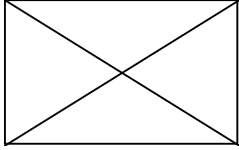
TEXTILE TESTING-I, SEMESTER-IV

BOOKS RECOMMENDED:

Name	Author	Publishers
Physical Testing-I & II	Angappan & R Gopalakrishnan	SSM Instt. Of Textile Technology, Komarapalayam
Physical Testing of Textiles	B. P. Saville	
Testing and Quality Management	Kothari	IAFL, New Delhi
Principles of Textile Testing	J. E. Booth	

TEXTILE TESTING

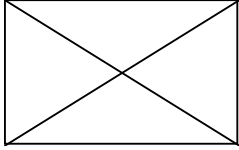


- **Testing can be defined as the process of determining the properties of different kinds of substances.**

- **Textile Testing is the process of determining the properties of different kinds of Textile substances.**

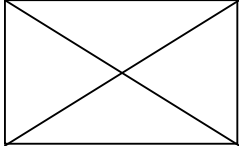
- **Types of Testing:**
  - **Routine process testing**
  - **Quality record testing**

Objectives of Testing



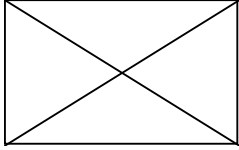
- Checking the quality and suitability of raw material and selection of material.
- Monitoring of production i.e. process control.
- Assessment of final product, whether the quality is acceptable or not
- Investigation of faulty materials (analysis of customer complaint, identification of fault in machine etc.).
- Product development and research.
- Specification testing: Specifications are formed and the materials are tested to prove whether they fall within the limits allowed in the specification (e.g. specified by a customer).

Factors Affecting Test Result



- **Atmospheric conditions during test.**
- **Method of test.**
- **Testing instruments used.**
- **The efficiency of technicians etc.**

Different Test Carried out in Textiles



Fibre Test:

- Identification of fiber
- Grading
- Fiber length
- Strength and elongation ;tensile properties
- Fineness or linear density test
- Maturity test
- Trash, neps test etc

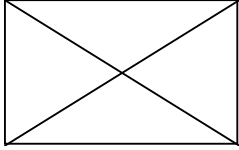
Yarn Test:

- Yarn count or linear density
- Twist per unit length
- Strength and elongation i.e. tensile properties
- Appearance
- Evenness and regularity
- Hairiness

Fabric Test:

- Strength and elongation test i.e. tensile properties
- Width, Thickness
- Number of ends and picks per unit length
- The count of yarn used
- Fabric weight per unit length
- Design and construction of the cloth
- Air permeability, Thermal properties
- Stiffness, handle, drape
- Crease resistance and recovery
- Abrasion, Pilling, Shrinkage
- Water absorbency or resistance etc.

MOISTURE REGAIN AND MOISTURE CONTENT



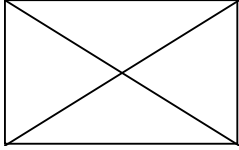
Relative humidity (RH) is the ratio of the partial pressure of water vapour to the equilibrium vapour pressure of water at a given **temperature**.

MOISTURE REGAIN : Moisture regain is defined as the percentage of water present in a textile material of oven dry weight.

If weight of water = W, Oven Dry Weight = D and Moisture Regain =M.R

Then, M.R= W/D * 100%

MOISTURE REGAIN AND MOISTURE CONTENT



Moisture content :

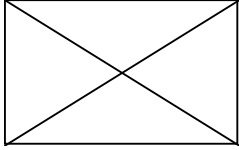
M.C is defined as the Percentage of water present in a textile material of total weight.

If , Weight of water =W, over dry weight = D and Moisture Content =MC ,

Then,

$$M.C = W/(W+D)*100\%$$

MOISTURE REGAIN AND MOISTURE CONTENT



$$\text{Moisture Content (M)} = \frac{\text{Weight of water}}{\text{Total weight of the material}} \times 100$$

$$\textbf{Moisture Regain (R)} = \frac{\textbf{Weight of water}}{\textbf{Oven Dry weight of material}} \times 100$$

