

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-III Regular Examination January 2011

Subject code: 730904

Subject Name: Design of Material handling Equipments

Date: 10 /01 /2011

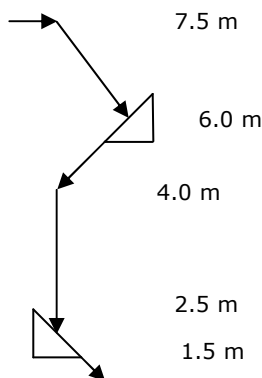
Time: 02.30 pm – 05.00 pm

Instructions:

Total Marks: 70

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What is the function of feeder in belt conveyor? Explain different types of feeder 07
based on their construction, mode of operation and applications.
- (b) Find the lump velocity at chute exit for the following application. Also find the equivalent 07
free fall height relative to chute exit point and relative to moving belt.
Lump mass = 12 kg
Lump discharge velocity = 2.5 m/s
Lump discharge = +7.5 m
Lump direct fall and 1st impact = 6.0 m
Lump slide down at 55° inclination to level = 4.0 m
Lump direct fall & 2nd impact at = 2.5 m
Lump slide down at 55° inclination to level = 1.5 m
Receiving belt conveyor velocity = 2.5 m/s
At each impact consider 65% loss of kinetic energy.



- Q.2** (a) What is the need of dust control system in belt conveyor? Explain dust suppression 07
equipment and dust extraction system used in belt conveyor
- (b) A hand operated wire rope hoist is to raise a load of 200 kg. The force on the 07
operating lever is limited to 20 kg and the rope is being wound on a drum of 25 cm
diameter. The effective length of the lever is 35 cm. Determine the number of ropes
leading to the hook block, the efficiency of the hoist and factor of safety of the
hoist, assuming that it is reefed with 15 mm-
6 x 37 wire rope. Assume for the wire rope $C = 1.076$ and hoisting block with five
sheaves.

OR

- (b) Suggest the suitable size of 6 x 19 hoisting steel wire rope for an inclined mine shaft of 1000 meter length and inclination of the rails 60° with the horizontal. The loaded skip weighs 10,000 kg. The maximum acceleration is limited to 1.5 m/s^2 . Diameter of the drum on which the rope is being wound may be taken as 80 times the diameter of the rope. The car friction is 20 kg/tonne of weight normal to the incline and friction of the rope on the guide roller is 50 kg/tonne of weight normal to incline.

The weight of the rope may be taken as $0.34 d^2 \text{ kg}$ where d is the diameter of the rope in cm. Assume factor of safety to be 6.

For 6 x 19 flexible hoisting rope assume

Breaking load in kg = $5100 d^2$

Diameter of wire in cm = $0.063 d$

Area of wire rope in $\text{cm}^2 = 0.38 d^2$

Modulus of elasticity of the rope material = $0.84 \times 10^6 \text{ kg/cm}^2$.

- Q.3 (a)** Decide the shaft diameter at coupling, bearing, hub and at the center of a drive pulley of 800 mm diameter and 1600 mm face width. **07**

Load assumption (during operation)

T_{1a} = Tight side tension = 10840 kg

T_{2a} = slack side tension = 3925 kg

Dead weight of pulley = 2000 kg.

Yield stress of shaft material = 275 Mpa

Ultimate tensile stress (UTS) = 560 Mpa

Bending stress = 0.36 UTS

Factor of safety = 2.5

Modulus of elasticity = $2.1 \times 10^6 \text{ kg/cm}^2$

Bearing center-center distance = 200 cm

Distance between two diaphragms = 133.5 cm

Distance between diaphragm and bearing center = 33.25 cm

Resultant load with greater than 180° wrap and horizontal.

Angle of wrap = 210° , rubber lagging = 12mm thick

Motor rpm = 1500

Gear ratio = 18, motor power = 350 KW,

Modulus of rigidity (G) = $0.84 \times 10^6 \text{ kg/cm}^2$

Length of shaft at coupling = 21.5 cm

- (b) Discuss the design procedure for bucket elevator. **07**

OR

- Q.3 (a)** Select a Suitable Gearbox ratio for Wagon Tippler drive unit as per the below data given. Also draw a line diagram (free-hand sketch) showing right from Electric Motor to End-Frame. **07**

(1) Tips per hour : 20 (DESIGN)

(2) End frame Pitch Circle Diameter : 7.272 Meter.

(3) Drive pinion Pitch Circle Radius : 0.216 Meter.

(4) Max tipping angle : 150 Degree.

