NATIONAL UNIVESITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF TEXTILE TECHNOLOGY

END OF SECOND SEMESTER EXAMINATIONS – MAY 2011

TXT 1209: TEXTILE MECHANICS

TIME: 3HOURS

TOTAL MARKS: 100

INSTRUCTIONS

Answer **ALL Parts of Question ONE** in Section A and **ANY THREE** questions from Section B**.** Section A carries **40 marks** and Section B carries **60 marks.**

SECTION A

QUESTION 1

1. (a) Briefly explain the working principles of a hydro-extractor with the aid of relevant mathematical expressions and a diagram. **(5)**

   (b) A hydro-extractor consists of a perforated shell of diameter 80cm, mounted on a vertical spindle and rotating at 300rev/min. With what force will 1kg of yarn press against the inside of the drier? **(4)**

   (c) In a loom producing plain weave fabric, one held shaft is lifted 12cm, and the other one simultaneously lowered the same distance, in a quarter of a second. If the crankshaft turns through exactly half a revolution in the process, calculate the relative velocity of the warp threads controlled by the shafts, as they pass one another at the centre of the shed, assuming exact S.H.M is taking place. **(5)**

   (d) Briefly explain the following giving relevant examples in textile mechanisms.
   - (i) Damped oscillations. **(5)**
   - (ii) Forced oscillations. **(5)**

   (e) A screw of pitch 2.5cm is worked by a lever 2.2m in length. If a force of 15N, applied at the end of the lever is just sufficient to raise a mass of 450kg, Calculate:-
   - (i) The velocity Ratio **(2)**
   - (ii) The efficiency **(2)**

(iii) The work done by the effort in raising the mass 10cm. (2)

(f) Explain the following giving relevant mathematical equations as applied in textile mechanics.

(i) Principle of a moment (5)

(ii) Parallel axis theorem. (5)

SECTION B

QUESTION 2

2. (a) Write brief notes on any two of the following power transmission ways:-

(i) Belt drives

(ii) Worms

(iii) Ratchets (10)

(b) It is found that a light helical spring stretches 3cm when a 3kg mass is suspended from it. The spring is subsequently suspended, in its un-stretched state, from a fixed point and a mass of 5kg is suddenly hooked on it. Calculate:-

(i) How far the spring descends. (2)

(ii) The spring tension at the lowest point. (2)

(iii) The periodic time of oscillation. (2)

(iv) The length of the simple pendulum that would have the same period. (4)

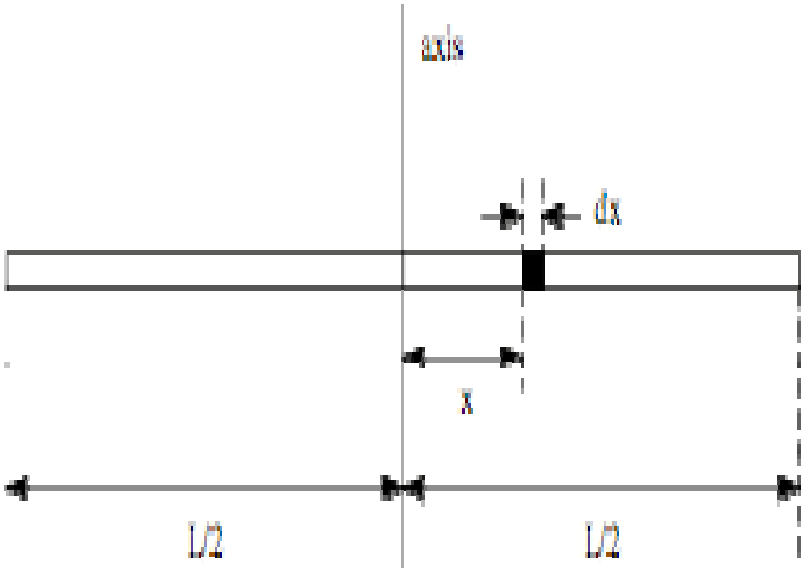
3. (a) A sphere of mass 20kg, moving at 8m/s, overtakes and collides with a second one of mass 40kg, travelling at 5m/s along the same straight line. Find the velocities of the two after impact and the kinetic energy loss in each case.

(i) If collision is perfectly inelastic.

(ii) If the collision is perfectly elastic.

(iii) If the coefficient of restitution is 0.5

(b) (i) Consider a rod of length L and mass m. What is the moment of inertia with respect to an axis through its center of mass? [5]



(iii) Using the Parallel axis Theorem, Find the moment of inertia with respect to an axis through its center of mass? (5)

4. (a) (i) What do you understand by the term Equilibrium. (2)

(ii) State fully the two conditions for Equilibrium, giving a mathematical expression for each. (6)

(b) The weighting uniform lever for a loom let-off is 50cm in length, pivoted at one end, and supported by a chain placed 10cm from that end. If the mass of the uniform lever is 2kg and masses 8kg and 12kg are placed 40cm and 45cm respectively, from the fulcrum.

(i) Draw a diagram showing all the forces acting on the lever. (4)

(ii) Find the tension in the chain. (4)

(iii) What will be the tension in the chain if it is moved to the 25cm mark from the pivot. (4)

5. (a) A heavy flywheel of radius 20cm is set into motion by exerting a driving tension of 40N in a belt passing round its circumference. If the flywheel reaches its operating speed of 150rev/min in 10s from rest, Calculate:-

(i) Its moment of inertia. (3)

(ii) Its rotational kinetic energy. (2)

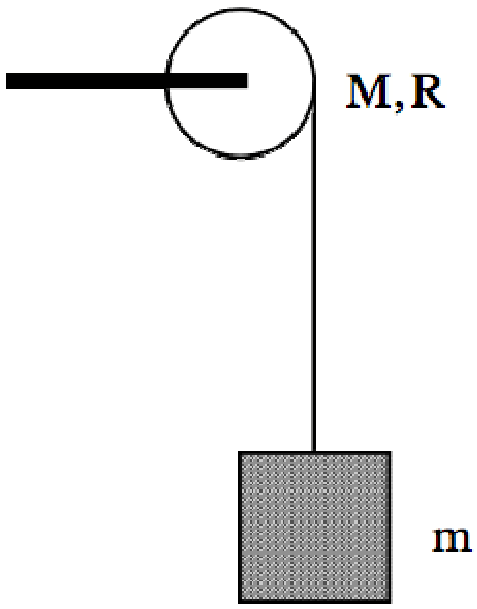
(b) Describe briefly each of the Damping categories. Represent all the three on a single displacement time graph.

(i) Under damping (5)

(ii) Critical damping (5)
(iii) Over damping (5)

6. (a) Describe the three classes of lever systems. (4)

(b) Consider a uniform disk with mass M = 5kg and radius R= *20cm*. The disk is mounted on a fixed axle. A block with mass *m=2kg* hangs from a light cord that is wrapped around the rim of the disk. [$I = ½(MR^2)$]



Find the:-

(i) Acceleration of the falling block (4)
(ii) The angular acceleration of the disk (4)

(iii) The tension of the cord. (4)
(iv) The rotational kinetic energy of the disk (4)

THE END