (3) the work done per kg air (4) the thermal efficiency. **07**
- Q.7** (a) (I) What should be the properties of common refrigerants? **03**
 (II) Explain Function and working of Fusible plug used in boiler. **04**
- (b) Explain types of belt drive. **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- 1st / 2nd EXAMINATION (New Syllabus) – WINTER 2014

Subject Code: 2110006

Date: 26-12-2014

Subject Name: Elements of Mechanical Engineering

Time: 10.30a.m.-01.00a.m.

Total Marks: 70

Instructions:

1. Question No. 1 is compulsory. Attempt any Four out of remaining Six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of Steam Tables is permitted

Q.1

MARKS

(a) Answer the given MCQ.

07

1. The unit of work is
(a) N.m (b) Joule (c) $\text{kg.m}^2/\text{s}^2$ (d) all the above
2. The function of ozone layer is
(a) protects the earth from harmful effect of ultraviolet rays
(b) increase the temperature of earth
(c) increases CO_2 in atmosphere
(d) none of the above
3. In the Polytropic Process $PV^n = C$, if $n = \infty$, the process is called
(a) isochoric (b) isobaric (c) isothermal (d) adiabatic
4. Saturation temperature of steam increase
(a) With decrease in pressure (b) with increase in pressure
(c) is unaffected by pressure (d) none of the above
5. During adiabatic process
(a) heat transfer is zero (b) work transfer is zero (c) enthalpy remains constant
(d) enthalpy change is zero.
6. The processes of Carnot cycle are
(a) Two adiabatic and two constant volume
(b) Two constant pressure and two constant volume
(c) Two isothermal and two adiabatic
(d) Two isothermal and two isentropic
7. The air standard cycle on which the petrol engine work is
(a) Otto cycle (b) Carnot cycle (c) Joule cycle (d) Dual cycle

OR

(a) Answer the given MCQ.

07

1. Pump is a machine which is used to do
A) lift liquid from low height to higher elevation B) To store liquid
C) To compress liquid D) none of the above
2. which of the following energy is converted into electricity in a Hydro power plant
A) Nuclear energy B) Potential Energy of water
C) Thermal Energy D) all of the above
3. which of the following is a unit of Electric current
A) Ampere B) Volt
C) Meter D) kilogram
4. Which of the following instrument is used to measure length
A) Vernier calliper B) Manometer
C) Thermometer D) none of the above
5. In a simple gear train having two gears, if driving gear rotates in clockwise direction then driven gear rotates in
A) Clockwise direction B) Anti clockwise direction
C) depend on size of gear D) depend on no. of teeth
6. In a IC engine which energy is converted into mechanical energy
A) Chemical energy of fuel. B) potential energy
C) kinetic energy D) All of the above
7. which of the following instrument is used for drawing a straight lines
A) T- Square B) French curves
C) Protractor D) Compass

