Total Marks: 30 (Activity Planning and Execution-20; Poster and demonstration-10)

Instructions for all the groups:

1. Develop a **comprehensive plan for all the activities, outlining step-by-step demonstration** procedures for each session. Arrange for the measurement of relevant parameters using **low-cost and resource-efficient** experimental methods.
2. All groups are encouraged to apply their **own engineering judgment and problem-solving skills** to execute and optimise the given activities.
3. Each group is advised to **prepare a poster** following the prescribed format and a demonstration video, and upload both to the shared drive folder. The poster template will be shared in due course.
4. Go through the basics of **Model-Based (Virtual) Soft Sensors,** Calibration using cost-effective methods
5. Arrange Foam/sponge (rectangular cross section) for compression test (Minimum thickness= 60 mm), Foam (circular cross section) for torsion test (minimum dia= 60 mm), Transparent Elastomer band (Minimum width= 150 mm, Length= 200 mm), Double tape, Permanent marker, ruler, scissor.

Group No.	Activity
1	**Model soft pneumatic actuator (using a silicone tube that inflates and bends/extends under air pressure)** a. Physically inflate it (using a syringe, etc) b. Measure its deformation c. Model the material using hyperelastic theory d. Link pressure → deformation → control. Think about how you can measure pressure.
2	**Soft sensor modelling for wearable electronics** a. Model how strain in a flexible sensor changes electrical resistance. b. Stretch a conductive rubber/graphite-coated strip c. Measure resistance change d. Develop strain–resistance model
3	**Gait Analysis Using Simple Tactile Pressure Mapping** a. Biomechanics principle-Gait cycle phases (Stance and swing phase) b. Arrange Thin foam sheet or EVA foam mat c. Printed grid or drawn grid or dark markers or ink dots(e.g., 1 cm × 1 cm) d. Use Measurement principle (no force sensors) In gait analysis, pressure is not directly measured; it is inferred from surface deformation using continuum mechanics principles.
4	**Vision-based surface deformation tracking for gesture control** a. Use phone camera to detect skin deformation for gesture sensing. b. Record hand/skin deformation c. Track displacement d. Relate to applied force

Total Marks: 30 (Activity Planning and Execution-20; Poster and demonstration-10)

5 **Viscoelasticity of polymers**

a. Demonstrate stress relaxation.
b. Hang weights on polymer strip
c. Record time-dependent deformation
d. Fit Maxwell/Kelvin–Voigt model

6 **Soft material indentation project**

a. Estimate elastic modulus of soft materials via indentation.
b. Indent gel/rubber with known weights
c. Measure displacement (camera phone)

7 **Vision-based strain measurement (Digital Image Correlation)**

a. Measure strain fields using images of a deforming specimen under torsion loading.
b. Record a torsion test (circular cross-section foam)
c. Apply speckle pattern or rectangular grids
d. Use Python to track deformation
e. Compute displacement and strain fields

8 **Study the crack growth in a material**

a. Observe crack propagation.
b. Test notched specimens (Make a cut with a scissor in the elastomer band)
c. Use the phone camera to track the crack growth
d. Write a code to measure the crack growth with loading cycles

9 **Vision-Based Strain Measurement (Digital Image Correlation)**

a. Measure strain fields using images of a deforming specimen under bending loading.
b. Record a bending test (long rectangular cross-section foam)
c. Apply speckle pattern or rectangular grids
d. Use Python to track deformation

Compute displacement and strain fields

10 **Gait Analysis Using Simple Tactile Pressure Mapping**

e. Biomechanics principle-Gait cycle phases (Stance and swing phase)
f. Arrange Thin foam sheet or EVA foam mat
g. Printed grid or drawn grid or dark markers or ink dots(e.g., 1 cm × 1 cm)
h. Use Measurement principle (no force sensors)
i. In gait analysis, pressure is not directly measured; it is inferred from surface deformation using continuum mechanics principles.

11 **Vision-based surface deformation tracking for gesture control**

a. Use phone camera to detect skin deformation for gesture sensing.
b. Record hand/skin deformation
c. Track displacement
d. Relate to applied force

Total Marks: 30 (Activity Planning and Execution-20; Poster and demonstration-10)

12 Soft sensor modelling for wearable electronics

a. Model how strain in a flexible sensor changes electrical resistance.
b. Stretch a conductive rubber/graphite-coated strip
c. Measure resistance change
d. Develop strain–resistance model

13 Model soft pneumatic actuator (using a silicone tube that inflates and bends/extends under air pressure)

a. Physically inflate it (using a syringe, etc)
b. Measure its deformation
c. Model the material using hyperelastic theory
d. Link pressure → deformation → control. Think about how you can measure pressure.

14. Flexible electronics deformation study (Arrange PCB)

a. How bending affects flexible circuits.
b. Take a flexible electronic structure (flex PCB or copper-on-polymer strip), bend it repeatedly or to increasing curvature, and study
c. Strain induced in copper traces
d. Change in electrical resistance
e. Onset of damage / failure
f. Predict where and when failure occurs