Date: 16/09/2018

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department: Mechanical and Production Engineering
Program: B.Sc. in Computer Science and Engineering
Semester Final Examination: Spring 2018
Year: 1st Semester: 2nd
Course Number: ME 1211
Course Name: Basic Mechanical Engineering

Time: 3 (three) hours **Full Marks: 70**

COP

Use separate answer script for each section

Section A

Instructions:
i) There are 5 (Five) Questions in this section, Answer any 4 (Four)
ii) Marks allotted are indicated in the right margin
iii) Symbols and characters have their usual meaning

Question 1. [11⅔ marks]

a) Which parameter is used for assessing the performane of a heat engine? (2)

b) With a schematic diagram, briefly describe the ideal cycle for a steam power plant. (4⅔)

c) A heat engine receives heat from a heat source at 1200°C and has a thermal efficiency of 38 percent. The heat engine does maximum work equal to 500 kW. Determine (a) the heat supplied to the heat engine by the heat source, and (b) the temperature of the heat sink. (5)

Question 2. [11⅔ marks]

a) What is a refrigerant? What are the commonly used refrigerants? (2⅔)

b) What is the most efficient refrigeration cycle? Describe this cycle with a schematic diagram. (4)

c) Describe the main components of an abosorption refrigeration system with a schematic diagram. (5)

Question 3. [11⅔ marks]

a) What is a reciprocating engine? Give two examples of commonly used reciprocating engines. (2⅔)

b) Draw the nomenclature for a reciprocating engine and show the main components. (4)

c) Distinguish between 2-stroke and 4-stroke engines. (2)

d) What is the thermodynamics cycle for a compression-ignition engine? Describe the processes in this cycle using a P-V diagram? (3)

Question 4. [11⅔ marks]

a) What are the factors that are effecting human comforts? (2⅔)

b) A room contains air at 1 atm, 30°C and 60% relative humidity. Using the psychrometric chart, determine: (i) the specific humidity, (ii) the enthalpy, (iii) the wet-bulb temperature, (iv) the dew point temperature, (v) the specific volume of the air. (5)

c) What is meant by a robot? List some of the common actuators. (4)

Question 5. [11⅔ marks]

a) What are the mechanisms of heat transfer? Give two examples for each mechanism. (3⅔)

b) Distinguish between forced and natural convection with suitable examples. (3)

c) Both a gage and a monometer are attached to a gas tank to measure its pressure. If the reading on the pressure gage is 80 kPa, determine the distance between the two fluid levels of the manometer if the density of the fluid is 5,000 kg/m^3. The atmospheric pressure can be considered as 101 kPa. (5)

Section B

Instructions: i) There are 3 (Three) questions. Answer any 2 (Two) questions.
ii) Marks allotted are indicated in right margin
iii) Assume any reasonable data if needed
iv) Symbols and characters have their usual meaning

Question 6. [$11\frac{2}{3}$ marks]

(a) A frame ABC is supported in part by cable DBE that passes through a frictionless ring at B as shown in **Figure Q 6 (a)**. Knowing that the tension in the cable is 385 N, determine the components of the force exerted by the cable on the support at E. ($5\frac{2}{3}$)

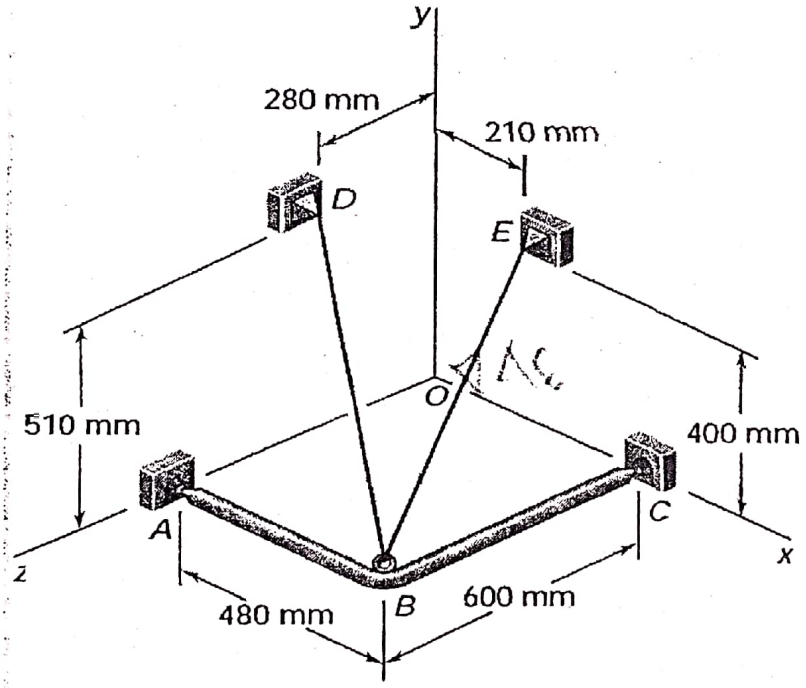

Figure Q 6 (a)

(b) A lever AB is hinged at C and attached to a control cable at A as shown in **Figure Q 6 (b)**. If the lever is subjected to a 75 lb vertical force at B, determine (6)

i. the tension in the cable,
ii. the reaction at C.

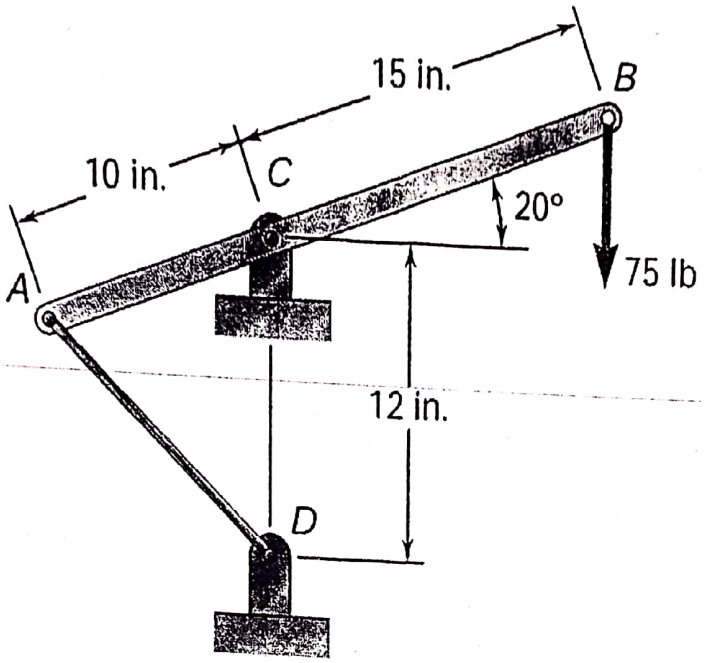

Figure Q 6 (b)

Question 7. [$11\frac{2}{3}$ marks]

(a) Using the method of joints, determine the force in each member of the truss as shown in **Figure Q 7 (a).** ($6\frac{2}{3}$)

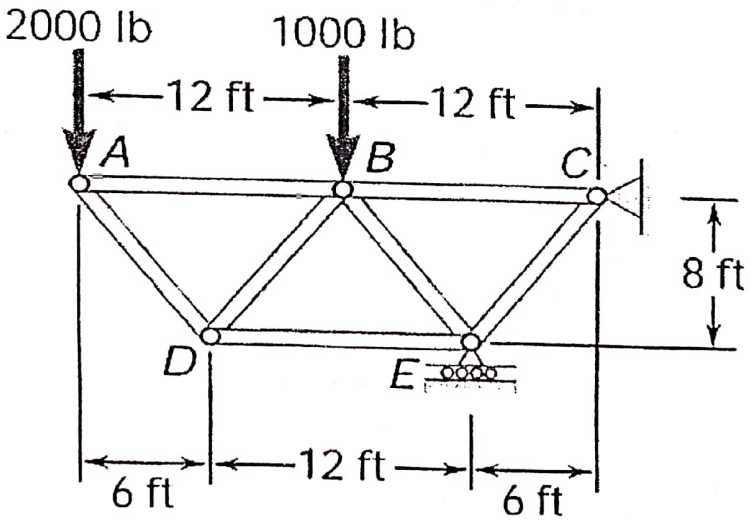

Figure Q 7 (a)

$\circlearrowleft +$ T_D ($F_D \sin\alpha$)16 − 75 × 15.