- (b) Answer the given MCQ. 07**
1. Which of the following are boiler mountings?
(a) Economiser (b) Fusible Plug (c) Super heater (d) Air preheater
 2. The function of steam stop valve is
(a) to regulate flow of steam from boiler to steam pipe
(b) to separate steam from water
(c) to collect steam from steam drum
(d) to provide safety of boiler
 3. Petrol engine is
(a) Compression ignition engine (b) Spark ignition engine (c) mixed ignition engine (d) all of the above
 4. Which of the following is a positive belt drive.
(a) V-belt (b) flat belt (c) Cross belt (d) timing belt
 5. A operation of filling passage ways with liquid from outside source before starting pumps is known as
(a) cavitation (b) cleaning (c) priming (d) chocking
 6. _____ is the ability of a material to resist deformation under stress.
(a) strength (b) stiffness (c) hardness (d) brittleness
 7. A one ton refrigeration system means that its refrigerating system is
(a) 50 KJ/min (b) 210 KJ/min (c) 300 KJ/min (d) 350 KJ/min
- Q.2 (a) Write a short note on solar energy? 03**
- (b) Explain Barrel calorimeter with neat sketch. 04**
- (c) One kg of gas is compressed polytropically from 160 kpa pressure and 280 K temperature to 760 KPa. The compression is according to law $PV^{1.3} = \text{Constant}$. Find: (1) Final Temperature (2) work done (3) change in internal energy (4) amount of heat transfer and (5) change in enthalpy. Take $R=0.287$ KJ/KgK and $C_p= 1.002$ KJ/KgK. 07**
- Q.3 (a) Show the function and location of the following in the boiler plant: 03**
(i) Economiser (ii) Steam stop valve (iii) Fusible plug.
- (b) Derive $C_p - C_v = R$, with usual notations. 04**
- (c) 1.5 kg of steam at a pressure of 10 bar and temperature of 250°C is expanded until the pressure becomes 2.8 bar. The dryness fraction of steam is then 0.9. Calculate change in internal energy. 07**
- Q.4 (a) Compare Rankine cycle with Carnot cycle. 03**
- (b) In an Otto cycle the compression ratio is 10. The temperature at the beginning of compression and at the end of heat supply is 300 K and 1600 K respectively. Assume, $\gamma = 1.4$ and $C_v = 0.717$ KJ/KgK. 04**
Find: (i) Heat supplied (ii) Efficiency of the cycle.
- (c) Sketch and explain a Cochran boiler. 07**
- Q.5 (a) Explain with the help of neat sketches, the working of two stroke petrol engine. 07**
- (b) Derive an equation for air standard efficiency of Otto cycle. 07**
- Q.6 (a) Explain working of a centrifugal pump. 03**
- (b) What is compressor? Give uses of compressed air. 04**
- (c) Explain Vapor Compression Refrigeration system with neat sketch. Also draw p-h and T-s diagram for the same. 07**
- Q.7 (a) Define the following mechanical properties 03**
(i) Ductility (ii) Hardness (iii) Plasticity
- (b) What is belt drive? Describe briefly types of belt drives. 04**
- (c) What is coupling? Explain internal expanding shoe brake with a neat sketch? 07**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER– 1st / 2nd (NEW SYLLABUS) EXAMINATION – SUMMER 2015

Subject Code: 2110006**Date: 04/06/2015****Subject Name: Elements of Mechanical Engineering****Time: 10.30am-01.00pm****Total Marks: 70****Instructions:**

1. Question No. 1 is compulsory. Attempt any four out of remaining six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a) Multiple choice questions: 07**
- 1 Work is considered positive when
a) Work is done on the system b) work is done by the system c) both a and b d) none of the above
 - 2 A source of energy is known as renewable source
a) Fossil fuel b) Nuclear c) CNG d) All of the above
 - 3 When driving and driven shafts are at comparatively larger distance apart, the type of drive suitable is :
a) Gear drive b) Belt drive c) friction drive d) chain drive
 - 4 The clutch ordinarily remains in disengaged condition when it is used for power transmission in:
a) Automobile b) Machine tools c) Crane d) Elevator
 - 5 Which of the following type of centrifugal pump converts kinetic energy of pump into pressure energy:
a) Foot valve b) Casing c) Suction pipe d) Impeller
 - 6 For earth moving machines, widely used engines are:
a) Petrol engine b) Steam engine c) Diesel engine d) Gas engine
 - 7 The correct location of economizer is :
a) Between furnace and preheater b) between airpreheater and chimney
c) between forced draft fan and furnace d) near the superheater

OR

- (a) Multiple choice questions: 07**
- 1 COMPRESSOR is a machine which is used to do
A) lift liquid from low height to higher elevation B) To store liquid
C) To compress liquid OR gas. D) none of the above
 - 2 Which of the following energy is converted into electricity in a Hydro power plant
A) Nuclear energy B) Potential Energy of water
C) Thermal Energy D) all of the above
 - 3 Which of the following is a unit of Power.
A) Joules B) Watt
C) Meter D) kilogram
 - 4 Which of the following instrument is used to measure temperature
A) Vernier calliper B) Manometer
C) Thermometer D) none of the above
 - 5 In a simple gear train having two gears , if driving gear rotates in clockwise direction then driven gear rotates in
A) Clockwise direction B) Anti clockwise direction
C) Depend on size of gear D) depend on no. of teeth

