

07/03/17

# Ahsanullah University of Science and Technology

Department of Mechanical and Production Engineering

Program: B. Sc. In Computer Science & Engineering

1<sup>st</sup> Year 2<sup>nd</sup> Semester Final Examination (Fall 2016)

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

Full Marks: 70

Time: 3 Hours

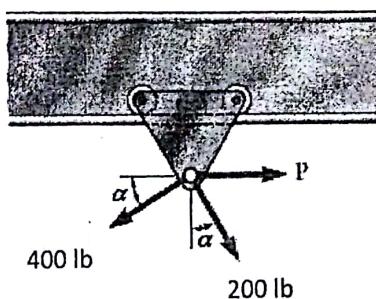
**USE SEPARATE SCRIPTS FOR EACH SECTION**

## **SECTION-A**

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

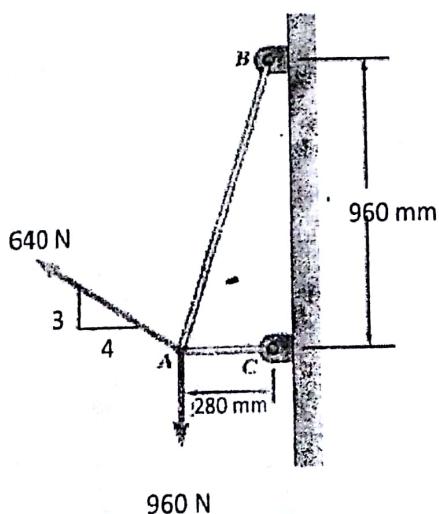
**All problem solutions must include a FBD**

- 1.a) A hoist trolley shown in figure 1(a) is subjected to the three forces as [6] shown. Knowing that  $P = 250$  lb., determine,  
(i) the required value of  $\alpha$  if the resultant of the three forces is to be Vertical,  
(ii) the corresponding magnitude of the resultant



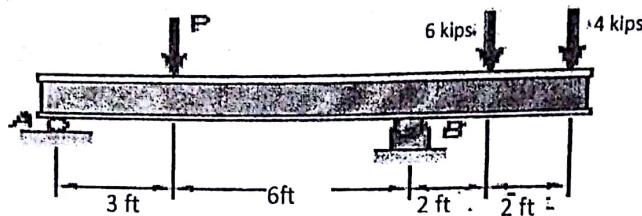
**Figure 1(a)**

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



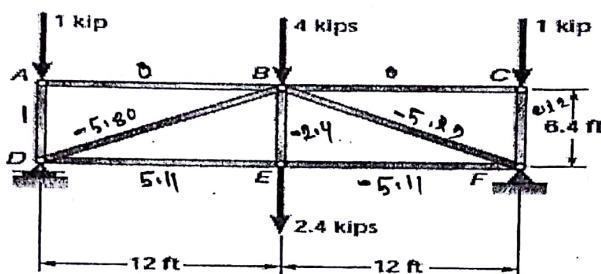
**Figure 1(b)**

- 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.



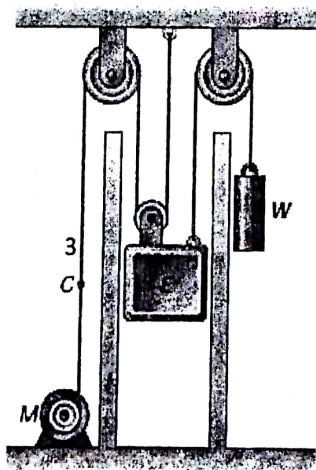
**Figure 2(a)**

- 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 [6] 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.