16 =

(b) In the frame shown in **Figure Q 7 (b)**, members ACE and BCD are connected by a pin at C and by the link DE. For the loading shown, determine the force in link DE and the components of the force exerted at C on member BCD. (5)

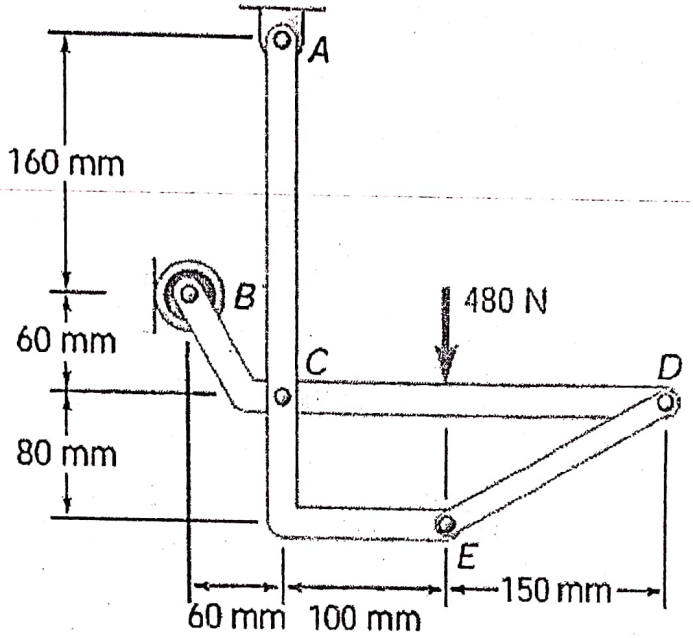

Figure Q 7 (b)

Question 8. [$11\frac{2}{3}$ marks]

(a) The elevator E shown in **Figure Q 8 (a)** starts from rest and moves upward with a constant acceleration. If the counterweight W moves through 30 ft in 5 s, determine ($5\frac{2}{3}$)

i. the acceleration of the elevator E and the cable C,

ii. the velocity of the elevator after 5 s.

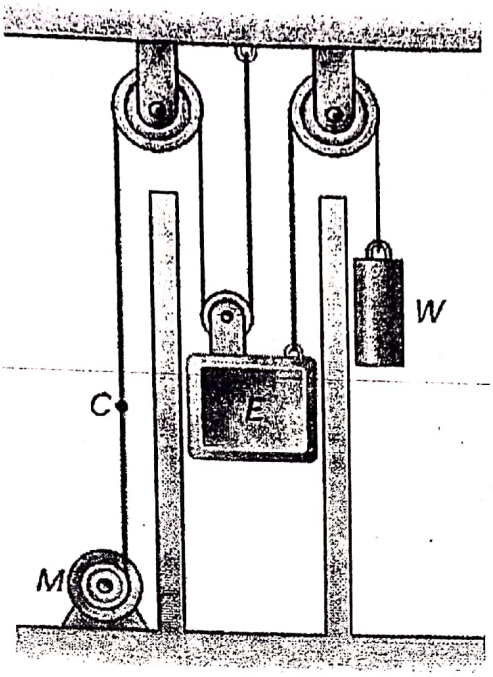

Figure Q 8 (a)

(b) The two blocks shown in **Figure Q 8 (b)** starts from rest. The horizontal plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord. (6)

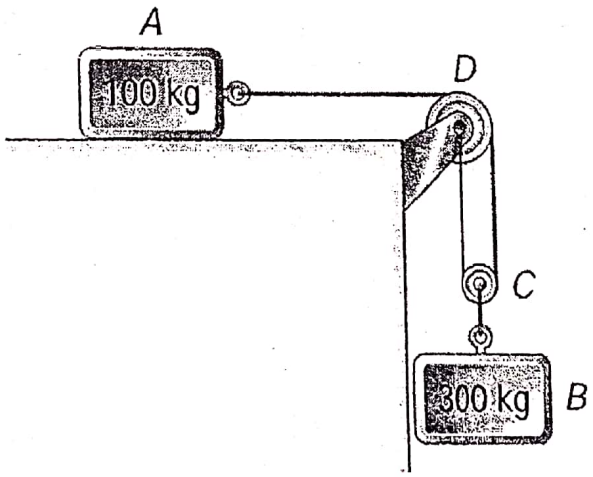

Figure Q 8 (b)

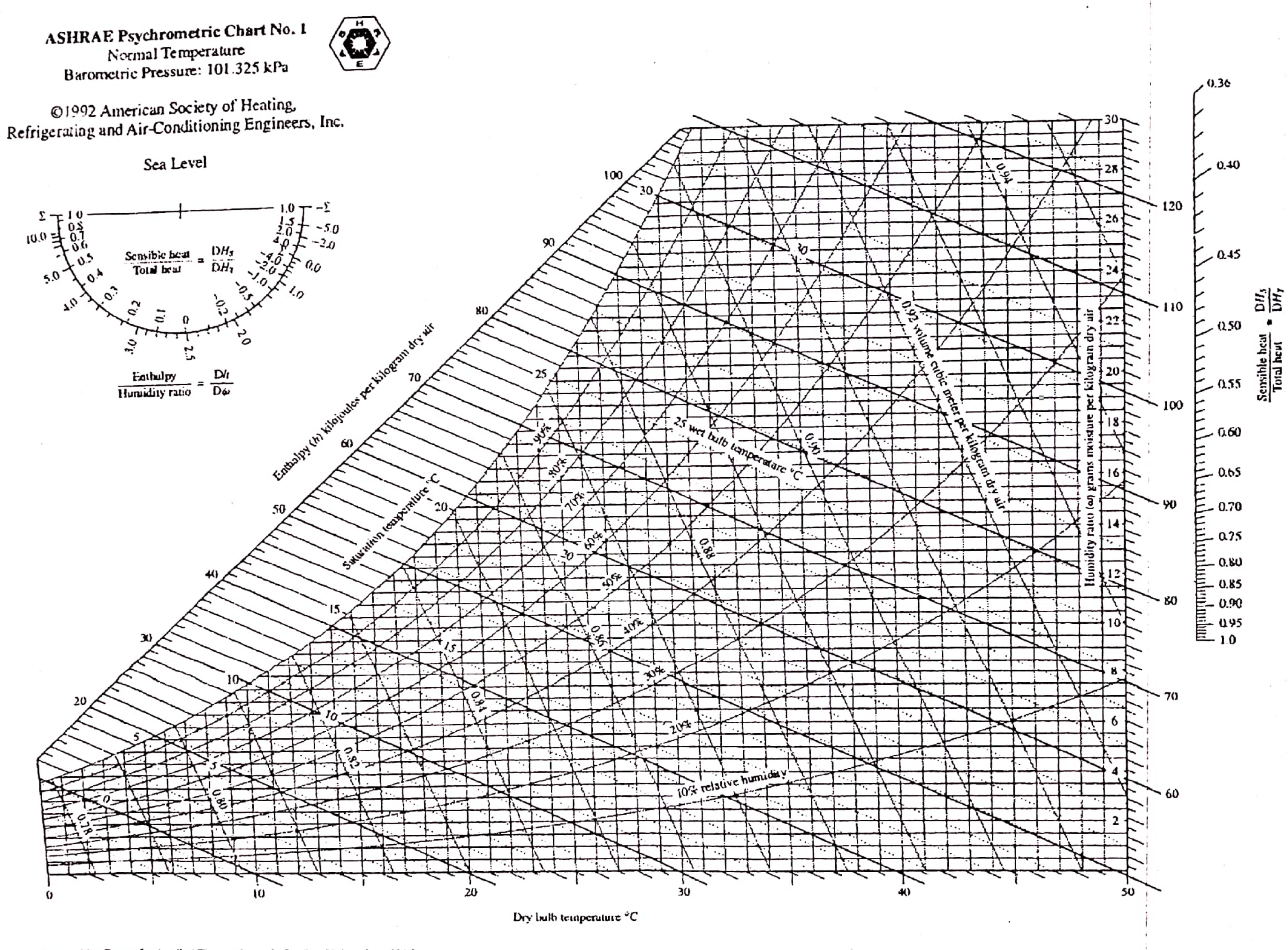

FIGURE A–31
Psychrometric chart at 1 atm total pressure.