- 6 In a IC engine from which of the following source energy is converted into mechanical energy
 A) Chemical energy of fuel. B) potential energy
 C) kinetic energy D) All of the above
- 7 Which of the following instrument is used for drawing curved lines
 A) T- Square B) French curves
 C) Protractor D) Compass
- (b) Select the correct option: **07**
- Water after being pumped into a boiler cannot come out because of:
 a) Steam stop valve b) Feed check valve c) Safety valve d) Blow off valve
 - For the same compression ratio, the thermal efficiency of otto cycle is :
 a) Greater than Diesel engine b) less than Diesel engine c) equal to Diesel Engine d) None of the above
 - Diesel cycle consists of :
 a) Two isentropic process and two isothermal process b) two isentropic, one constant pressure, one constant volume process c) two isothermal and two constant pressure process d) two isentropic, Two constant volume process
 - Dryness fraction of a steam (x) is given by:
 a) m_s / m_w b) m_w / m_s c) $(m_s + 1) / m_w$ d) $m_s / (m_s + m_w)$
 - The material for making packing for covering steam pipes to avoid heat transfer, are made up of :
 a) Asbestos b) Gold c) Iron d) Aluminum
 - The relation between C_p and C_v is:
 a) $C_p - C_v = R$ b) $C_v - C_p$ c) $C_p + C_v = R$ d) $C_p \cdot C_v$
 - Specific heat is defined as the amount required
 a) To raise unit degree of temperature of a substance
 b) To raise unit mass of a substance through unit degree of temperature
 c) To raise unit mass of a substance through 10°C
 d) None of the above.
- Q.2** (a) Define the following terms: **03**
 i) Higher calorific value ii) Mountings and accessories of boiler
 iii) critical point and triple point of water.
- (b) Differentiate: **04**
 (i) Belt drive, chain drive and gear drive
 (ii) Brake and Clutch
- (c) Mention different parts of vapor compression refrigeration cycle along with their functions. Also draw a neat diagram of vapor compression refrigeration cycle. **07**
- Q.3** (a) List methods of measuring dryness fraction. Explain any one of them. **07**
 (b) Determine the work done in compressing one kg of air from a volume of 0.15m^3 at a pressure of 1 bar to a volume of 0.05m^3 , when the compression is 1) adiabatic 2) isothermal. Take $\gamma = 1.4$. Give your comments. **07**
- Q.4** (a) Explain water Temperature- Enthalpy Diagram for water. **07**
 (b) What amount of heat is required to produce 5 kg of steam at a pressure of 5 bar and temperature of 250°C from water at 30°C , take $C_{p_s} = 2.1\text{kJ/kg K}$ **07**
- Q.5** (a) Discuss Rankine cycle in detail with flow diagram and P-V diagram. **07**

- (b) An engine working on ideal Otto cycle has a clearance volume of 0.03m^3 and swept volume of 0.12m^3 . The temperature and pressure at the beginning of compression are 100°C and 1 bar respectively. If the pressure at the end of heat addition is 25 bar, calculate i) ideal efficiency of the cycle. ii) Temperature at key points of the cycle. Take $\gamma = 1.4$ for air. **07**
- Q.6** (a) Classify Air Compressors. Give the uses or application of compressed air. **07**
(b) During testing of single cylinder two stroke petrol engine, following data is obtained: Brake torque 640 Nm, cylinder diameter 21 cm, Speed 350 rpm, stroke 28 cm, mean effective pressure 5.6 bar, oil consumption 8.16 kg/hr, C.V = 42705 kJ/kg. Find, i) Mechanical Efficiency, ii) Indicated thermal efficiency iii) brake thermal efficiency iv) brake specific fuel consumption. **07**
- Q.7** (a) Explain flange coupling with neat sketch **07**
(b) Classify properties of engineering material. Explain any three of them. **07**

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-1st / 2nd (NEW) EXAMINATION – WINTER 2015

Subject Code: 2110006

Date: 23/12/2015

Subject Name: Elements of Mechanical Engineering

Time: 10:30am to 01:00pm

Total Marks: 70

Instructions:

1. Question No. 1 is compulsory. Attempt any four out of remaining Six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Steam tables are permitted.