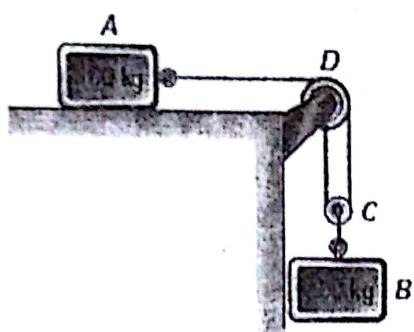


Figure 3(b)

### 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  $35^{\circ}\text{C}$  and the coil-side temperature of  $-20^{\circ}\text{C}$ . 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  $25^{\circ}\text{C}$  and 60% relative humidity is mixed with 1 kg of fresh air at  $40^{\circ}\text{C}$  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<sub>3</sub> + Cl<sub>2</sub> → ClO + O<sub>2</sub>*

- Q.6** (a) Draw the major components of a reciprocating single cylinder petrol engine (4) and label it.
- (b) Show the processes involved in air standard Otto cycle on P-V and T-S (4) diagram and derive the equation for efficiency in terms of compression ratio.
- (c) The compression ratio in an air-standard Otto cycle is 10. At the beginning of (6) 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:
- (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  
 1<sup>st</sup> Year 2<sup>nd</sup> Semester Final Examination (Spring 2016)

Course No: ME 1211  
 Time: 3 (three) hours

Course Title: Basic Mechanical Engineering  
 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 (4) of refrigeration system?
  - (b) What do you understand by ozone depletion? What are the effects of ozone (3) depletion?
  - (c) With a block diagram describe briefly the working principle of a vapor (4) absorption refrigeration system.
  - (d) A vapor compression refrigeration system has got condenser-side temperature (3) 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.  $\frac{P}{f}$

- 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 (4) the devices that are split as 'hot-side' and 'cold-side' in a split-type air-conditioning system?
  - (c) Briefly describe the cooling with humidification psychometric process with (3) example.
  - (d) The dry bulb and wet bulb temperature of the air in a room are 35° C and (4) 25°C respectively. By using the supplied psychometric chart, determine the following of the air:

- (i) The relative humidity 45%
- (ii) The absolute humidity 0.016
- (iii) The specific enthalpy 62
- (iv) The dew point temperature.  $21^{\circ} \text{C}$

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. (2)
- (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)

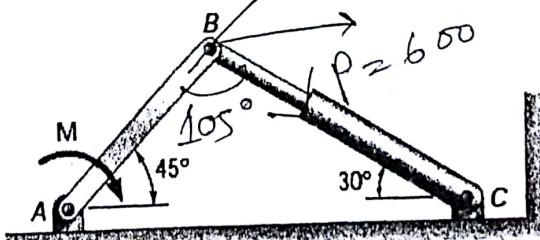


Figure for Q. 5(a)

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

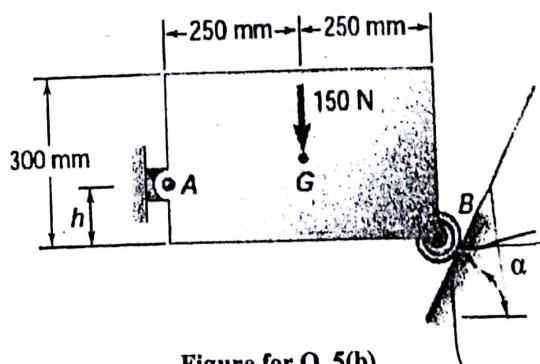


Figure for Q. 5(b)

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

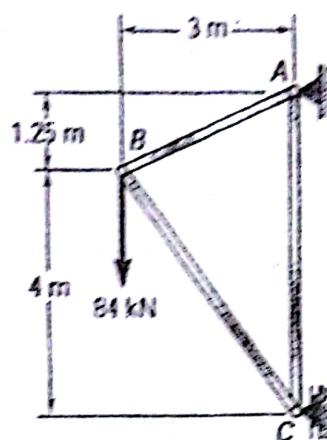


Figure for Q. 6

- 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)

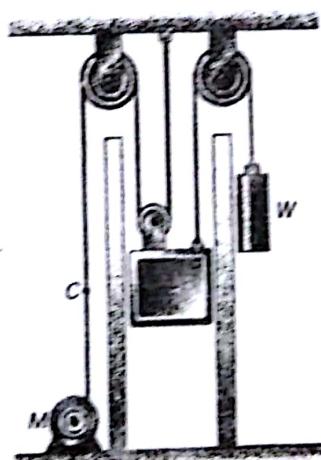


Figure for Q. 7(a)

- (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.