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Thermodynamics related Formulas

Thermal Efficiency (η_{th}) Related

$$\eta_{th} = \frac{W_{net,out}}{Q_H} = \frac{Q_H - Q_L}{Q_H}$$

$$\eta_{th,rev} = 1 - \frac{T_L}{T_H}$$

Coefficient of Performance (COP) Related

$$COP_R = \frac{Q_L}{W_{net,in}} = \frac{Q_L}{Q_H - Q_L}$$

$$COP_{HP} = \frac{Q_H}{W_{net,in}} = \frac{Q_H}{Q_H - Q_L}$$

$$COP_{HP} = COP_R + 1$$

$$COP_{R,rev} = \frac{1}{T_H/T_L - 1}$$

$$COP_{HP,rev} = \frac{1}{1 - T_L/T_H}$$

Temperature Related

$$\left(\frac{Q_H}{Q_L}\right)_{rev} = \frac{T_H}{T_L}$$

General Energy Balance

$$E_{in} - E_{out} = \Delta E_{system}$$

$$\Delta E_{system} = \Delta U + \Delta KE + \Delta PE$$

Fluid Statics Related

$$p = \gamma h + p_0$$

$$p_{abs} = p_{gage} + p_{atm}$$

Heat Transfer related Formulas

Conduction

$$\dot{Q}_{cond} = kA\frac{T_1 - T_2}{\Delta x} = -kA\frac{\Delta T}{\Delta x}\ (W)$$

Convection

$$\dot{Q}_{conv} = hA_S(T_S - T_\infty)$$

Radiation

$$\dot{Q}_{emit,max} = \sigma A_S T_S^4\ (W)$$

$$\dot{Q}_{absorbed} = \alpha \dot{Q}_{incident}\ (W)$$

$$\dot{Q}_{rad} = \epsilon\sigma A_S(T_S^4 - T_{surr}^4)$$

$$\dot{Q}_{total} = h_{combined}A_S(T_S - T_\infty)$$

General

- Universal gas constant, $R_u = 8.31447\ kJ/kmol \cdot K$
- Stefan-Boltzmann constant, $\sigma = 5.670 \times 10^{-8}\ W/m^2 \cdot K^4$

Date of Examination: 13/05/2019

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Mechanical and Production Engineering

Program: B.Sc. in Computer Science and Engineering

Final Examination Fall 2018

Year: 1st Semester: 2nd

Course No: ME 1211 Course Name: Basic Mechanical Engineering

Time: 3 (three) hours **Full Marks: 70**

Use separate answer script for each section

Instructions:

i) **There are FOUR Questions in each section. Answer any THREE from each section**

ii) Marks allotted are indicated in right margin

iii) Assume any reasonable data if needed

iv) Symbols and characters have their usual meaning

v) A Psychrometric chart is provided with this question. Students answering Q 3(c) and/or Q 4(a) must submit the chart along with the answer script

Section A

Question 1. [$11\frac{2}{3}$ marks]

a) In the automobile industry, Air Standard Cycles are used by scientists and engineers in order to estimate key performance metrics such as engine power, thermal efficiency and so on. What are the assumptions of this "Air Standard Cycle"? **(2)**

b) The Diesel Cycle, one of the most well-known Air Standard Cycle, is the core principle that governs the design and operation of Diesel Engines in most load-hauling vehicles. With suitable figures, explain how the Diesel Cycle works. **(5)**

c) In an Otto Cycle, air at 1 bar and 290 K is compressed isentropically until the pressure becomes 15 bar. The heat is added at constant volume until the pressure rises to 40 bar. Calculate the air standard efficiency and the mean effective pressure for the cycle. Take Cp = 0.717 kJ/kg.K, Ru (Universal gas constant) = 8.314 kJ/kg.mole.K and $\gamma = 1.4$. **($4\frac{2}{3}$)**

Question 2. [$11\frac{2}{3}$ marks]

a) With a labelled diagram, describe the Solar Vapor Absorption Refrigeration system. **(5)**

b) A vapor compression refrigerator works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no undercooling of the liquid before the expansion valve. Determine **($6\frac{2}{3}$)**

i. C.O.P of cycle;

ii. Capacity of refrigerator if the fluid flow is at the rate of 5 kg/min

Data table is given in the next page

Pressure (bar)	Saturation Temperature (K)	Enthalpy (kJ/kg)		Entropy (kJ/kg.K)	
60	295	151.96 (l)	293.29 (g)	0.554 (l)	1.0332 (g)
25	261	56.32 (l)	322.58 (g)	0.226 (l)	1.2646 (g)

Question 3. [$11\frac{2}{3}$ marks]

a) With a schematic diagram, describe the working principle of a Split-Type Air Conditioning system. (4)

b) In modern Split A/C system, a thermostatic expansion valve (TXV) ensures the complete vaporization of the mixed refrigerant flowing through the evaporator coils before entering the scroll compressor. Explain how the TXV operates in this context with a suitable diagram. (3)

c) 39.6 m^3/min of a mixture of recirculated room air and outdoor air enters a cooling coil at 31° DBT and 18° WBT. The effective surface temperature or ADP of the coil is 4.4°C. The surface area of the coil is designed to provide 12kW of refrigeration with the given state of air. Determine ($4\frac{2}{3}$)

i. DBT and WBT of the air leaving the coil
ii. Bypass factor

Mark the state points with X, Y and Z, and draw the process line in the psychrometric chart.

Question 4. [$11\frac{2}{3}$ marks]

a) An HVAC system operating at a pressure of 1bar, takes in air at 15°C DBT and 11°C WBT. This moist air comes in contact with a heating coil whose temperature is 40°C. Take by-pass factor of 0.35. Determine ($3\frac{2}{3}$)

i. DBT, WBT and RH of the outlet air.
ii. Total sensible heat added if the system took in 15 kg of dry air.

Mark the state points with A, B and C, and draw the process line in the psychrometric chart.

b) Explain the importance of sensors in robotics with suitable examples. (3)

c) Differentiate between the SCARA and the Spherical robotic arm configurations. (3)

d) Draw the work envelop of a cylindrical robot arm and mention its application. (2)

Section B

Instructions: i) There are 4 (Four) questions. Answer any 3 (Three) questions.
ii) Marks allotted are indicated in right margin
iii) Assume any reasonable data if needed
iv) Symbols and characters have their usual meaning

Question 5. [$11\frac{2}{3}$ marks]

(a) State the Zeroth law of thermodynamics and the Second law of thermodynamics. **(3)**

(b) For an ideal gas prove that PV^{γ} = constant for an adiabatic process. **(3)**

(c) 0.336 m^3 of gas at 10 bar and 150°C expands adiabatically until its pressure becomes 4 bar. It is then compressed isothermally to its original volume. Find the final temperature and pressure of the gas. Also determine the change in internal energy. **($5\frac{2}{3}$)**
Take C_p = 0.996 kJ/kg. K and C_v = 0.703 kJ/kg. K.

Question 6. [$11\frac{2}{3}$ marks]

(a) Compare between the forced convection and the free convection with suitable examples. **(3)**

(b) The following is the Stefan-Boltzmann formula for radiation heat transfer, **($2\frac{2}{3}$)**

$$Q = \sigma A T^4$$

What is the significance of this equation?

(c) A furnace wall is made up of refractory bricks of 300 mm thick. The inner and outer surfaces of the wall have temperature of 1000°C and 150°C respectively. Find the heat loss per square meter per hour. **(6)**
If the outside temperature becomes 50°C, the furnace wall is covered with insulating bricks of 200 mm thickness. Find the reduction in heat loss.
Take thermal conductivity of refractory bricks and insulating bricks as 4.5 W/m. K and 0.5 W/m. K respectively.

Question 7. [$11\frac{2}{3}$ marks]

(a) A lever AB is hinged at C and attached to a control cable at A as shown in **Figure Q 7 (a)**. If the lever is subjected to a 75 lb vertical force at B, determine **($5\frac{2}{3}$)**
i. the tension in the cable, and
ii. the reaction at C.