Q.1 Objective Question (MCQ)

(a) 07

1. Prime mover is a device which converts natural resources into _____ energy.
(a) With decrease in pressure (b) with increase in pressure
(c) is unaffected by pressure (d) none of the above
2. Zeroth law of thermodynamics forms the basis of measurement of the following.
(a) heat exchange (b) work (c) pressure (d) Temperature
3. Polytropic expansion of a gas is given by the law
(a) $pV^n = C$ (b) $pV^{\gamma} = C$ (c) $pV = C$ (d) $pV^0 = C$
4. Behaviour of vapour can be determined by
(a) Boyles law (b) Charles law (c) Combined law (d) none of the above
5. Bucket pump is a type of _____ pump.
(a) rotary (b) Centrifugal (c) reciprocating (d) axial
6. Centrifugal compressor is suitable for producing?
(a) High pressure (b) medium pressure (c) low pressure (d) all of the above
7. Spur gear has teeth _____ to the axes of the gears.
(a) inclined (b) parallel (c) perpendicular (d) any of the above

(b) 07

1. The energy absorbed by brakes is released in surrounding in form of
(a) heat energy (b) kinetic energy (c) potential energy (d) pressure energy
2. Which engine produces more power for same compression ratio
(a) 4- stroke diesel engine (b) 4- stroke petrol engine
(c) 2- stroke diesel engine (d) 2- stroke petrol engine
3. The operation of filling passage ways with liquid from outside source before starting pumps is known as _____.
(a) cavitation (b) cleaning (c) priming (d) chocking
4. One ton of refrigeration is equal to
(a) 221 kJ/min (b) 420 kJ/min (c) 600 kJ/min (d) 210 kJ/min
5. Belt drive provides _____ flexibility compared to gear drive.
(a) more (b) less (c) same (d) can't say
6. Which of the following elements is used to connect two shafts _____.
(a) clutch (b) brakes (c) Couplings (d) none of above
7. _____ is the characteristic of cast iron.
(a) ductile (b) malleable (c) very brittle (d) all of the above

Q.2 (a) Write a short note on Global Warming. 03

(b) Define isothermal process. Derive the expression for work done, change in internal energy and heat transfer for this process. 04

(c) One cubic meter of air at pressure of 1.5 bar and 80°C is compressed to final pressure 8 bar and volume 0.28 m³. Determine (i) mass of air (ii) 07

index of 'n' compression (iii) change in internal energy (iv) Heat transfer during compression. Take $\gamma = 1.4$ and $R = 287 \text{ J/kgK}$.

- Q.3** (a) Show the function and location of the following in the boiler plant: **03**
 (i) Feed check valve (ii) Air superheater (iii) Fusible plug.
 (b) Explain Throttling calorimeter with neat sketch and calculation of dryness fraction. **04**
 (c) Sketch and explain a Babcock and Wilcox boiler. **07**
- Q.4** (a) Differentiate between Two stroke and Four stroke I.C engines. **03**
 (b) Determine the quality of steam for the following cases: **04**
 (i) $P = 10 \text{ bar}$, $v = 0.180 \text{ m}^3/\text{kg}$
 (ii) $P = 10 \text{ bar}$, $t = 200^\circ\text{C}$
 (iii) $P = 25 \text{ bar}$, $h = 2750 \text{ kJ/kg}$
 (c) Derive equation for air standard efficiency of Diesel cycle. **07**
- Q.5** (a) Explain the working principle of centrifugal pump with neat sketch? **03**
 (b) The following data refers to a single cylinder 4 strokes petrol engine. **04**
 Cylinder diameter = 30 cm, piston stroke = 40 cm, engine speed = 1400 r.p.m, indicated mean effective pressure = 5 bar, fuel consumption = 17.568 kg per hour, calorific value of the fuel is 45000 kJ/Kg; specific gravity of the fuel is 0.8. Determine the indicated thermal efficiency.
 (c) Explain Vapor Compression Refrigeration system with neat sketch. Also draw p-h and T-s diagram for the same. **07**
- Q.6** (a) Define air-conditioning. Classify the air conditioning system in detail. **03**
 (b) Why multi-stage compression is required? Write advantages of the multi-staging compression. **04**
 (c) What are the different types of couplings? Explain the centrifugal clutch. **07**
- Q.7** (a) Define the following mechanical properties **03**
 (i) Elasticity (ii) Toughness (iii) Ductility
 (b) Explain the working principle of vane pump with neat sketch? **04**
 (c) What are bearings? Explain with neat sketch worm and worm wheel. **07**