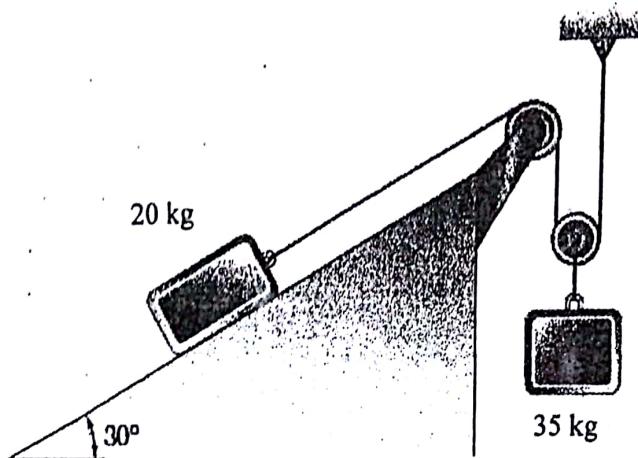


Figure for Q.7 (b)

Date: 21/03/16

## Ahsanullah University of Science and Technology

Department of Mechanical and Production Engineering

Program: B.Sc. in Computer Science and Engineering

1<sup>st</sup> Year 2<sup>nd</sup> 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 depends 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 (3)  
tension (i) in cable AC, (ii) in cable BC.

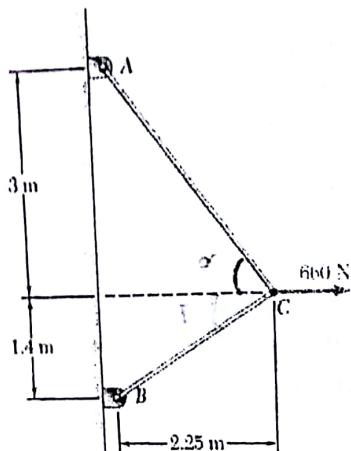


Figure for Q. 1(a)

- (b) A fixed crane has a mass of 1000 kg and is used to lift a 2400-kg crate. It is (4)  
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.

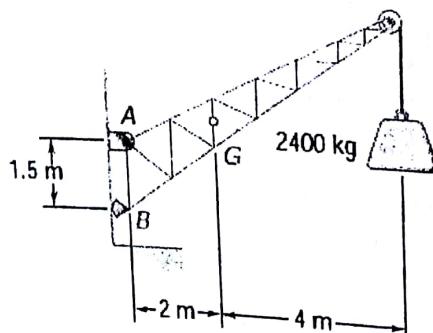


Figure for Q. 1(b)

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

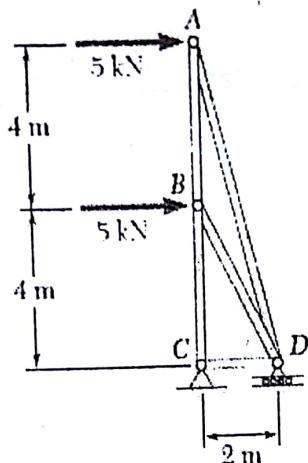


Figure for Q. 2

6. Collar A and block B are connected by a cable passing over three pulleys C, D, (7)

(a) 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  $3 \text{ m/s}$ . 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  $12 \text{ m/s}$  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.