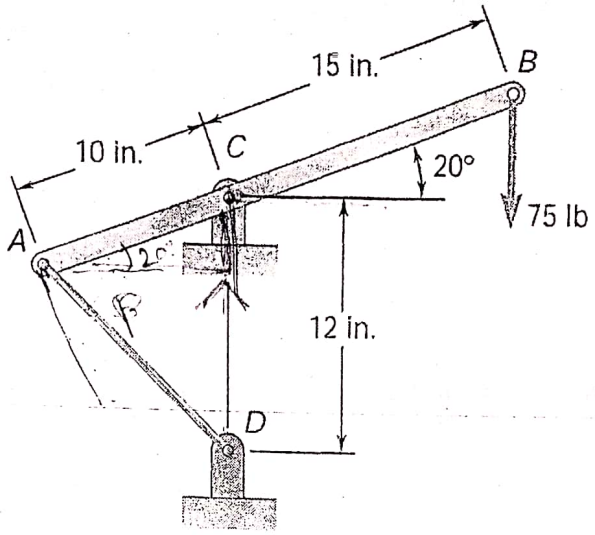

Figure Q 7 (a)

(b) Using the method of joints, determine the force in member BC and CD of the truss as shown in **Figure Q 7 (b).** State whether the members are in tension or compression. **(6)**

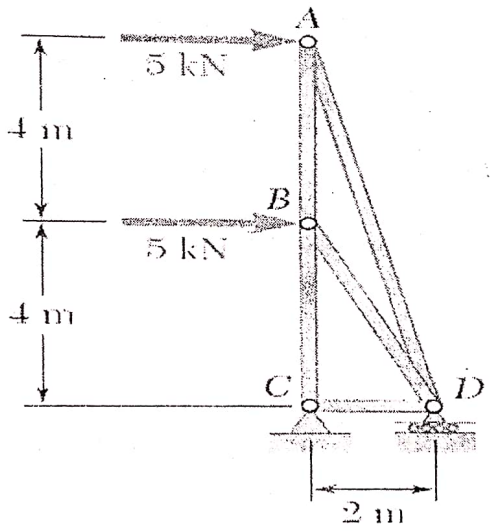

Figure Q 7 (b)

Question 8. [$11\frac{2}{3}$ marks]

(a) A small package is released from rest at A and moves along the skate wheel conveyor ABCD as shown in **Figure Q 8 (a)**. The package has a uniform acceleration of 4.8 m/s^2 as it moves down sections AB and CD, and its velocity is constant between B and C. If the velocity of the package at D is 7.2 m/s, determine **($4\frac{2}{3}$)**

i. the distance d between C and D, and

ii. the time required for the package to reach D.

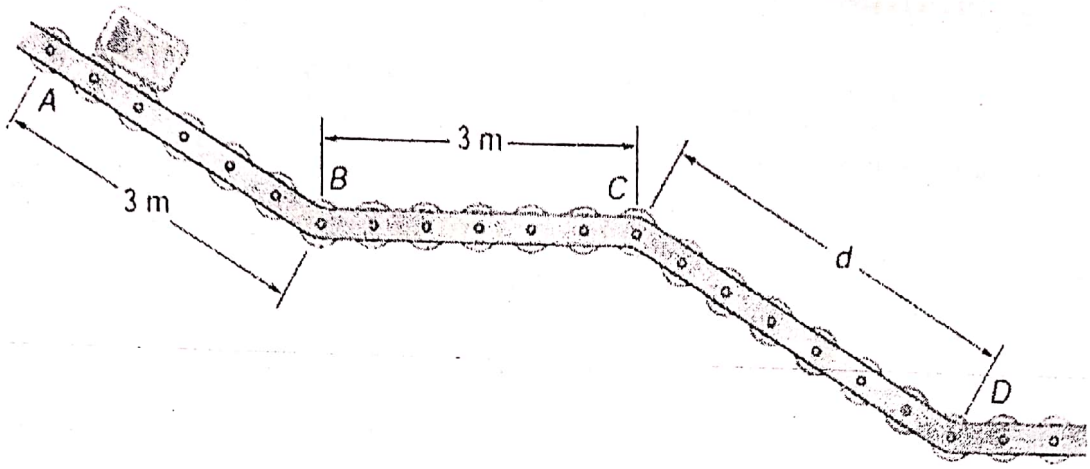

Figure Q 8 (a)

(b) The two blocks shown in **Figure Q 8 (b)** starts from rest. The horizontal plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord. (7)

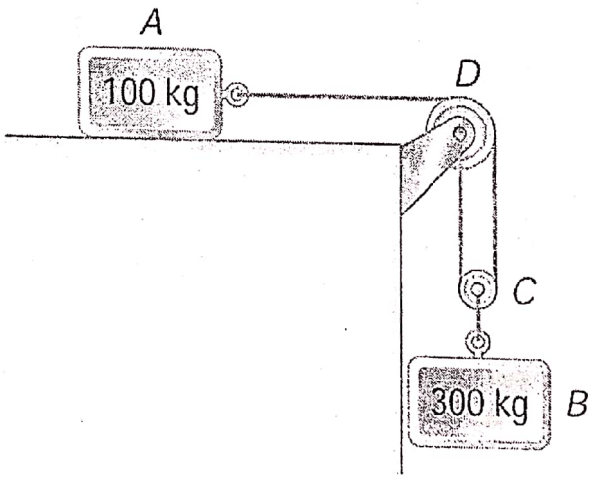

Figure Q 8 (b)

07/03/17

Ahsanullah University of Science and Technology

Department of Mechanical and Production Engineering

Program: **B. Sc. In Computer Science & Engineering**

1st Year 2nd Semester Final Examination (Fall 2016)

Course No: ME 1211. Course Name: Basic Mechanical Engineering

Full Marks: 70 Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **THREE** questions in this section. Answer any **TWO**.

All problem solutions must include a FBD

1.a) A hoist trolley shown in figure 1(a) is subjected to the three forces as shown. Knowing that P = 250 lb., determine, **[6]**

(i) the required value of α if the resultant of the three forces is to be Vertical,

(ii) the corresponding magnitude of the resultant

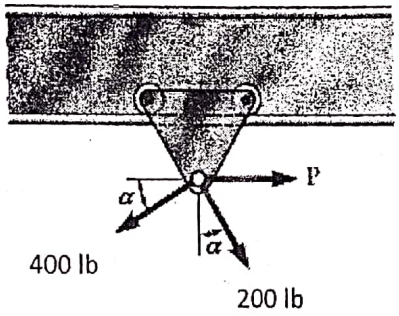

Figure 1(a)

b) Two cables are tied together at A and loaded as shown in figure 1(b). Draw the free-body diagram and determine tension in each cable. **[8]**

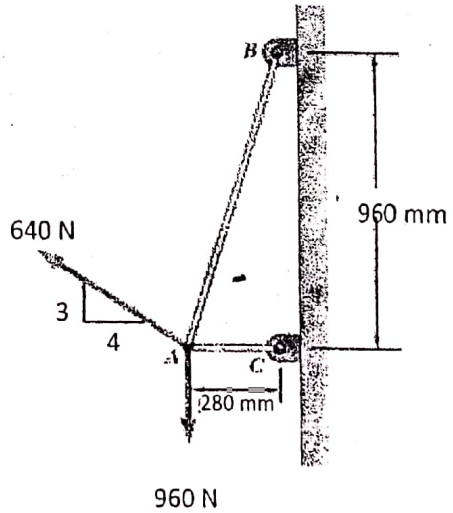

Figure 1(b)

2.a) Three loads are applied to a beam as shown in figure 2(a). The beam is supported by a roller at *A* and by a pin at *B*. Neglecting the weight of the beam, determine the reactions at *A* and *B* when *P*=15 kips. **[5]**