If, Oven dry weight = D

Weight of water = W

Regain = R

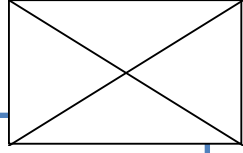
Moisture Content = M

Then,

$$R = \frac{100W}{D} \quad \text{and}$$

$$M = \frac{100W}{D+w}$$

MOISTURE REGAIN AND MOISTURE CONTENT



We Know,

$$M = \frac{100W}{D+W}$$

$$= \frac{\frac{100W}{D}}{\frac{D+W}{D}}$$

$$= \frac{R}{1+\frac{W}{D}}$$

$$= \frac{R}{1+\frac{\frac{RD}{100}}{D}}$$

Since, $R = \frac{100W}{D}$

$W = \frac{RD}{100}$

Therefore, $M = \frac{R}{1+\frac{R}{100}}$

We Know,

$$R = \frac{100W}{D}$$

$$= \frac{100W}{\frac{100W}{M} - W}$$

Since, $M = \frac{100W}{D+W}$

$D + W = \frac{100W}{M}$

$D = \frac{100W}{M} - W$

$$= \frac{100W}{\frac{100W - MW}{M}}$$

$$= \frac{100W}{\frac{W(100-M)}{M}}$$

$$= 100W \times \frac{M}{W(100-M)}$$

$$= \frac{100M}{(100-M)}$$

Therefore, $R = \frac{M}{1-\frac{M}{100}}$

MOISTURE REGAIN AND MOISTURE CONTENT

$$R = \frac{100W}{D}$$

Therefore, $$W = \frac{RD}{100}$$

We Know, $$M = \frac{100W}{D+W}$$

$$= \frac{\frac{100W}{D}}{\frac{D+W}{D}}$$

$$= \frac{R}{1+\frac{W}{D}}$$

$$= \frac{R}{1+\frac{\frac{RD}{100}}{D}}$$

Since, $W = \frac{RD}{100}$

Therefore, $M = \frac{R}{1+\frac{R}{100}}$

We Know,

$$R = \frac{100W}{D}$$

$$= \frac{100W}{\frac{100W}{M} - W}$$

$$= \frac{100W}{\frac{100W - MW}{M}}$$

$$= \frac{100W}{\frac{W(100-M)}{M}}$$

$$= 100W \times \frac{M}{W(100-M)}$$

$$= \frac{100M}{(100-M)}$$

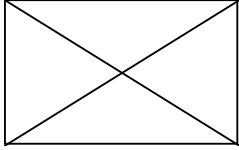
Since, $M = \frac{100W}{D+W}$

$D + W = \frac{100W}{M}$

$D = \frac{100W}{M} - W$

Therefore, $R = \frac{M}{1-\frac{M}{100}}$

MOISTURE REGAIN AND MOISTURE CONTENT



Example.

The weight of a sample of cotton was found to be 105 grains. When heated at 105^0C for 2 hrs, the weight of the sample was reduced to 100 grains. Find out the moisture content and regain.

Sol.

Given, **W+D** **= 105 grains**

D **= 100 grains**

W **= (105-100) = 5 grains**

Therefore, $R = \frac{W}{D} \times 100 = \frac{5}{100} \times 100 = 5\%$

Therefore, $M = \frac{W}{W+D} \times 100 = \frac{5}{105} \times 100 = 4.76\%$

Influence of Humidity on Fibre Properties and Textile Processing

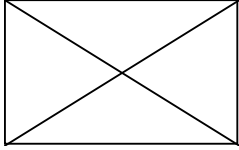
INFLUENCE OF HUMIDITY ON FIBRE PROPERTIES

Changes in humidity cause changes in the physical properties of a textile material. The properties could be any that are commonly evaluated, such as dimensions, tensile strength, elastic recovery, elastic resistance, rigidity, electrical properties and so on.

Cotton and flax absorb moisture more rapidly when exposed to high humidity and so they increase in weight and also in strength. Increase in strength with moisture is a special property of only these two fibres. Most other fibres lose some strength and a few of them show no change in strength with moisture. For example, man-made fibres like viscose rayon, acetate, etc., show a distinct reduction in strength corresponding with an increase in the amount of moisture in the fibres.

Synthetic fibres, such as nylon, polyester, acrylic, polypropylene, etc., are hydrophobic (i.e. water-hating or water-repelling) and will therefore not be affected much because they do not contain an appreciable amount of moisture. Looking at fibre behaviour from the practical point of view, all textile fibres show increased pliability or spinning capability and greater resistance to static electrical influence with increase in the amount of moisture.