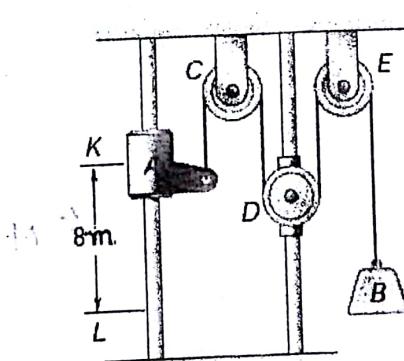


Figure for Q. 3(a)

- 7
- (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)

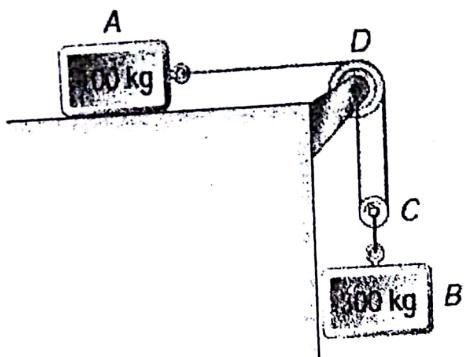


Figure for Q.3 (b)

- 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)

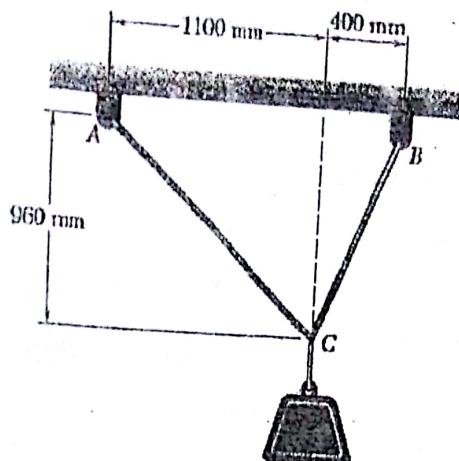


Figure for Q. 5(a)

- (b) Determine the reactions at A and C when  $\alpha = 90^\circ$ .

(8)

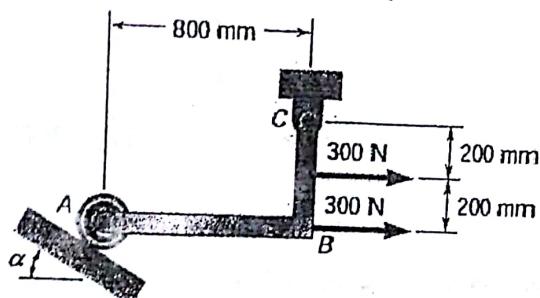


Figure for Q. 5(b)

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

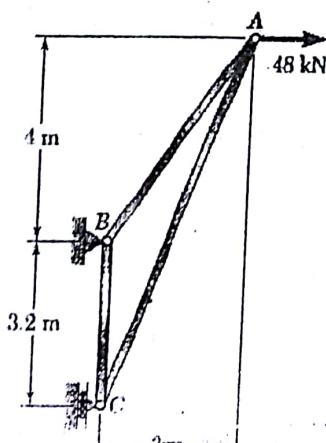


Figure for Q. 6

- 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)

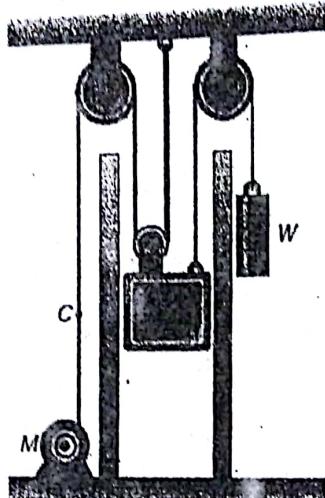


Figure for Q. 7(a)

- (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)

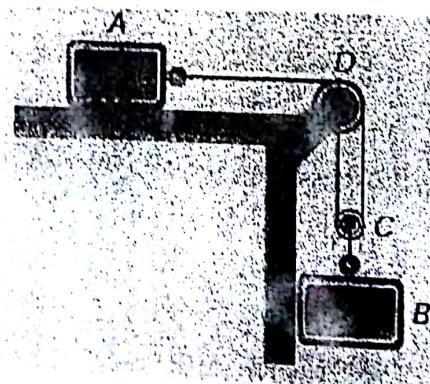


Figure for Q. 7 (b)

Q

9/05/16

**Ahsanullah University of Science and Technology**  
**Department of Mechanical and Production Engineering**  
**Program: B.Sc. in Computer Science and Engineering**  
**1<sup>st</sup> year 2<sup>nd</sup> Semester Final Examination (Fall 2014)**

Course no- ME 1211

Time: 3 hours

Course Title: Basic Mechanical Engineering

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.