Seat No.: _____

Enrollment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- 1st / 2nd EXAMINATION (NEW SYLLABUS) – SUMMER 2016

Subject Code: 2110006

Date: 01/06/2016

Subject Name: Elements of Mechanical Engineering

Time: 02:30 PM to 5:00 PM

Total Marks: 70

Instructions:

1. Question No. 1 is compulsory. Attempt any four out of remaining Six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of steam table is allowable.

Q.1	Objective Question (MCQ)	Mark
(A)	Select the correct answer	07
1.	The S.I. unit N-m/s is called (a) Watt (b) Joule (c) Calorie (d) None of the above.	
2.	The Universal gas Constant is equal to (a) M/R (b) R/M (c) M*R (d) All of the above	
3.	The law $PV = C$ is related to this process (a) Adiabatic (b) Isobaric (c) Isochoric (d) Isothermal	
4.	Dryness fraction(x) of superheated steam is (a) equal to 0 (b) greater than 1 (c) less than 1 (d) equal to 1	
5.	Cut-off ratio is related to (a) Carnot cycle (b) Otto cycle (c) Diesel cycle (d) Rankine cycle	
6.	The compression ratio for Diesel engine is in the following range: (a) 12 to 22 (b) 5 to 10 (c) 10 to 12 (d) None of the above	
7.	Gear pump and Vane pump are types of (a) Rotary pump (b) Reciprocating pump (c) Centrifugal pump (d) None of the above.	
(B)	Select the correct answer	07
1.	The work done on compressor is least when the compression is (a) Isothermal (b) Adiabatic (c) Polytropic (d) None of the above	
2.	Inter cooling in multi stage compression is used to (a) cool air (b) Minimize the work done (c) reduce volume of air (d) none of the above.	
3.	In the domestic refrigerators the bank of tubes at the back of the refrigerator are (a) Condenser tubes (b) Evaporator tubes (c) Capillary tubes (d) All of the above	
4.	Heat is absorbed by refrigerant during refrigeration cycle in (a) Condenser (b) Evaporator (c) Capillary (d) None of the above	
5.	The unit of pressure is (a) Pascal (b) N/m ² (c) bar (d) all of the above	
6.	The sealing ring for pressure cooker is made from (a) Leather (b) Rubber (c) Plastic (d) Aluminum	
7.	Plate type, Cone type and Centrifugal type are the types of (a) Couplings (b) Brakes (c) Clutches (d) Gear drives	
Q.2	(a) Classify the engineering materials.	03
	(b) Explain with neat sketch the working of belt drives and gear drives.	04
	(c) What do you understand by the term 1 ton of refrigeration? What are the main components of vapour compression refrigeration system? Write their functions.	07