Influence of Humidity on Fibre Properties and Textile Processing



INFLUENCE OF HUMIDITY ON TEXTILE PROCESSING

- Textile Processing also influenced with the change in amount of moisture in the atmospheric conditions.
- Generation of static charges.
- Flexibility or pliability of fibres.
- Dust and fly generation.
- Gain or loss in strength by some fibres.
- Bodily comfort or discomfort to the technicians and machine operators.

MOISTURE REGAIN AND MOISTURE CONTENT OF FIBRES

Standard Regain of a Fibre

This is the moisture regain of a fibre obtained under standard testing atmospheric conditions, viz.65 ± 2 % RH and 20 ± 2°C temperature.

The standard regain values of some textile fibres are given below:

Material	Standard Regain
Raw cotton	8-8.5 %
Cotton yarn	7-7.5 %
Silk	11 %
Wool	17 %
Viscose rayon	13 %
Acetate fibre	6.5 %
Nylon 6, 6.6	4 %
Acrylic fibre	1 - 2 %
Polyester (PET) fibre	0.4 %

MOISTURE REGAIN AND MOISTURE CONTENT OF FIBRES

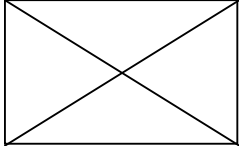
FACTORS AFFECTING FIBRE REGAIN

There are **four** major factors that can affect the regain of textile fibres. These are briefly explained below:

1. Relative Humidity
2. Time
3. Temperature
4. The previous history of the sample

Relative Humidity:

Relative humidity is the most important factor that affects the regain of textile materials. The higher the relative humidity of the atmosphere, the higher is the regain of textile material which is exposed to it. If the relative humidity in the air is more then there will be more moisture regain or more rate of conditioning of textile materials and vice versa.

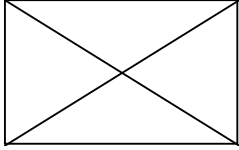


FACTORS AFFECTING FIBRE REGAIN (contd…)

Time:

Material that is in equilibrium at a particular relative humidity which is then moved to an atmosphere with a different relative humidity takes a certain amount of time to reach a new equilibrium. The time taken depends on the physical form of the material and how easily the moisture can reach or escape from the individual fibres. For example the British Standard for count testing suggests a period of one hour for yarn in hank form to reach equilibrium, but three hours for yarn on packages.

A material placed in a given atmosphere takes a certain time to reach equilibrium. The rate of conditioning depends on several factors, such as;
The size and form of sample
The type of material
External conditions



FACTORS AFFECTING FIBRE REGAIN (contd…)

Temperature:

The effect of temperature on regain is not important. A change of 10 0C will give a change in regain of cotton of about 0.3 percent. This effect can be ignored. Now we can say that for practical purposes the temperature does not affect the regain of a sample.

The previous history of the sample:

The previous history of the sample can affect the equilibrium regain of the sample. The hysteresis is a good example. Processing can also change the regain. When oils, waxes and other impurities are removed then regain may change

EFFECTS OF REGAIN ON FIBRE PROPERTIES

The major effects of regain on fibre properties:

- **Fibre Dimension: Absorption of moisture changes the diameter of fibre. Shrinkage occurs due to fibre swelling. Dimensional changes of fabric i.e wrinkles due to change in atmosphere.**

- **Mechanical Properties** : **In case of Vegetable fibers such as cotton and flax - an increase in strength (8-10%) is noticed when moisture absorbed by the fiber. Other than these fibers strength will be decreased when moisture absorbed by the fiber. In case of viscose fibres about 50% strength is decreased.**

  Extensibility, crease recovery, flexibility is also effected by change of regain value.

EFFECTS OF REGAIN ON FIBRE PROPERTIES

The major effects of regain on fibre properties:

- **Electrical Properties: The electrical resistance varies with different regain values. When the sample is dry, resistance to the flow of current is maximum. When wet, it will be minimum.**

- **Thermal Effect: When textile material absorbs moisture, heat is generated. They tend to be exothermic. The heat is referred to as the 'heat of absorption' or sometimes heat of wetting.**
  In winter from a hot room (low RH %) to outside (cold and high RH%) heat generation balancing of heat, otherwise body would suffer.

Measurement of Relative Humidity

The instruments used in the determination of humidity is known as HYGROMETERS OR PSYCHOMETERS The following are the methods used to measure the relative humidity.