(5) Open pair : 80:23 Teeth

(80 spur wheel teeth & 23 spur pinion teeth)

(6) ELECTRIC MOTOR : 960 rpm (TIPPING) 1500 RPM (During Return)

(7) Available gear box ratio are – 40, 45, 50, 56

ASSUME : Tipping time = 77 Sec. Return time = 45 Sec.

- (b) What is the importance of bucket elevator in material handling system? Enlist different types of bucket elevator and explain any one of them with neat sketch. **07**

- Q.4 (a)** What are the factors that must be considered for selection of material handling equipment? Also differentiate between unit load and bulk load. **07**
- (b)** Explain the need of idlers in belt conveyor of materials handling system. Explain trough impact idler, transition idler and rubber disc fitted return idlers with the help of neat sketches. **07**

OR

- Q.4 (a)** An incline conveyor handles an ore having $\rho = 1.5 \text{ t/m}^3$. The material has to be conveyed over distance of 2 km & a height of 450 m. If the belt speed is 120 m/min, then determine the standard width of 4 ply belt so that the material can be conveyed at a rate of 3 t/hr. Also determine the diameter & width of drive pulley & gear reduction ratio of motor, if motor speed is 1440 rpm. Assume the material for ply of belt has a material factor $K_1 = 2.5$ & the belt tension & arc of contact factor, $K_2 = 80$ Standard pulley diameters = 315,400,500,630,800,1000 mm For incline belt flowability factor is given in the table below. **07**

Conveyor inclination	10-15	16-20
Flowability factor, C1	2.65×10^{-4}	2.5×10^{-4}

- (b)** The Garland idlers are used instead of fixed frame idlers for certain application based on its characteristics. Justify the statement focusing the characteristics of garland idler. **07**

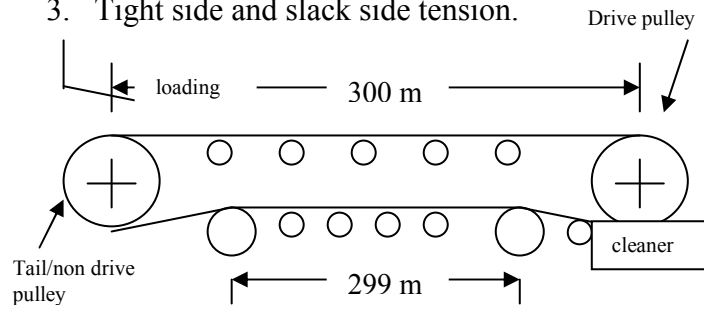
- Q.5 (a)** Define angle of repose and surcharge angle. What is the importance of the angle of repose and surcharge angle in the design of material handling equipments? **07**
- (b)** Explain at least four different ways of storing the bulk materials in material handling system. **07**

OR

- Q.5 (a)** A horizontal conveyor is used in transporting a mineral ore. The detail of the conveyor is shown in figure. The maximum capacity of conveyor is 225 tph, at belt speed of 2 m/s. Mineral ore has density of 800 kg/m^3 . A 3 ply belt is used for conveyor & the surcharge factor for the belt can be taken as 0.08. Mass of each idler can be assumed as 20 kg. **07**
- Assume the following data for the conveyor
- Friction factor for idler (f) = 0.025
 - Snub factor for both the snub pulley = 0.02
 - Snub factor for drive and tail pulley = 0.06
 - Material velocity along path of belt = 1 m/s
 - Circumferential velocity of the rotary brush cleaner $V_{\text{clean}} = 2 \text{ m/s}$
 - Cleaning factor = $5 \times V_{\text{clean}}$
 - Unloading resistance = $3.5 m_m g B$
 - Angle of wrap = 210°
 - Coefficient of friction between belt and drive pulley = 0.4
 - Ultimate tensile strength per unit width of ply = 60 N/mm
 - Drive efficiency = 93 %
 - Motor speed = 1440 rpm
 - Carrying idler pitch = 1.5 m
 - Approximate return idler pitch = 2 x carrying idler pitch
 - Pulley diameter = 125 times number of ply
 - Belt width = 1 m
 - Mass of belt (m_B) = 16 kg/m
 - Mass of material conveyed per unit length (m_m) = 31.25 kg/m

Determine

1. Number of carrying and return side idler pulley
2. Exact return idler pitch
3. Tight side and slack side tension.



- (b) What are the basic steps that must be taken into account in designing a package 07
whether it is a folding box, crate, corrugated shipping container or any other form.
Also differentiate between consumer packaging and industrial packaging.