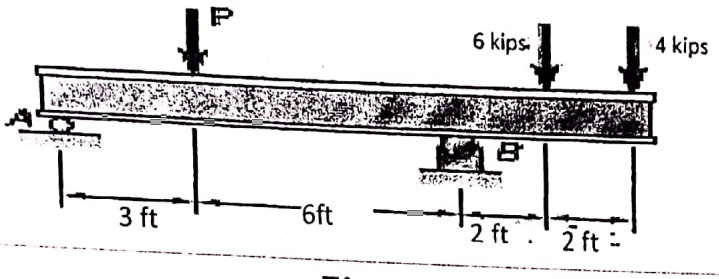

Figure 2(a)

b) Using the method of joints, determine the force in each member of the truss shown in figure 2(b). State whether each member is in tension or compression. **[9]**

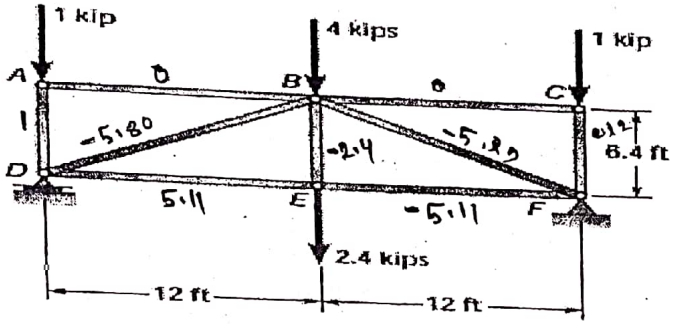

Figure 2(b)

3.a) The elevator E shown in the figure 3(a) moves downward with a constant velocity of 4 m/s. Determine (*i*) the velocity of the cable *C*, (*ii*) the velocity of the counterweight *W*, (*iii*) the relative velocity of the cable *C* with respect to the elevator, (iv) the relative velocity of the counterweight *W* with respect to the elevator. **[8]**

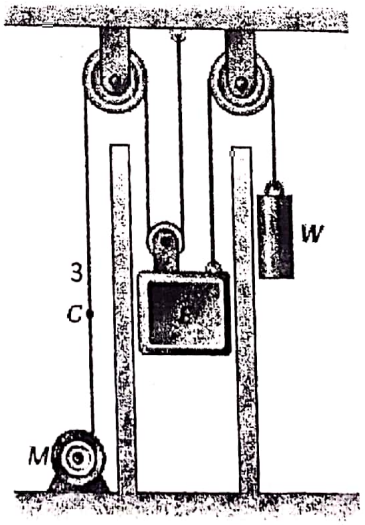

Figure 3(a)

b) The two blocks shown in the figure 3(b) start from rest. The horizontal plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord. **[6]**

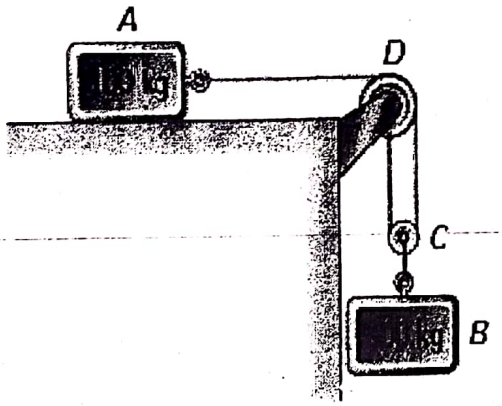

Figure 3(b)

Section B

There are FOUR Questions in this Section. Answer any THREE Questions.
The figures in the margin indicate full marks.
Assume reasonable values for missing data.
All symbols have their usual meaning.

Q.4 (a) What are the different processes involved in standard vapor compression refrigeration system? Draw the schematic diagram of the system and show the processes on p-h and T-S diagram. **(5)**

(b) An air conditioning unit working on vapor compression refrigeration system has got condenser-side temperature of 35°C and the coil-side temperature of -20°C. What is its COP? **(2)**

(c) With a block diagram describe briefly the working principle of a vapor absorption refrigeration system. **(4)**

(d) What do you understand by ozone layer depletion? What are the effects of ozone layer depletion? **(3)**

Q.5 (a) Draw the schematic diagram of central A/C system. **(4)**

(b) Briefly describe the cooling with dehumidification psychometric process with example. **(3)**

(c) In an air conditioning system 3 kg of return air at 25° C and 60% relative humidity is mixed with 1 kg of fresh air at 40°C and 50 % relative humidity to form a mixture. By using the supplied psychrometric chart, determine the following of the mixture: **(7)**

(i) The relative humidity
(ii) The absolute humidity
(iii) The specific enthalpy
(iv) The specific volume
(v) The dry bulb temperature
(vi) The wet bulb temperature
(vii) The dew point temperature.

Attach the used psychrometric chart with your answer script.

$O_3 + Cl_2$ *
$ClO + O_2$

Q.6 (a) Draw the major components of a reciprocating single cylinder petrol engine and label it. (4)

(b) Show the processes involved in air standard Otto cycle on P-V and T-S diagram and derive the equation for efficiency in terms of compression ratio. (4)

(c) The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke the pressure is 0.1 MPa and the temperature is 30° C. The heat transfer to the air per cycle is 2000 KJ/Kg. Assume the value of C_v is 0.7165 kJ/kg.K. Determine: (6)

(i) the thermal efficiency of the cycle, and

(ii) the pressure and temperature at the end of each process of the cycle.

Q.7 (a) Define end effectors, give the name of some common type of end effectors. (3)

(b) Write the name of different type of sensors that are commonly used in robot. (3)

(c) Describe the coordinate systems that are used in robot. (4)

(d) What do you mean by 'Degree of Freedom'? Show with a neat sketch the degrees of freedom of a typical human hand. (4)

Date: 05 / 09/2016

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

1st Year 2nd Semester Final Examination (Spring 2016)

Course No: ME 1211 **Course Title: Basic Mechanical Engineering**

Time: 3 (three) hours **Full Marks: 70**

There are SEVEN Questions. Answer any FIVE Questions.
The figures in the margin indicate full marks.
Assume reasonable values for missing data.
All symbols have their usual meaning.

Q.1 (a) Define refrigeration process and Ton of refrigeration. What are the applications of refrigeration system? (4)

(b) What do you understand by ozone depletion? What are the effects of ozone depletion? (3)

(c) With a block diagram describe briefly the working principle of a vapor absorption refrigeration system. (4)

(d) A vapor compression refrigeration system has got condenser-side temperature of 35°C and the evaporator-side temperature of 5°C. What is its COP? Also find the power rating of its compressor if it has a cooling load of 10 ton. (3)

Q.2 (a) What are the differences between air-conditioner and refrigeration system. (3)

(b) Draw the schematic diagram of a split type air-conditioning system. What are the devices that are split as 'hot-side' and 'cold-side' in a split-type air-conditioning system? (4)

(c) Briefly describe the cooling with humidification psychometric process with example. (3)

(d) The dry bulb and wet bulb temperature of the air in a room are 35° C and 25°C respectively. By using the supplied psychometric chart, determine the following of the air: (4)

(i) The relative humidity

(ii) The absolute humidity

(iii) The specific enthalpy

(iv) The dew point temperature.

Attach the used psychrometric chart with your answer script.

Q.3 (a) Draw the major components of a reciprocating single cylinder petrol engine and label it. (4)

(b) Show the processes involved in air standard Otto cycle on P-V and T-S diagram. (2)

(c) What are the functions of lubricating oil in internal combustion engine? Draw the flow diagram of lubrication system in a car engine. (4)

(d) Draw the valve timing diagram of a typical 4-stroke petrol engine. Also show valve overlap and spark advance on that diagram and discuss them in brief. (4)

Q.4 (a) Define a robot and mention some of its application. (4)

(b) Give the name of some common type actuators. (2)

(c) Describe the coordinate systems that are used in robot. (4)

(d) Define payload, reach, precision and repeatability. (4)

Q.5 (a) The hydraulic cylinder BC exerts on member AB a force P directed along line BC as shown in the figure for Q. 5(a). Knowing that P must have a 600-N component perpendicular to member AB, determine (i) the magnitude of the force P, (ii) its component along line AB. (7)