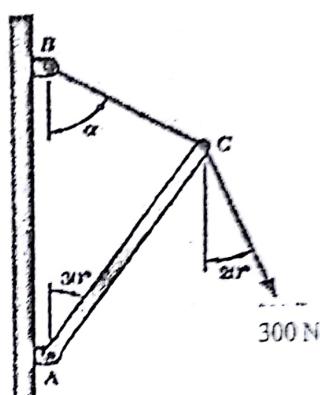


Figure 1(a)

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.

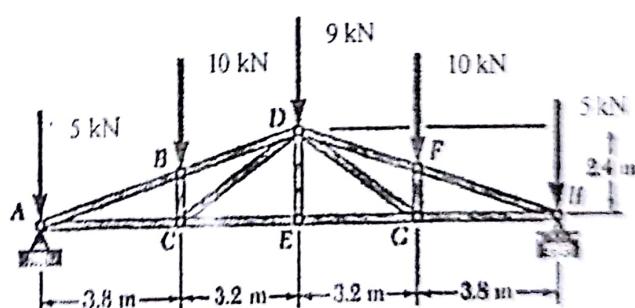


Figure 1(b)

Page 1 of 6

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]

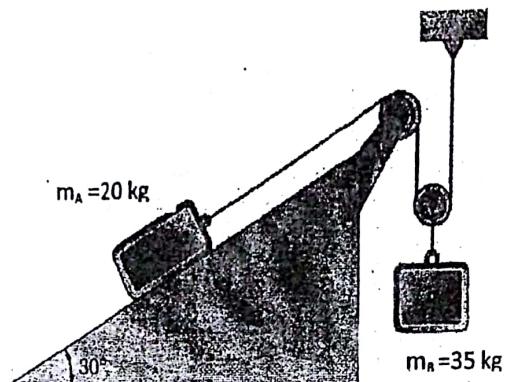


Figure 2(b)

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]

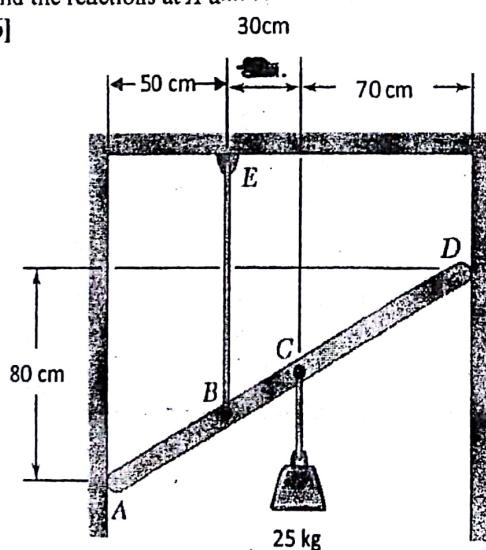


Figure 3(a)

Page 2 of 6

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

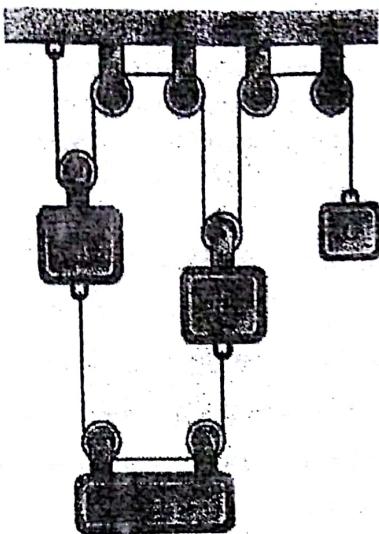


Figure 3(b)

$$x_C + (x_B - x_C) \rightarrow x_D$$

$$2x_C + v_B t \rightarrow x_D$$

$$a_C = 4$$

$$v_B = -3$$

$$v = u + a_C t$$

$$v(0)$$

$$v(t)$$

$$v(t)$$

$$v(t)$$

Page 3 of 6

Date: 09/09/2014

Ahsanullah University of Science and Technology

Program: B.Sc. in Computer Science and Engineering

1<sup>st</sup> Year 2<sup>nd</sup> Semester Final Examination (Spring 2014)