- Q.3** (a) Differentiate between a Brake and a Clutch. **03**
 (b) How the air compressors are classified based on different criteria. **04**
 (c) Draw air standard diesel cycle on p-V and T-s diagrams. Derive its efficiency equation with usual notations. **07**
- Q.4** (a) With neat sketch explain in brief the working of Vane pump. **03**
 (b) Compare: S.I. engines and C.I. engines. **04**
 (c) The following readings were recorded during the test on single cylinder four stroke diesel engine. **07**
 (1) Cylinder diameter = 250 mm
 (2) Stroke length = 350 mm
 (3) Mean effective pressure = 6.7 bar
 (4) Speed of engine = 250 r.p.m.
 (5) Net brake load = 1070 N
 (6) Effective brake drum diameter = 1.5 m
 (7) Fuel consumption rate = 10 kg per hour.
 (8) C.V. of the fuel = 44300 kJ/kg.
 Calculate: (1) Indicated Power (2) Brake Power (3) Mechanical efficiency. (4) Brake thermal efficiency.
- Q.5** (a) Explain the difference between boiler mountings and accessories. **03**
 (b) Calculate the air standard efficiency of the engine working on Otto cycle in which air initially at 1 bar and 20°C is compressed adiabatically to the pressure of 16 bar. Maximum pressure of cycle is 45 bar and adiabatic index $\gamma = 1.4$. **04**
 (c) With neat sketch explain the construction and working of (i) Fusible plug and (ii) Air pre heater. **07**
- Q.6** (a) Prove that $C_p - C_v = R$ with usual notations. **03**
 (b) Write a short note on "Solar Energy". **04**
 (c) A cylinder contains 0.6 m³ of a gas at a pressure of 1 bar and 90 °C. The gas is compressed to a volume of 0.18 m³ by the law $PV^n = C$. The pressure of gas at the end of compression is 5 bar. Calculate: (1) Mass of gas (2) value of index n (3) The change in internal energy of the gas. (4) Work done (5) The heat received or rejected by the gas during the process. Take $\gamma = 1.4$ and $R = 0.294$ kJ/kg K. **07**
- Q.7** (a) Explain in brief Open system and closed system giving examples. **03**
 (b) Draw neat and labeled diagram of Cochran Boiler **04**
 (c) Calculate the total amount of heat required to produce 6 kg of steam at a pressure of 6 bar and temperature of 258 °C from the water at 30 °C. Take specific heat of steam = 2.1 kJ/kg-K. and the specific heat of water = 4.187 kJ/kg-K. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEMESTER 1st / 2nd (NEW) EXAMINATION WINTER 2016

Subject Code: 2110006**Date: 23/01/2017****Subject Name: Elements of Mechanical Engineering****Time: 10:30 AM TO 1:00 PM****Total Marks: 70****Instructions:**

1. Question No. 1 is compulsory. Attempt any four out of remaining Six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of property table is permitted.

Q.1	Objective Question (MCQ): Choose right answer.	Mark
(a)		07
1.	The sum of internal energy (U) and the product of pressure and volume (p.v) is known as A. workdone B. entropy C. enthalpy D. heat	
2.	The energy which is not derived from the sun is _____. A. bio-mass B. fossil fuels C. nuclear energy D. geo-thermal energy	
3.	An adiabatic process is one in which A. no heat enters or leaves the gas B. the temperature of the gas changes C. the change in internal energy is equal to the mechanical work done D. all of the above	
4.	The ratio of specific heat at constant pressure (c_p) and specific heat at constant volume (c_v) is A. equal to one B. less than one C. greater than one D. none of these	
5.	Superheated vapour behaves A. exactly as gas B. as steam C. as ordinary vapour D. approximately as a gas	
6.	The behaviour of a perfect gas, undergoing any change in the variables which control physical properties, is governed by A. Boyle's law B. Charles' law C. Gay-Lussac law D. all of these	
7.	The efficiency of Diesel cycle increases with A. decrease in cut-off B. increase in cut-off C. constant cut-off D. none of these	

(b)

1. Which of the following statement is correct?
 - A. A fire tube boiler occupies less space than a water tube boiler, for a given power.
 - B. Steam at a high pressure and in large quantities can be produced with a simple vertical boiler.
 - C. A simple vertical boiler has one fire tube.
 - D. all of the above
2. The compression ratio for petrol engine is
 - A. 3 to 6
 - B. 5 to 8
 - C. 15 to 20
 - D. 20 to 30
3. The impeller of a centrifugal pump may have
 - A. volute casing
 - B. volute casing with guide blades
 - C. vortex casing
 - D. any one of these
4. The maximum delivery pressure in a rotary air compressor is
 - A. 10 bar
 - B. 20 bar
 - C. 30 bar
 - D. 50 bar
5. During a refrigeration cycle, heat is rejected by the refrigerant in a
 - A. compressor
 - B. condenser
 - C. evaporator
 - D. expansion valve
6. A hydraulic coupling belongs to the category of
 - A. power absorbing machines
 - B. power developing machines
 - C. energy transfer machines
 - D. energy generating machines
7. An open belt drive is used when
 - A. shafts are arranged parallel and rotate in the opposite directions
 - B. shafts are arranged parallel and rotate in the same directions
 - C. shafts are arranged at right angles and rotate in one definite direction
 - D. driven shaft is to be started or stopped whenever desired without interfering with the driving shaft

