NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF TEXTILE TECHNOLOGY
END OF SEMESTER EXAMINATIONS APRIL 2009
TXT 2109 – TEXTILE MECHANICS
TIME: 3 HOURS

INSTRUCTIONS

ANSWER **ALL** PARTS OF QUESTION 1 IN **SECTION A** AND **ANY THREE** QUESTIONS FROM **SECTION B**. SECTION A CARRIES **40 MARKS** AND SECTION B CARRIES **60 MARKS**.

SECTION A

1. (a) (i) Differentiate between speed and velocity. **[2]**

(ii) A yarn of linear density 40tex is wound onto an empty package continuously for 20 minutes. At the end of this time, the mass of the yarn on the package is found to be 49g. Calculate the winding speed and the diameter of the delivery rollers used in the winding if they are running at 600rev/minute. **[4]**

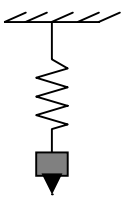
(b) The beater blade of a scutcher revolves at 1500 rev/min in a circle of radius 30cm. Calculate:

(i) the angular speed in radians per second.
(ii) the linear speed of the end of the blade; and
(iii) the linear speed of the drive belt if the driving pulley on the shaft is 35cm in diameter. **[6]**

(c) (i) In textiles, there exists both useful friction and inconvenient friction, what is the difference between the two? Give an example of each. **[4]**

(ii) A leather brake is held against the rim of a 40cm diameter pulley by a 15kg load. If the coefficient of kinetic friction is 0.45, calculate the power used in braking if the pulley speed is maintained at 150rev/minute. **[2]**

(d) For an object of mass m attached to a spring of spring constant k and executing S.H.M as shown in the diagram below:



Show that:

(i) the sum of potential energy and strain energy at maximum elevation is equal to the maximum strain energy of the spring at the position of lowest elevation (reference level). **[5]**

(ii) Show that maximum velocity for the system is given by $V_{max} = s\sqrt{\frac{k}{m}}$, where the symbols have their usual meanings. **[5]**

(iii) Show also that the angular velocity w is given by $w = \sqrt{\frac{k}{m}}$. **[2]**

(iv) A mass of 6kg suspended from a spring extends it 30cm. If the mass is pulled down a further 2cm and released, find the periodic time of the motion and the highest speed of the mass. **[6]**

(e) (i) Define stress and strain. **[2]**

(ii) A piece of wire of length 3m and cross-sectional diameter of 0.8mm is loaded with a bob of mass 2kg to make a plumb line. The extension caused is found to be 0.72mm. Calculate the modulus of elasticity in the wire. **[2]**

SECTION B

2. (a) Explain the application of the principle of centripetal force in hydro-extraction in the textile industry. **[10]**

(b) A Hydro-extractor has a perforated shell of diameter 88cm, mounted on a vertical spindle and rotating at 320rev/min. With what force will 2kg of yarn press against the inside of the dryer? **[5]**

(c) Define the following quantities for a machine.

(i) mechanical advantage(M.A)

(ii) velocity ration(V.R)

(iii) machine efficiency **[5]**

3. (a) Explain the concept of the "Law of the machine", you could possibly include graphical illustrations in your explanation. **[10]**

(b) The load and effort of a sheaved pulley system with a velocity ratio (V.R) of 4 were measured at various values of load and found to be as set in the table below:

Load(N)	0	50	100	150	200	250	300
Effort (N)	14.2	28.9	42.3	57.8	71.2	86.7	100.1

Derive the law of the machine and find the resistance to motion of the moving parts. **[10]**

4. (a) What is the period of a simple pendulum 1m long when $g = 9.81 m/s^2$ **[1]**

(b) Suggest how one may use the simple pendulum to measure the magnitude of acceleration due to gravity (g) on a location on earth. Use relevant equations in your suggestion. **[5]**

(c) How would you use a simple pendulum as a clock? **[4]**

(d) By means of a graph, illustrate
(i) underdamping
(ii) critical damping
(ii) overdamping **[3]**

(d) An underdamping pendulum is set in motion by releasing it from an angular displacement of 0.8rad. After it has completed two oscillations its angular displacement is 0.5rad.What is its predicted angular displacement after 7 oscillations? **[7]**

5. (a) Show that for mass attached by a string to fixed point so that its motion describes a conical pendulum, the height of the cone of revolution depends only on acceleration due to gravity (g) and the angular velocity (w). **[6]**

(b) A mass is suspended by a string of length 40cm. It is rotated from a fixed point at a rate of 40rev/min. Find the diameter of the circle; center O that is the locus of the movement of the mass. **[6]**

(c) Explain with the help of an illustration how the conical-pendulum principle can be used for speed regulation on engines **[8]**

6. (a) Find the minimum force needed to move a packing case of mass 45kg along a horizontal surface if $\mu = 0.25$. **[4]**

(b) The line-shaft bearings in a mill absorbs 5% of the engine output of 0.75MW in friction .If ball-bearings would reduce friction to one-tenth of its existing value, what annual saving in power cost would result from the use of ball-bearings if it is assumed that there are 2000 running hours per year and the cost is 8.5 cents per kilowatt-hour? **[8]**

(c) If the force between the bottom of a loom shuttle and the race board is equal to its weight and, in addition, the side of the shuttle presses against the reed with force equal to twice the shuttle weight, what is the total resistance to shuttle movement if $\mu = 0.4$ between shuttle and raceboard and 0.3 between shuttle and reed? What will be the retardation of the shuttle if its resistance acts on it during its passage between the shuttle boxes? **[8]**

END OF QUESTION PAPER