THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY

DIPLOMA IN TECHNOLOGY – LEVEL 04

FINAL EXAMINATION 2008/2009

MEX4231 / MED2202 – ELEMENTARY MACHINE DESIGN – PAPER II

DATE : 12th March 2009
TIME : 0930 hours to 1330 hours
DURATION : Four hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTION PAPER

This question paper has only one question, but it has several parts. Attempts all parts.

Spent 10 to 15 minutes to read carefully and understand the question.

Wherever appropriate, use catalogues, tables, data sheets and charts provided to you at the examination hall.

At the end of the examination, hand over all such literature to the supervisors or an invigilator. Do not write anything on these literatures.

Any missing data may be sensibly and reasonably assumed, provided that such data are clearly stated with reasons to accept them.

Any ideas/ opinions presented in the form of neatly drawn sketches are encouraged.

Present the calculations and answers to the questions neatly and clearly. Results from calculations should be presented with their correct units, unless they are dimensionless. All such answers should be underlined.

All rough work or/ and any information, which do not require the examiners attention should be cancelled by drawing a cross (X) on it.

It is important the candidates answer all parts of the question listed in that given order in the question.

Question

ABC construction (Pvt.) Ltd. decided to fabricate and assemble a mechanical hoist to lift construction material from ground level to next floor level of a building. The Figure D.1 shows the schematic view of the mechanical hoist, which ABC constructions are looking for. Following is a brief description of its arrangement.

Electric motor (a) supplies the mechanical power needed by the hoist to lift the load, and centrifugal clutch (b) mounted on the shaft of the electric motor prevents the rotation of the motor rotor when the hoist moves downwards. This centrifugal clutch engages with driver pulley (c). Power transmits through the pulley (c), which drives pulley (e) by a system of V – belt (d), to single speed reduction gear box (f), then through a chain drive system, of which the driving sprocket (g) drives the driven sprocket (i) by a roller chain (h) to rotate the drum (j), on the shaft of which the sprocket (i) is rigidly mounted. Around the drum the cable (k) winds and unwinds as the load moves up and down. The cable (k) runs over two V – grooved pulleys (m & n) and connects to lifting platform (p). These two V-grooved pulleys (m & n) are mounted on a vertical swivel shaft which is mounted on fabricated steel column (q). A Mechanical break system (l) is energized to apply brakes to control the downward speed of the lifting platform (p). The platform moves along the guide- ways mounted on the fabricated steel column.

Use the information given above and at the end, and answer the following questions.

1. Calculate the power requirement of the hoist and hence select a suitable motor for the machine.
2. Design the centrifugal clutch by considering the following requirements.
    - Engaging speed of the clutch is 50% of the working speed of motor.
    - The clutch should transmit the full working torque at 75% of the working speed of the motor.
    - Friction surface of the clutch is the inner surface of the drive pulley(c).
    - Number of contact shoes for the clutch – 4

3. Design a suitable V-belt drive system.
    - Specify the dimensions of driving and driven pulleys, centre distance between the two pulleys, the required number of V-belts and important parameters of the selected belts.
    - Determine the initial tension to be set up in the belt.
4. Design the gear drive assuming spur gear wheels and a suitable gear geometry.
    - Specify the gear module, wheel diameters considering economy is the required criterion for gear design. Gear teeth should have the required strength from the stand point of bending, wear and dynamic loading.
    - Sketch a schematic view of the shaft and wheel layout in the gear box proposing and identifying the requirements to have bearings, keys, snap rings oil seals etc.
5. Select a suitable sprocket and chain system to couple gear box and cable drum.
6. Design the shafts on which the driver and driven gears are mounted inside the gear box.
7. Select suitable bearings to mount the cable drum.
8. Sketch a suitable mechanical breaking system to control the downward motion of the lifting platform.

Following Data are given

Diameter of cable-drum – 800 mm

Maximum speed of lifting platform in both directions – 0.5 m/s.

Maximum working load on lifting platform – 10,000 N.

Weight of lifting platform – 500 N.

Maximum acceleration of the lifting platform during its upward motion – 0.03 m/s^2.

Centre distances between the two pulleys and two sprockets has to be in the range of

0.4 – 0.6 m.

The mass of the drum may be considered as 5% of the maximum load to be lifted.