1. Gravimetric method
2. Chemical method
3. Dew point method.

The above methods are not commonly used in testing laboratories or textile mills as they are not convenient for routine work. Instruments specially devised for quick and easy determination of relative humidity are mainly used.

- Wet and Dry bulb hygrometer
- Hair hygrometer or Thermo hygrograph
- Electrolytic hygrometer
- Sling hygrometer.

Measurement of Relative Humidity

Wet and Dry bulb hygrometer

Principle of working

Demonstration in the laboratory.

Measurement of Moisture Content and Moisture Regain

MR & MC can be determined in the laboratory by using :

1. Conditioning Oven
2. Shirley Moisture meter

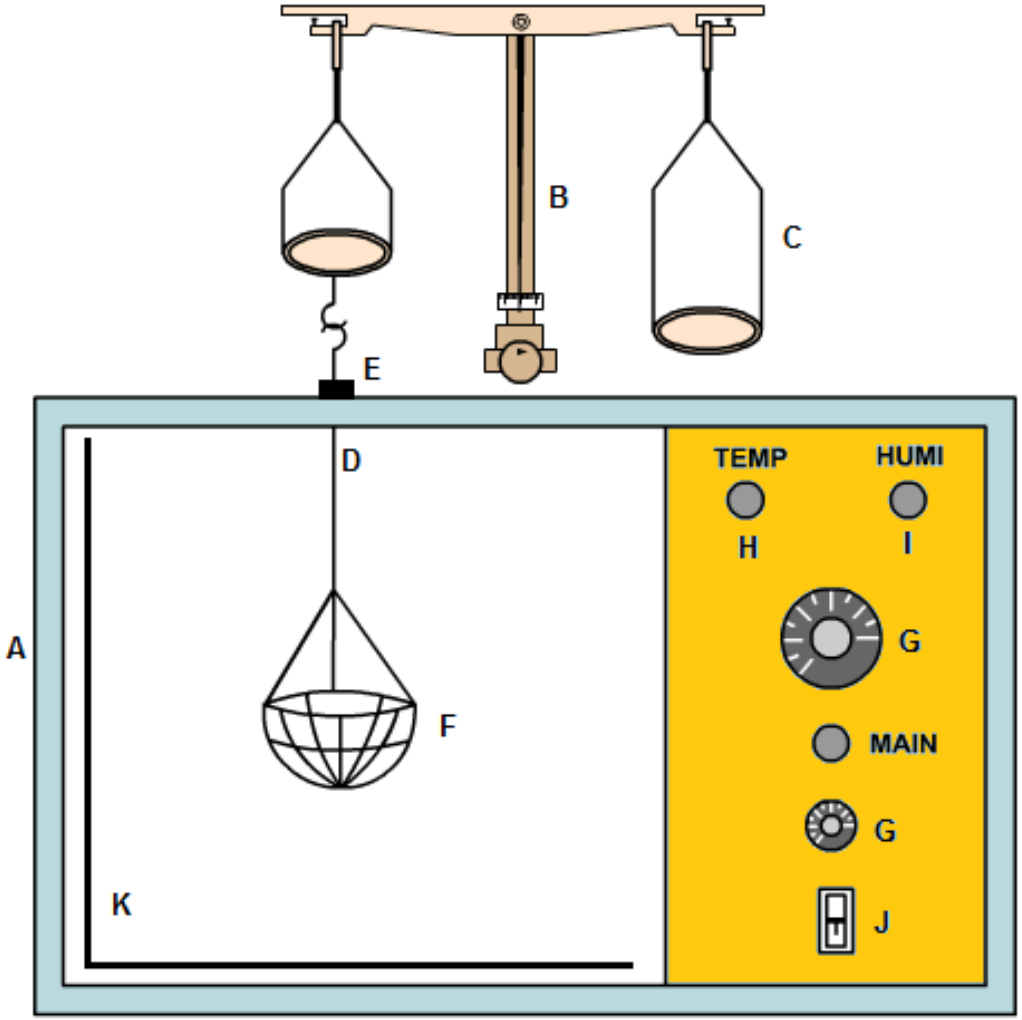
CONDITIONING OVEN

Principle

A sample of known weight is heated in a special oven at a temperature of 105±3 degree Celsius for 1 ½ to 2 hrs to constant weight or oven dry weight. The difference between the original weight and the oven dry weight of the sample gives the weight of moisture present in the sample.