Course No: ME 1211  
Time: 3 (three) hours

Course Title: Basic Mechanical Engineering  
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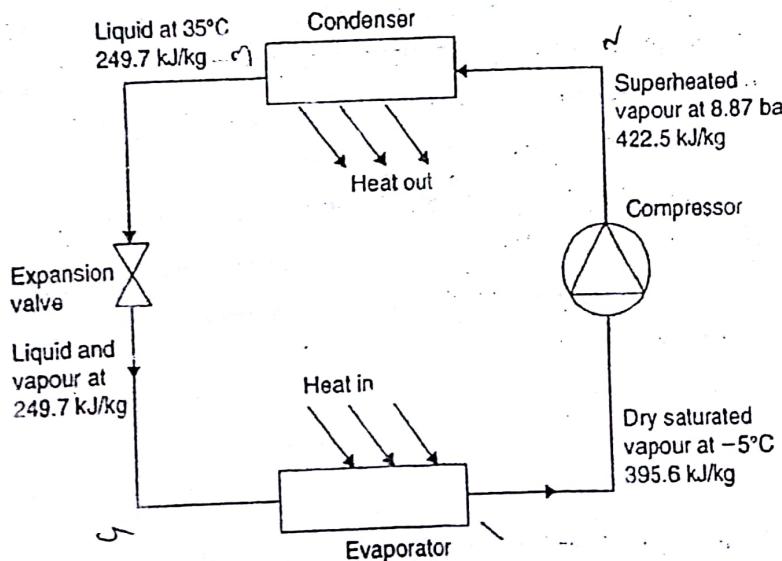
There are **SEVEN** Questions. Answer any **FIVE** Questions.

The figures in the margin indicate full marks.

Assume reasonable values for missing data.

All symbols have their usual meaning.

- Q.1 (a) Briefly describe the working principle of thermoelectric refrigeration system. (2)
- (b) What are the different processes involved in a standard vapor compression refrigeration system? Show these processes on p-h and T-s diagram. How COP can be calculated in this cycle? (5)
- (c) A Simple vapor compression cycle using R134a as refrigerant produces 50 kW of refrigeration effect. The value of the Enthalpy at different stages are given in the Figure. (5)



Estimate: (i) Coefficient of performance, COP  
(ii) Refrigerant mass flow rate, kg/s

- (d) Draw the schematic diagram of a two-cycle cascade refrigeration system. (2)

- Q.2 (a) What are the differences between air-conditioner, air-cooler and refrigeration system? (3)
- (b) Describe briefly the following psychometric processes with example: (4)
- (i) Cooling with Dehumidification      (ii) Cooling with Humidification
- (c) In an air conditioning system 4 kg of return air at  $20^{\circ}\text{C}$  and 60% relative humidity is mixed with 1 kg of fresh air at  $35^{\circ}\text{C}$  and 70% relative humidity to form a mixture. By using the supplied psychometric chart, determine the following of the mixture:
- (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.

- Q.3 (a) Show the processes involved in air standard Diesel cycle on P-V and T-S diagram and derive the equation for efficiency in terms of compression ratio. (4)
- (b) What are the functions of lubricating oil in internal combustion engine? (2)
- (c) The compression ratio in an air-standard Otto cycle is 8. At the beginning of the compression stroke the pressure is 0.1 MPa and the temperature is  $15^{\circ}\text{C}$ . The heat transfer to the air per cycle is 1800 KJ/Kg. Determine:
- (i) the pressure and temperature at the end of each process of the cycle,  
(ii) the thermal efficiency, and  
(iii) the mean effective pressure.