Power Losses:

Belt drive – 5%

Gears – 4%

Chain drive – 8%

Speed Ratios:

For belt drive: 7 - 8

Spur gears : 1 - 10

Chain drive : 5 - 7

Coefficient of friction for clutch and brake material – 0.25

Service Conditions: 8- 10 hrs operation under heavy shock conditions

Note:

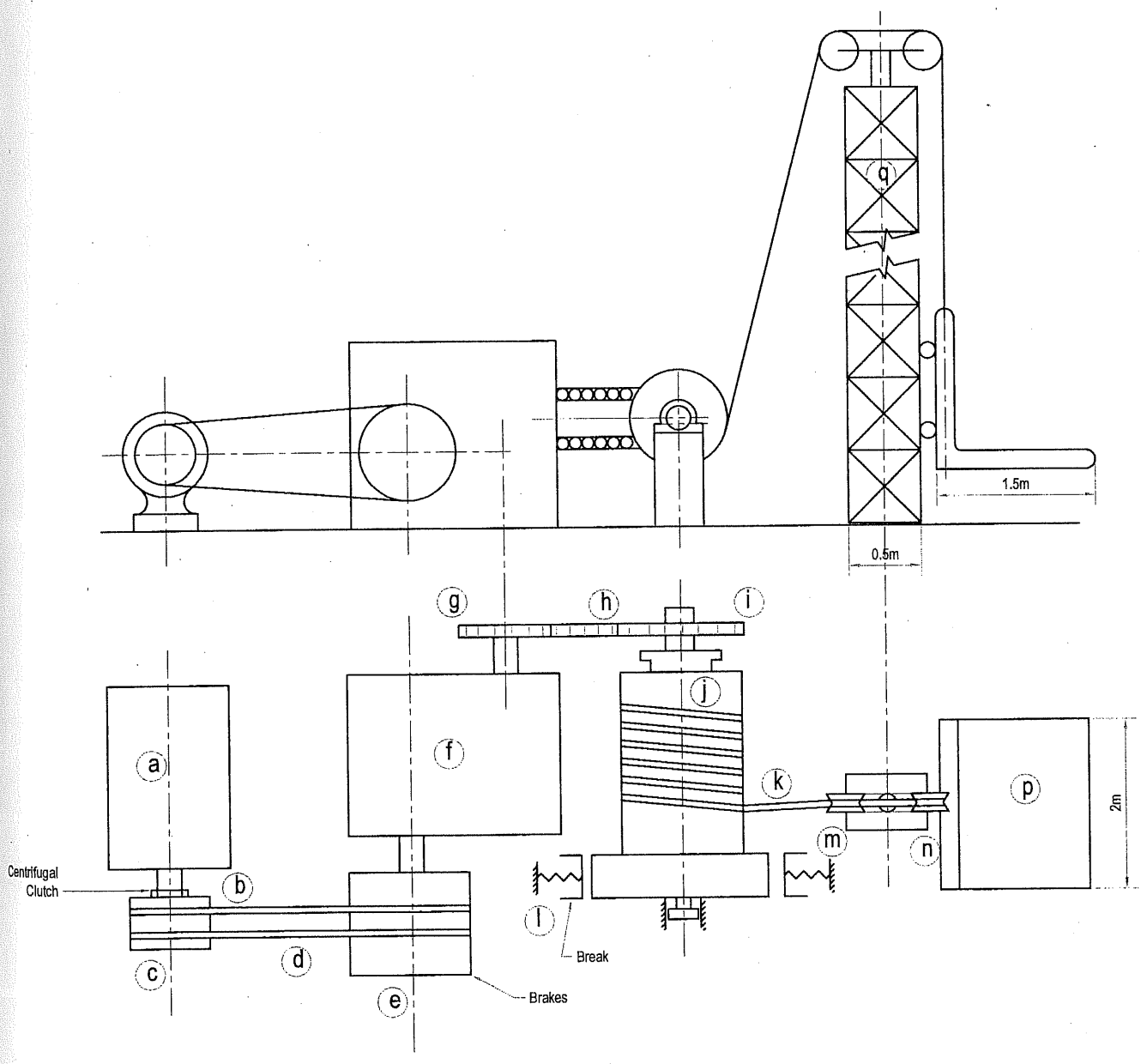
Do not attempt to design the steel column, lifting platform and guide-ways etc. due to time constraints.

When there are no keyways for shafts of whose materials have definite specifications, the design stresses are as follows.

Design value of the shear stress = 0.3 x Yield stress in tension
0.18 x Ultimate stress in tension
(Select the smaller value)

Design value of the normal stress = 0.6 x Yield stress in tension
0.36 x Ultimate stress in tension
(Select the smaller value)

If there are keyways present these values are to be reduced by 25%



MECHANICAL HOIST