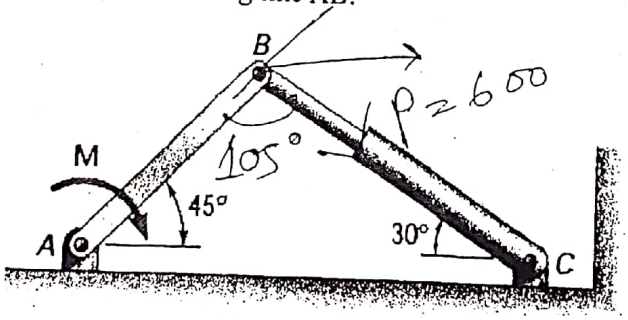

Figure for Q. 5(a)

(b) Determine the reactions at A and B when $\alpha = 0^\circ$ and h = 200 mm. (7)

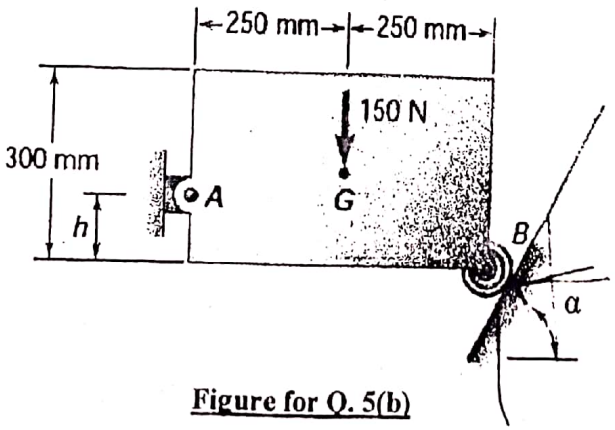

Figure for Q. 5(b)

Q.6. Using the method of joints, determine the force in each member of the truss shown. State whether the member is in tension or compression. **(14)**

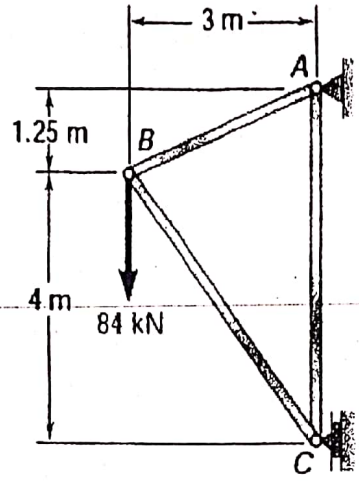

Figure for Q. 6

Q.7 (a) The elevator shown in the figure moves downward with a constant velocity of 4 m/s. Determine (i) the velocity of the cable C, (ii) the velocity of the counterweight W, (iii) the relative velocity of the cable C with respect to the elevator, (iv) the relative velocity of the counterweight W with respect to the elevator. **(7)**

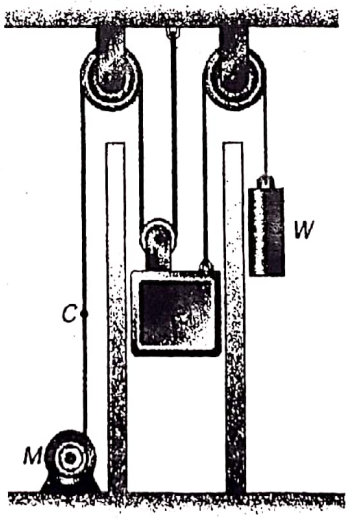

Figure for Q. 7(a)

(b) The two blocks as shown in the figure for Q. 7(b) are originally at rest. The incline plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord. **(7)**

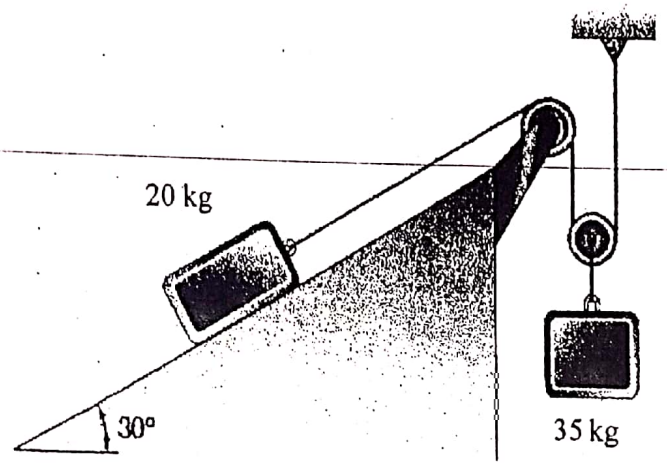

Figure for Q.7 (b)

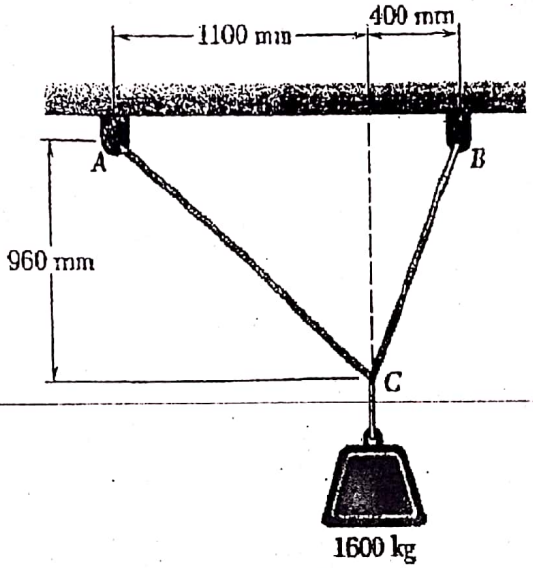

Figure for Q. 5(a)

(b) Determine the reactions at A and C when $\alpha = 90°$. (8)

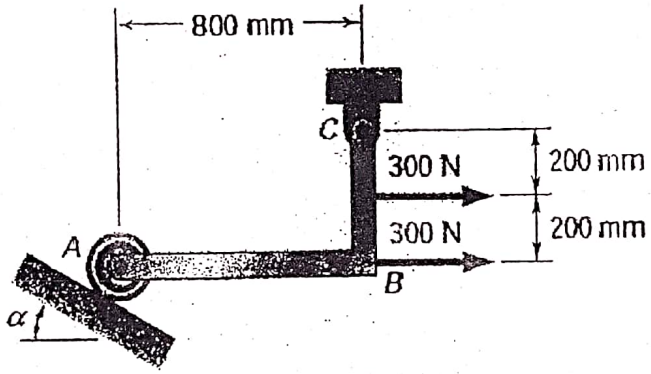

Figure for Q. 5(b)

Q.6. Using the method of joints, determine the force in each member of the truss shown. State whether the member is in tension or compression. (14)

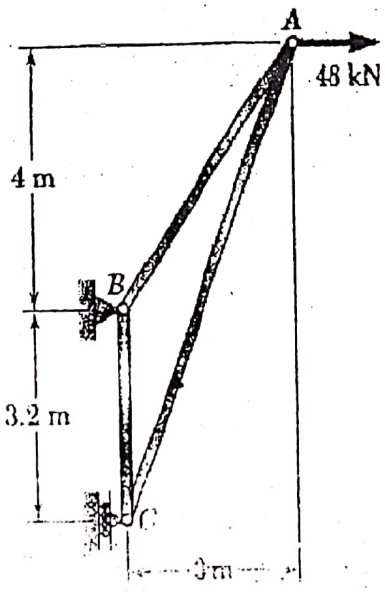

Figure for Q. 6

Q.7 (a) The elevator shown in the figure moves downward with a constant velocity of 4 m/s. Determine (i) the velocity of the cable C, (ii) the velocity of the counterweight W, (iii) the relative velocity of the cable C with respect to the elevator, (iv) the relative velocity of the counterweight W with respect to the elevator. (8)

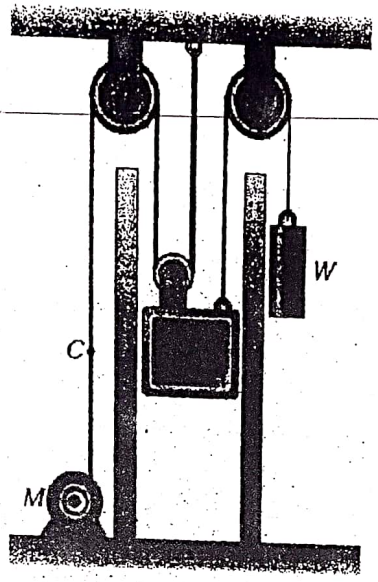

Figure for Q. 7(a)