- Q.4.(a) What are the main components of a Robot and mention their functions. (6)
- (b) What are the joints that commonly used in robotics and briefly describe them. (3)
- (c) What are the advantages and disadvantages of Robot. (5)

- Q.5 (a) The hydraulic cylinder BD exerts on member ABC a force P directed along line BD. Knowing that P must have a 750-N component perpendicular to member ABC, determine (i) the magnitude of the force P, (ii) its component parallel to ABC.. (6)

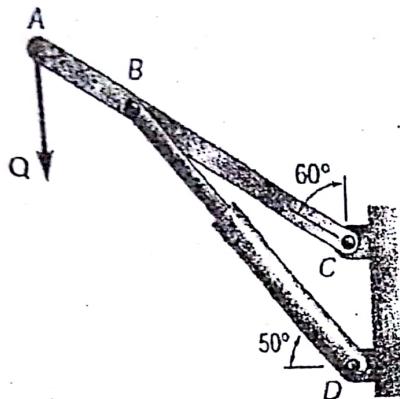


Figure for Q. 5(a)

- (b) Determine the reactions at A and C when  $\alpha = 0^\circ$ . (8)

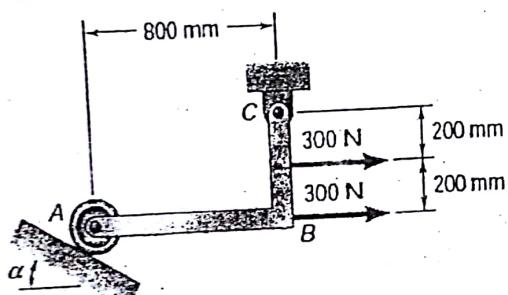


Figure for Q. 5(b)

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

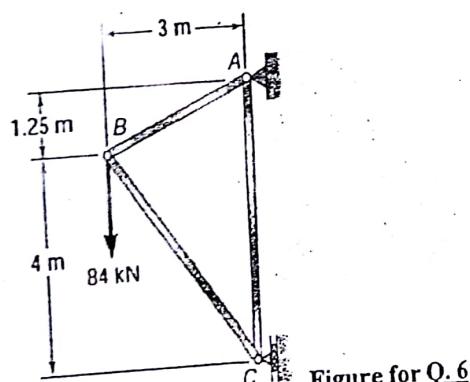


Figure for Q. 6

- 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)

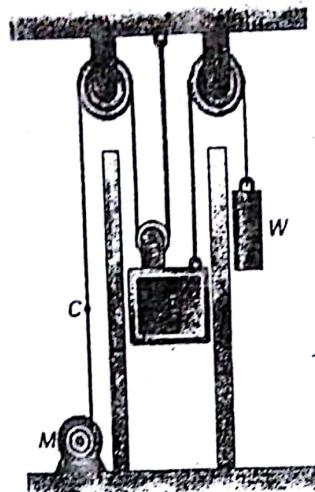


Figure for Q. 7(a)

- (b) The two blocks shown are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between block A and the incline, determine (i) the acceleration of each block, (ii) the tension in the cable. (6)

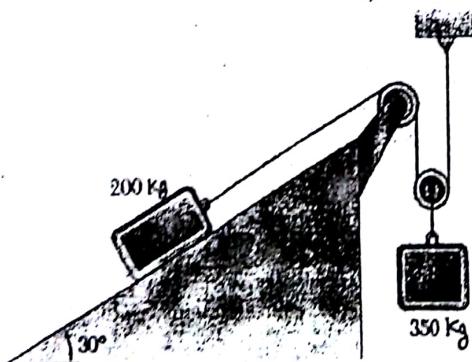


Figure for Q.7 (b)

