0026

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Textile and Apparel Technology

Study Programme	:	Bachelor of Science Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**TAX7369 – Engineering Aspects of Weaving**
Academic Year	:	2024/25
Date	:	26th January 2026
Time	:	13.30-16.30 hr
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This is a closed-book test (CBT).
3. Write your index number on all the pages of the answer script.
4. This question paper consists of **EIGHT (08)** questions across **seven (07)** pages.
5. Answer **QUESTION 1 (a to g), which is COMPULSORY**, and **ANY FIVE (05)** questions from Questions 2 to 8. Question 1 carries 25 marks, and each of Questions 2 to 8 carries 15 marks.
6. Do not answer the additional questions.
7. Start each question on a new page.
8. Write the numbers of the answered questions on the cover page of the answer book.
9. Write your answers in clear handwriting.
10. Do not use a red pen for writing your answers.

Question 1 **COMPULSORY QUESTION**

a) Why does the winding ratio (number of coils per traverse) decrease with increasing package diameter in random cross winding, and how does this limit the maximum stable package diameter? (3 marks)

b) What is a closed precision wound package, and why is it suitable for smooth, low-hairy yarns but not for rough, hairy yarns? (3 marks)

c) Define linear gain (g) in precision winding and explain its significance in preventing yarn coil overlap and improving package stability. (3 marks)

d) Figure 01. Shows the top elevation of surface yarn coils wound on a closed precision wound structure. Calculate linear gain (g).

(Yarn diameter (d) = 0.7 mm, angle of wind (β) = 30°).

(3 marks)

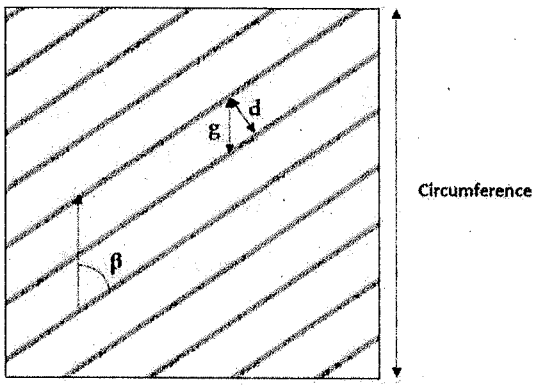


Figure 01.

e) List down five (05) factors that affect productivity and efficiency in the winding department. (5 marks)

f) State the principle of sectional warping and list three (03) of its main advantages. (4 marks)

g) Briefly explain the effect of size concentration on size pick-up during sizing and weaving performance. (4 marks)

Answer ANY FIVE (05) questions from Questions 2 to Question 8.

Question 2

Figure 02. shows a random cross-wound package. Based on Figure 02. Answer the following questions.

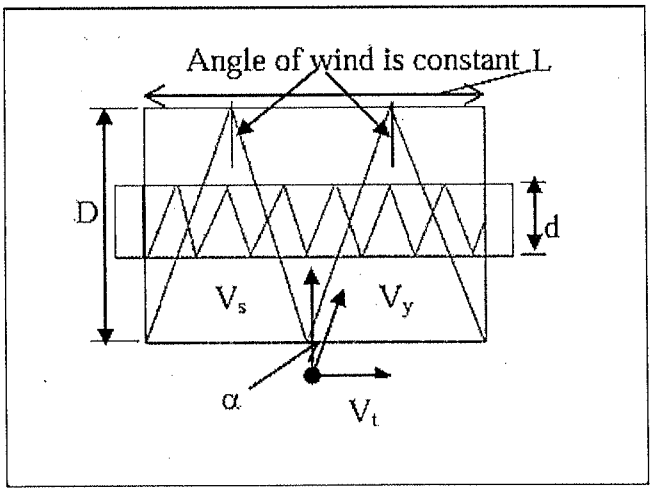


Figure 02.

a) Briefly explain the principle of random cross-winding and state the significance of maintaining a constant angle of wind during package build-up. (5 marks)

b) Derive expressions for the following (6 marks)

I) The angle of wind on the empty tube of diameter d with wind w_1.