(b) The two blocks shown start from rest. The horizontal plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord. (6)

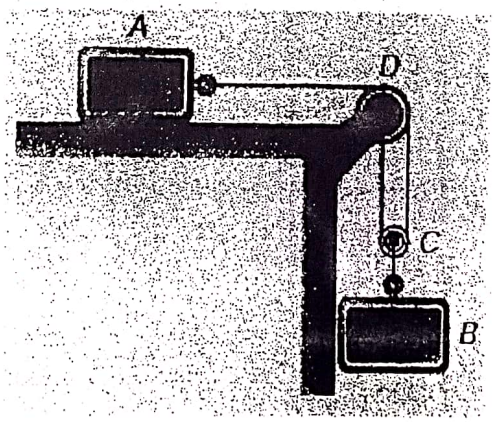

Figure for Q.7 (b)

Date: 21/03/16

Ahsanullah University of Science and Technology

Department of Mechanical and Production Engineering

Program: B.Sc. in Computer Science and Engineering

1st Year 2nd Semester Final Examination (Fall 2015)

Course No: ME 1211 **Course Name: Basic Mechanical Engineering**

Time: 3(Three) Hours **Full Marks: 70**

Use separate answer scripts for each section

Section A

There are 3(Three) questions in this section. Answer any 2(Two) questions.

1. a) With a block diagram describe briefly the working principle of a vapor compression refrigeration system. [4]

   b) Define COP of a refrigeration system. A refrigeration system has got temperatures of 20°C and -20°C for the compressor and the evaporator sides, respectively. Find its COP. If compressor work is 4 kW, find the refrigeration capacity in ton. [1+3]

   c) What is a refrigerant? Briefly describe some desirable properties of refrigerants. [1+3]

   d) Distinguish between vapor compression and vapor absorption refrigeration system. [2]

2. a) Define an air conditioning system. With a neat block diagram show the major components of a chiller-type central air conditioning system. [1+3]

   b) Write down the differences between window-type and split-type air conditioning systems. [3]

   c) On a typical summer day in a particular location, the dry bulb temperature is measured 31°C and wet bulb temperature is measured 26°C.Using the supplied psychometric chart, determine [5]
      (i) relative humidity,
      (ii) the absolute humidity,
      (iii) specific enthalpy,
      (iv) specific volume and
      (v) dew point temperature.

      Attach the used psychometric chart with your answer script.

   d) Describe shortly the heating and humidification psychometric process. [2]

3. a) What are the difference between 4-stroke and 2-stroke engine? [3]

   b) Show that the efficiency of a petrol engine running on air standard Otto cycle defends only on compression ratio. [4]

   c) The compression ratio in an air standard Diesel cycle is 20. At the beginning of the compression stroke, the pressure is 0.1 MPa and the temperature is 15°C. The cut-off ratio of the cycle is 2. Assume C_p and C_v to be 1.0035 kJ/kgK and 0.7165 kJ/kgK respectively. Determine, [7]
      i) the thermal efficiency of the cycle, and
      ii) the pressure and temperature at the end of each process of the cycle.

Section B

There are FOUR Questions in this Section. Answer any THREE Questions.

The figures in the margin indicate full marks.
Assume reasonable values for missing data.
All symbols have their usual meaning.

4. (a) Two cables are tied together at C and are loaded as shown. Determine the tension (i) in cable AC, (ii) in cable BC. (3)

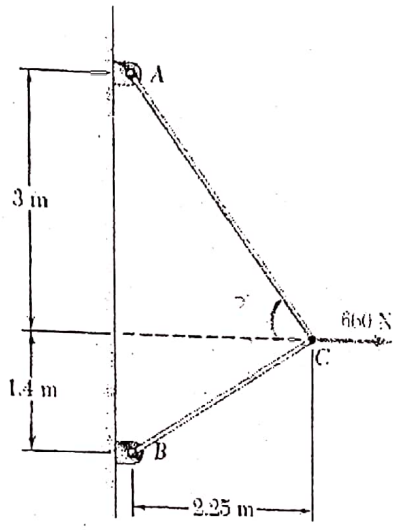

Figure for Q. 1(a)

(b) A fixed crane has a mass of 1000 kg and is used to lift a 2400-kg crate. It is held in place by a pin at A and a rocker at B. The center of gravity of the crane is located at G. Determine the components of the reactions at A and B. (4)

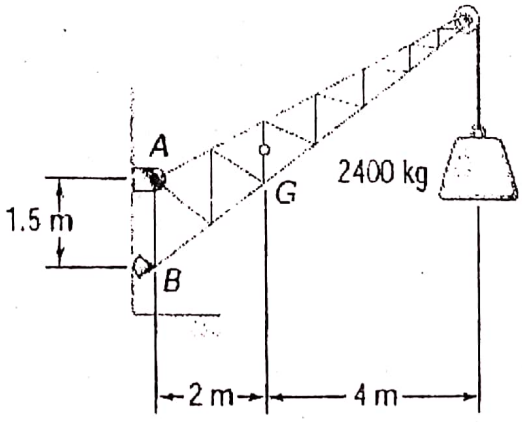

Figure for Q. 1(b)

5. Using the method of joints, determine the force in each member of the truss shown. State whether the member is in tension or compression. **(14)**

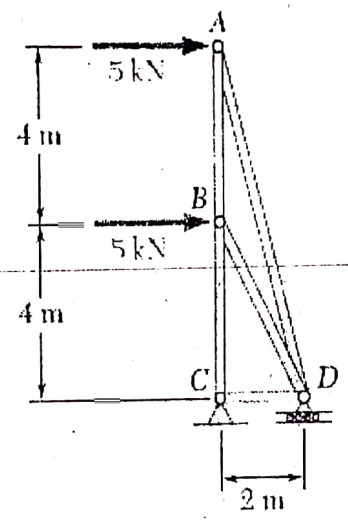

Figure for Q. 2

6. (a) Collar A and block B are connected by a cable passing over three pulleys C, D, and E as shown. Pulleys C and E are fixed, while D is attached to a collar which is pulled downward with a constant velocity of 3 m/s. At t = 0, collar A starts moving downward from position K with a constant acceleration and no initial velocity. Knowing that the velocity of collar A is 12 m/s as it passes through point L, determine the change in elevation, the velocity, and the acceleration of block B when collar A passes through L. **(7)**

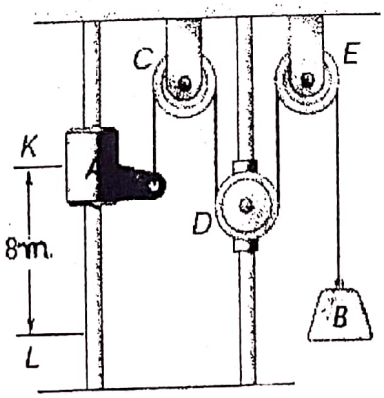

Figure for Q. 3(a)

(b) The two blocks shown start from rest. The horizontal plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord. (7)

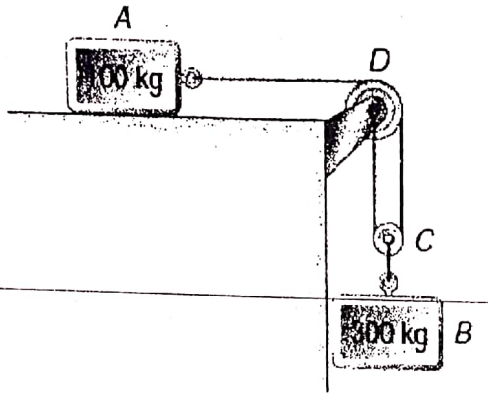

Figure for Q.3 (b)

7.(a) Define end effectors. Give the names of some common types of end effectors. (3)

(b) Write the names of different types of sensors that are commonly used in robot. (3)

(c) Describe the coordinate systems that are used in robot. (4)

(d) What do you mean by 'Degree of Freedom'? Show with a neat sketch the degrees of freedom of a typical human hand. (4)

04/05/15

Ahsanullah University of Science and Technology

Department of Mechanical and Production Engineering

Program: B.Sc. in Computer Science and Engineering

1st year 2nd Semester Final Examination (Fall 2014)

Course no- ME 1211 **Course Title: Basic Mechanical Engineering**

Time: 3 hours **Full Marks: 70**

[Use separate answer script for each section]

Section A

There are 3 (THREE) questions. Answer any 2 (TWO) questions.