Measurement of Moisture Content and Moisture Regain

CONDITIONING OVEN



A- Heating Chamber

B- Balance

C- Counter poise weight

D- Rod

E- Knob

F- Perforated Tray

G- Thermostat

H- Indicator light

I – Red Light

J – Switch

K – Heating Element

Measurement of Moisture Content and Moisture Regain

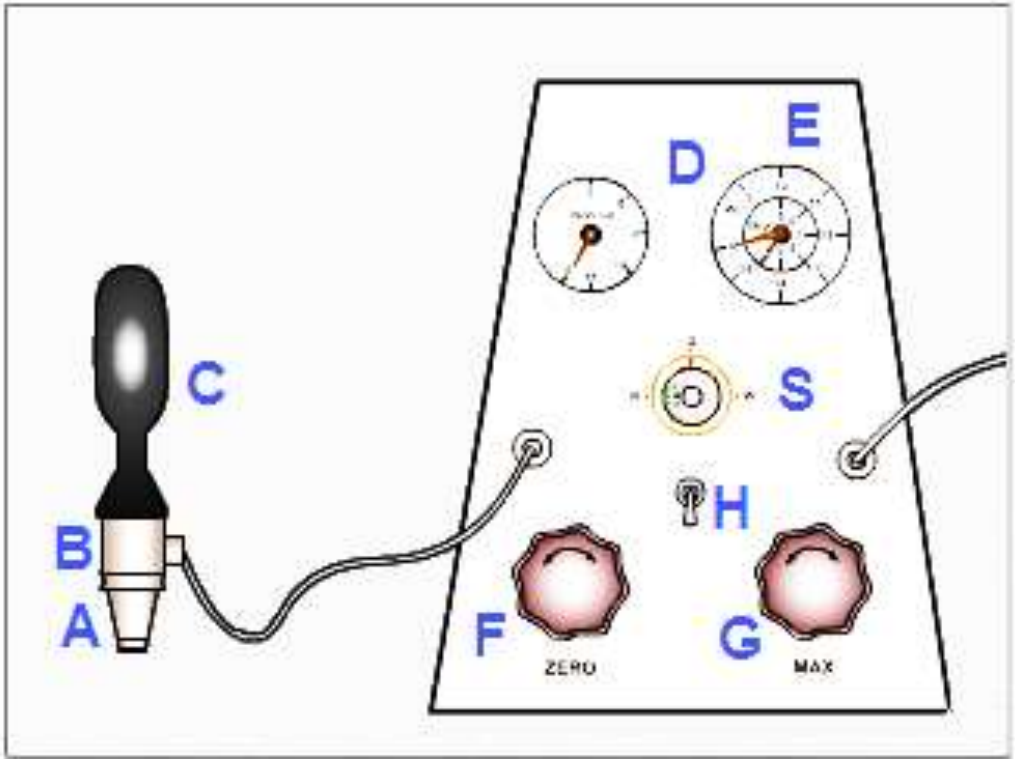
SHIRELY MOISTURE METER (Indirect Method)

Principle

The electrical resistance of a textile fibre varies with its regain. When the fibre is dry, the resistance to flow of electrical current will be at the practical maximum and when it is wet the resistance will be at the minimum level.

Measurement of Moisture Content and Moisture Regain

SHIRLEY MOISTURE METER (Indirect Method)



A- Electrode

B- Holder

C- Handle

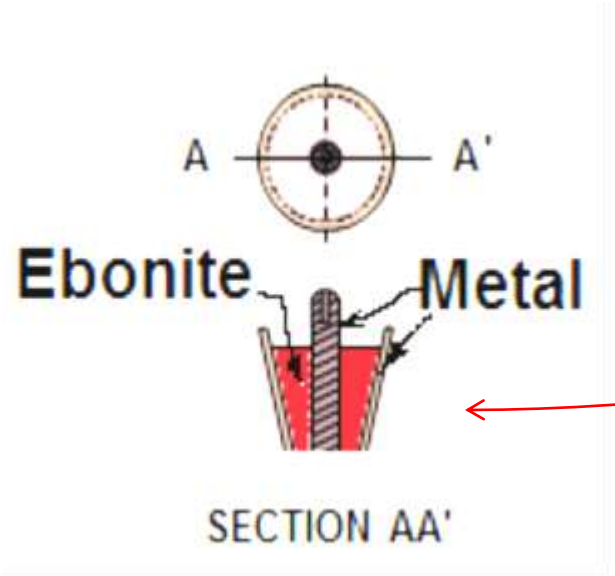
D- Dial (7-11%)