II) Maximum package diameter D_{max} with respect to wind w_1 and the wind at maximum diameter, w_2.

c) A random cross-wound package is wound on an empty tube of diameter d= 4cm with a wind of w_1=12 coils per traverse.
If the minimum wind required for package stability at the maximum diameter is 4 coils per traverse, calculate the maximum possible package diameter D_{max}.

(4 marks)

Question 3

a) A weaving factory has received an order for 150 pieces of woven fabric, each of 80 m in length and 1.5 m in width. The linear density of the warp yarn is 30 tex, and a warp crimp of 10% is expected in the finished fabric. The maximum warp length that can be wound onto a weaver's beam is 900 m. Calculate:

I. The total length of fabric to be produced.
II. The number of weaver's beams required. (4 marks)

b) If each weaver's beam is required to contain yarn for 8 pieces of fabric, calculate:

I. The length of warp to be wound onto each beam, assuming 6 m of warp is wasted during each looming operation.
II. The number of warp threads on each weaver's beam, assuming no selvedge yarns and a warp density of 28 ends/cm in the finished fabric. (5 marks)

c) A direct warping machine with a creel capacity of 700 packages is available. If one creeling is sufficient to prepare all the weaver's beams, calculate:

I. The number of back beams required
II. The number of ends on each back beam
III. The length of warp on each back beam
IV. The mass of yarn to be available on each supply package, assuming 1.5% additional yarn is provided on each package. (6 marks)

Question 4

a) Discuss the effect of sizing on weaving performance with special reference to warp end breakages, explaining how the suitability of the sizing recipe, optimum size percentage, and warp stretch (residue elongation) influence weaving efficiency. (4 marks)

b) Define the following sizing terms and give their mathematical expressions:

I. Size concentration
II. Size take-up
III. Size percentage
IV. Moisture regain (4 marks)

c) A 30 Tex cotton warp containing 2500 ends has 13% size added. In each kilogram of size paste, there are 70 g of solid ingredients (oven-dry mass). Consider 1 km of warp fed to the size box has a moisture regain of 7%. Calculate the mass of size paste to be taken up from the size box. (7 marks)

Question 5

a) What is the difference between a symmetric and an asymmetric warp shed, and how can the asymmetry of a shed be controlled in a weaving machine? (6 marks)

b) Figure 03. shows a warp shed. Explain how the geometry of the shed affects the elongation and frictional stroke of warp yarns at the heald eye during weaving. Derive the related equations to support your explanation and discuss their impact on warp yarn tension, stress, and the quality of the fabric produced.
(9 marks)

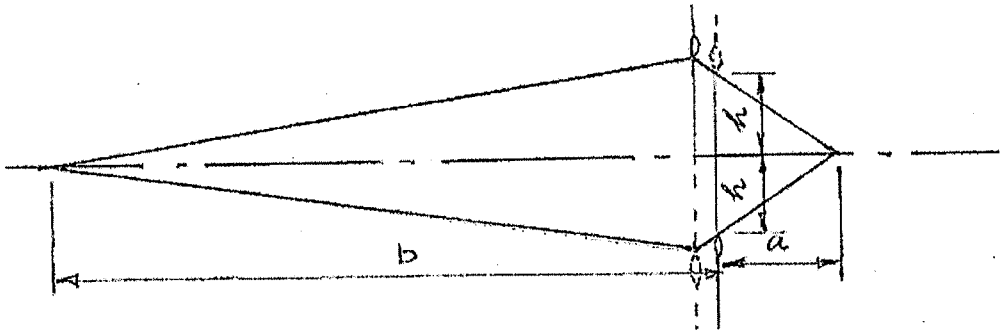


Figure 03.