Q.2 (a) State Zeroth law, First law and Second law of thermodynamics. **03**

(b) Describe any four form of energy in 100 words. **04**

(c) A balloon of spherical shape 6 m in diameter is filled with hydrogen gas at a pressure of 1 bar absolute and 20°C. At a later time, the pressure of gas is 94 per cent of its original pressure at the same temperature : **07**

- 1) What mass of original gas must have escaped if the dimension of the balloon is not changed?
- 2) Find the amount of heat to be removed to cause the same drop in pressure at constant volume.

Take molecular weight for hydrogen, $M = 2$ and specific heat constant volume for hydrogen, $c_v = 10400 \text{ J/kg.K}$

Q.3 (a) State Boyle's, Charle's and Avogadro law. **03**

(b) Identify the advantages and disadvantages of wind energy. **04**

(c) A rigid tank contains 10 kg of water at 90°C. If 8 kg of the water is in the liquid form and the rest is in the vapor form. Draw p-V diagram and identify the point in p-V diagram. Determine **07**

- 1) the pressure in the tank
- 2) the volume of liquid and water vapour

- 3) quality (dryness fraction) of steam and
- 4) volume of the tank by using dryness fraction
- Q.4** (a) Express the mathematical formula with standard notation/symbol of properties for **03**
- 1) Wetness fraction of steam
 - 2) Enthalpy of superheated steam
 - 3) Specific volume of wet steam
- (b) Explain the construction of Oldham's coupling with neat sketch in 150 words. **04**
- (c) Explain with neat sketch working of any one of the high pressure boiler in 300 words. Tell the two advantages and two disadvantages of it. **07**
- Q.5** (a) Define air standard efficiency. State any four assumptions considered for analysis of air standard cycle. **03**
- (b) In ideal Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Assume flow rate of 9.5 kg/s. Determine : **04**
- 1) The pump work,
 - 2) The turbine work,
 - 3) The Rankine efficiency,
 - 4) The dryness at the end of expansion.
- (c) Compare four stroke engine and two stroke engine based on following point/criteria. **07**
- 1) Number of piston strokes per cycle
 - 2) Number of crank rotation per cycle
 - 3) Number of power stroke per min
 - 4) Power
 - 5) Flywheel
 - 6) Size for same power output
 - 7) Thermal Efficiency and Mechanical Efficiency
- Q.6** (a) Define following terms with respect to compressor. **03**
- 1) Free air delivery
 - 2) Capacity
 - 3) Volumetric efficiency of an air compressor
- (b) A centrifugal pump handles water and drives by motor which consumes 32 kW. The pump running at 2000 rpm. The motor efficiency is 92%. The height of pump axis from sump water surface is 6 m and produces a delivery head of 24 m. The discharge rate of water is 260 m³/hr. Calculate the efficiency of pump. **04**
- (c) Sketch fluid flow diagram with component of ideal vapour compression refrigeration system. Sketch p-V, T-s, and p-h chart and show all thermodynamic process of ideal superheated vapour compression refrigeration system **07**
- Q.7** (a) Define following terms. **03**
- 1) Ductility
 - 2) Elasticity
 - 3) Pump
- (b) Classify plain carbon steel. Compare their properties and application. **04**
- (c) Compare belt drive, chain drive and gear drive based on following criteria : **07**
- 1) Main elements
 - 2) Application suitability w.r.t to distance and velocity ratio
 - 3) Space requirement
 - 4) Slip
 - 5) Design & Manufacturing complexity
 - 6) Life
 - 7) Maintenance