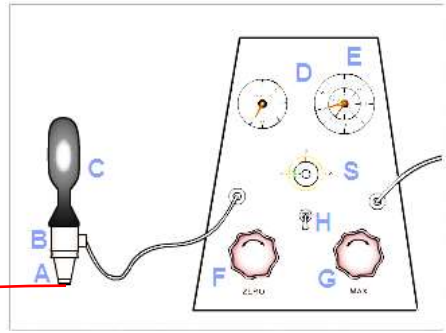
E- Dial (9-15%; 5-9%)

F, G- Knob for calibration

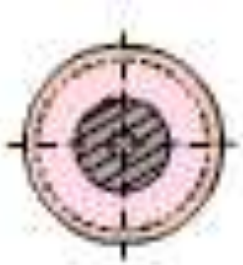
H- Switch

SHIRLEY MOISTURE METER (Indirect Method)



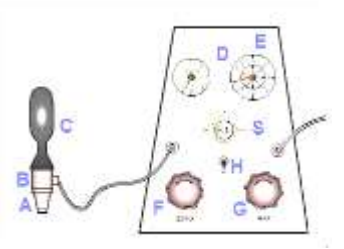


Electrode for YARN



Electrode for FIBRE

SHIRLEY MOISTURE METER (Indirect Method)



Procedure for determination of Moisture Regain

- Switch ON the instrument.
- Select appropriate ELECTRODE, based on materials to be tested i.e yarn or fibre.
- The SCALE –SELECT KNOB (S) is set to the required scale depending upon whether the test sample is wet, dry or a normal material.
- Then the "ZERO-SET" position under the chosen scale is selected using the same knob and the pointer on the chosen scale is checked to see whether it indicates exactly zero.
- Next, knob is turned to the "MAX-SET" position and the pointer is checked to see whether it accurately coincides with the maximum reading on the scale. Any variation in this can be set right by using "MAXIMUN ADJUST KNOB".
- Once the selected scale has been calibrated, Knob S is turn to the testing mode.

A sample, be it a tuft of cotton or a package of yarn, is then taken and pressed by the sensing end of the electrode. A firm pressure is applied to the holder in order to bring the electrode and the fibres in close contact. This is merely to ensure that the sample connects the terminals of the electrode and causes current to pass through it.

The moisture in the sample is noted on the chosen scale. If this scale is found to be unsuitable, another appropriate scale is selected following the above procedure.

A number of readings are taken at various parts of the material and the average value of regain is recorded.

SOME QUESTIONS ON MOISTURE AND TEXTILES

Define humidity, absolute humidity, relative humidity, moisture content and moisture regain.

State the relationship between moisture content and moisture regain of textile fibres.

The weight of a sample is 50 grams. Its oven-dry weight is 44 grams. Calculate the moisture content and moisture regain of the sample.

Mention the advantages of a humid atmosphere for textile spinning/weaving.

Define standard atmosphere are standard testing conditions. What are the advantages of standard atmospheric conditions in textile testing?

Define standard regain. Mention the standard regains of raw cotton, cotton yarn, silk, wool, viscose, acetate, nylon and polyester fibres.

Mention at least four reasons for differences in fibre regain value.

Explain the hysteresis effect shown by fibres with regard to humidity.

What is the influence of moisture on cotton and viscose fibre? On wool and polyester fibre?

SOME QUESTIONS ON MOISTURE AND TEXTILES

What are hydrophilic and hydrophobic fibres? Give two examples of each type.

State and discuss the factors affecting fibre regain.

Discuss the effects of regain on fibre properties.

Give the formula for finding out the corrected count of a yarn.

a. The count of a yarn is 42s. The yarn's standard regain is 7% and its actual regain is 4%. Find out the corrected count of the yarn.

b. A 30-tex yarn has a moisture regain of 5%. Its standard regain is 7.5%. Determine the count of the yarn corrected to its standard regain.

What is hygrometer or psychrometer? Explain the construction and working of a wet and dry bulb hygrometer.

State the instruments used to measure the moisture content and moisture regain of textile fibre.

Describe the principle and working of any instrument with line diagram which is used to measure the moisture content as well as moisture regain.