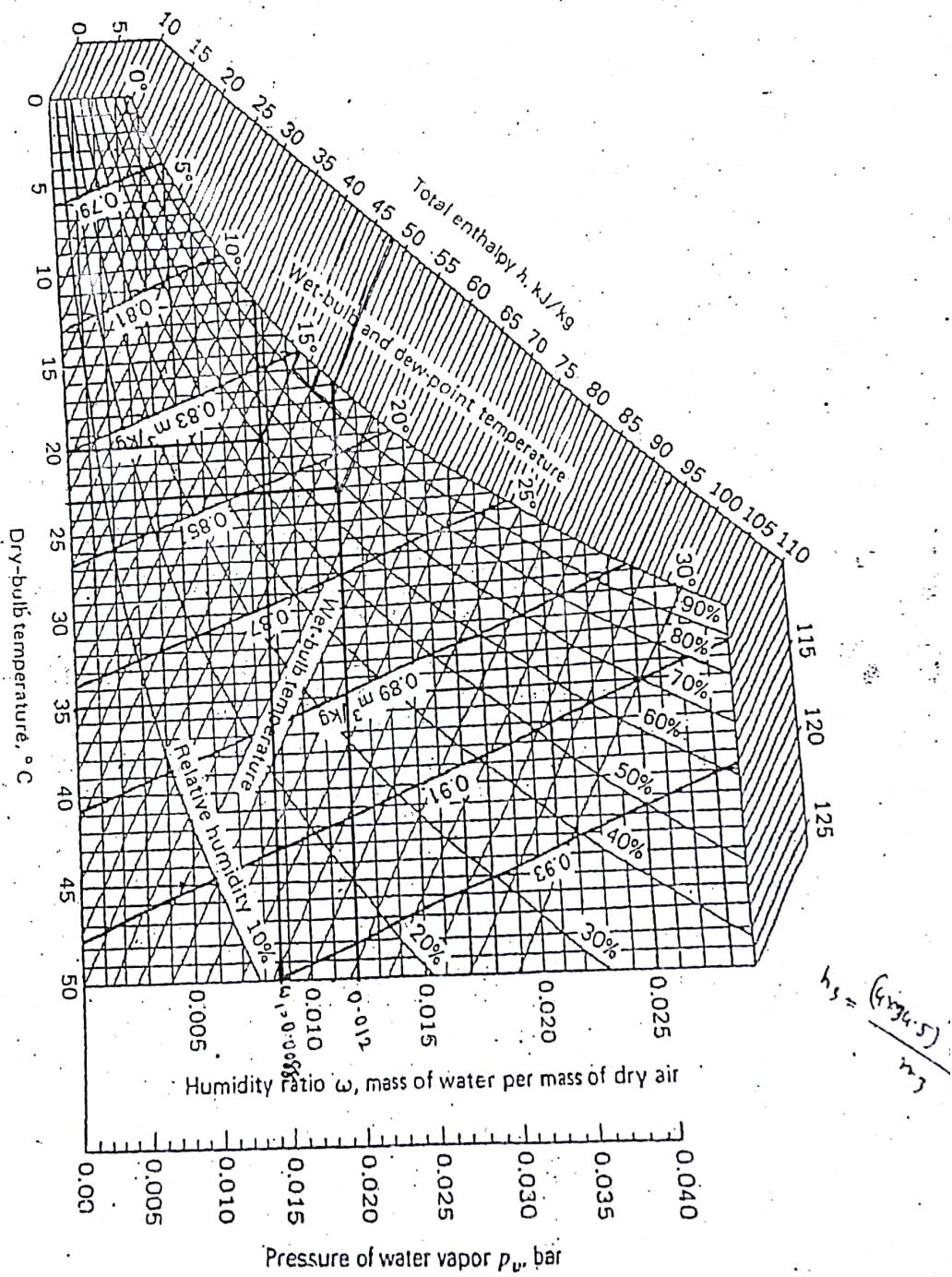


FIGURE A-25FM  
Psychrometric chart, metric units, barometric pressure 1.01 bars.