Symbol and characters used in the questions have their usual meanings.

The figures in the right margin indicate full marks. Assume any reasonable data if necessary.

1. (a) Knowing that $\alpha = 55^\circ$ and the boom AC exerts on pin C a force directed along line AC, determine (i) the magnitude of that force, (ii) the tension in cable *BC*. [6]

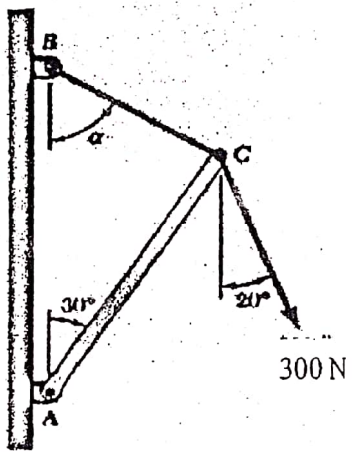

Figure 1(a)

1. (b) Determine the forces acting on members AB, DF, GD, GE of the Pratt roof truss. State whether those members are in tension or compression. [8]

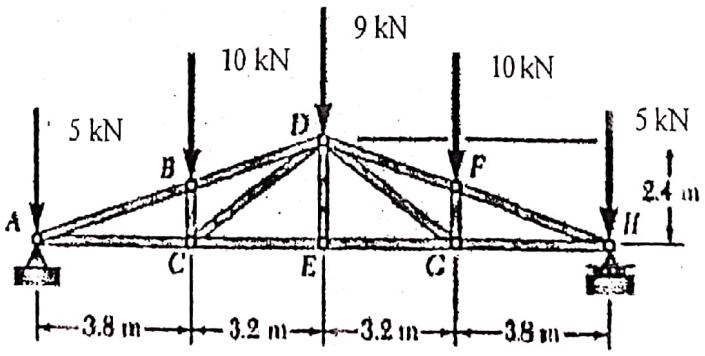

Figure 1(b)

2. (a) The motion of a particle is defined by the relation $x = 2t^3 - 15t^2 + 24t + 4$, where x is expressed in meters and t in seconds. Determine (a) when the velocity is zero, (b) the position and the total distance traveled when the acceleration is zero. [6]

(b) The two blocks shown in the **figure 2(b)** are originally at rest. Neglecting the masses of the pulleys determine (a) the acceleration of each block, (b) the tension in the cable. Assume the coefficients of friction between block A and the incline are $\mu_s = 0.25$, $\mu_k = 0.20$ [8]

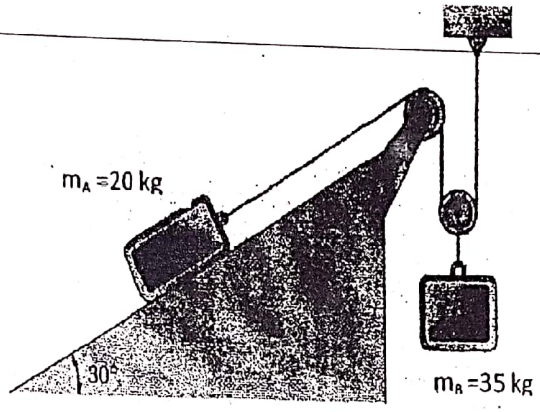

Figure 2(b)

3. **(a)** A light bar AD is suspended from a cable BE and supports a 25-kg block at C as shown fig.3(a). The ends A and D of the bar are in contact with frictionless vertical walls. Determine the tension in cable BE and the reactions at A and D [6]

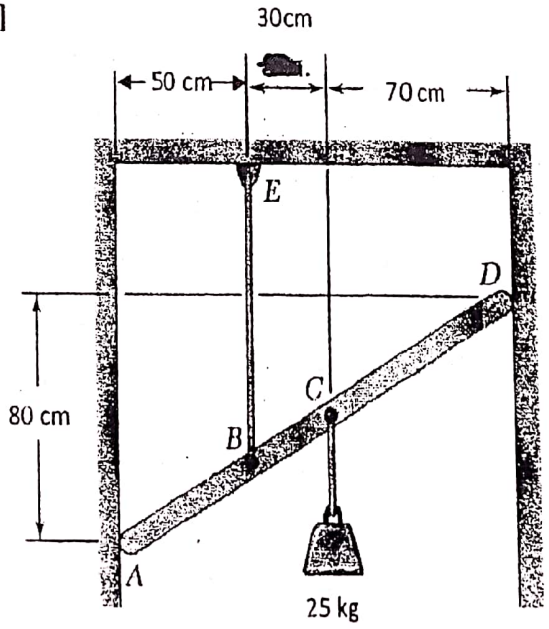

Figure 3(a)

3 (b) Block C in the **figure 3(b)** starts from rest at $t = 0$ and moves downward with a constant acceleration of 4 m/s^2. Knowing that block B has a constant velocity of 3 m/s upward, determine (a) the acceleration of each block, (b) the change in position of block C after 5 s. [8]

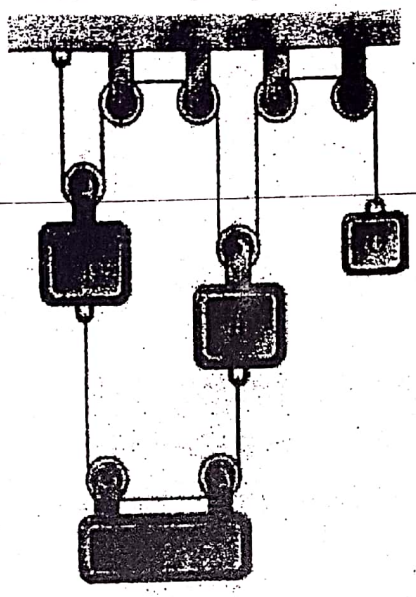

Figure 3(b)

Section B

There are FOUR Questions in this Section. Answer any THREE Questions.

The figures in the margin indicate full marks.
Assume reasonable values for missing data.
All symbols have their usual meaning.

Q.4 (a) What do you understand by ozone depletion? What are the effects of ozone depletion? (3)

(b) What are the different processes involved in a standard vapor compression refrigeration system? Show it on p-h and T-S diagram. (5)

(c) With a block diagram describe briefly the working principle of a vapor absorption refrigeration system. (4)

(d) An air conditioning unit working on vapor compression refrigeration system has got condenser-side temperature of 30°C and the coil-side temperature of -20°C. What is its COP? (2)

Q.5 (a) Draw the schematic diagram of central A/C system. (4)

(b) In an air conditioning system 3 kg of return air at 25° C and 60% relative humidity is mixed with 1 kg of fresh air at 40°C and 50 % relative humidity to form a mixture. By using the supplied psychrometric chart, determine the following of the mixture: (7)

(i) The relative humidity

(ii) The absolute humidity

(iii) The specific enthalpy

(iv) The specific volume

(v) The dry bulb temperature

(vi) The wet bulb temperature

(vii) The dew point temperature.

Attach the used psychrometric chart with your answer script.

(c) Briefly describe the cooling with dehumidification psychometric process with example. (3)

Q. 6 (a) Draw the major components of a reciprocating single cylinder petrol engine and label it. (4)

(b) Show the processes involved in air standard Otto cycle on P-V and T-S diagram and derive the equation for efficiency in terms of compression ratio. (4)

(c) The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke the pressure is 0.1 MPa and the temperature is 15° C. The heat transfer to the air per cycle is 2000 KJ/Kg. Assume the value of C_v is 0.7165 kJ/kgK. Determine: (6)

(i) the thermal efficiency, and

(ii) the pressure and temperature at the end of each process of the cycle.

Q. 7 (a) Define end effectors, give the name of some common type of end effectors. (3)

(b) Write the name of different type of sensors that are commonly used in robot. (3)

(c) Describe the coordinate systems that are used in robot. (4)

(d) What do you mean by 'Degree of Freedom'? Show with a neat sketch the degrees of freedom of a typical human hand. (4)