Question 6

a) What is meant by ballistic weft insertion in weaving? (4 marks)

b) Figure 04. shows the velocity/time diagram of a projectile of a Sulzer weaving machine. (11 marks)

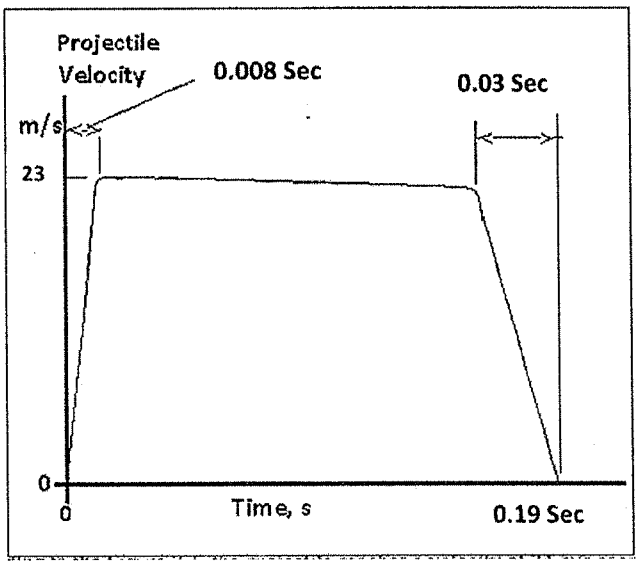


Figure 04.

A projectile in a Sulzer weaving machine reaches a velocity of 23 m/s within 0.008 s (acceleration time) immediately after the picking action. The projectile then travels across the shed, experiencing slight velocity loss due to air resistance and weft tension, and braking (checking) of the projectile takes place over 0.03 s. The total time available for the flight is 0.19 s. Assuming the projectile travels at an average velocity of 23 m/s during the flight, calculate the following:

I. The average acceleration during picking,
II. The retardation during checking (assume that there is no drop in velocity),
III. The distance traversed by the projectile and
IV. The speed of the machine (RPM) if the weft insertion corresponds to 172° of crankshaft rotation.

Question 7

a) Figure 05. Shows a drum accumulator used in air jet looms. Explain the purpose and working principle of a drum weft accumulator used for air-jet weaving. (6 marks)

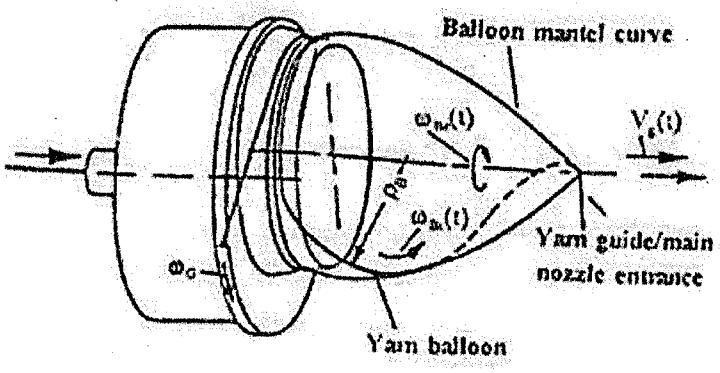


Figure 05.

b) Describe the different forces acting on the yarn during weft withdrawal from a **drum accumulator** in an air-jet loom, with reference to frictional resistance, centrifugal forces, air resistance, and Coriolis effects. (9 marks)

Question 8

In an air-jet weaving machine, the weft yarn is accelerated in the **main nozzle** by a high-velocity air stream acting along the yarn axis.

a) Explain the mechanism by which the air flow in the main nozzle produces the tractive force required for weft propulsion. (4 marks)

b) Explain the two main components of tractive force acting on the yarn in the main nozzle, namely frictional drag and body resistance. (5 marks)

c) Using appropriate equations, express the frictional drag force $F_{mn,1(t)}$ and the body resistance force $F_{mn,2(t)}$, and explain the physical significance of each term in the equations. (6 marks)