## DEPARTMENT OF CIVIL ENGINEERING

IIT DELHI

# VIRTUAL SMART STRUCTURES AND DYNAMICS LAB

**SPECIAL PACKAGE FOR**
**QUALITY ENHANCEMENT IN ENGINEERING EDUCATION (QEEE)**

**Last Updated on 21-07-2014**

## SUGGESTED SCHEDULE

***Session 1:*** Orientation

***Session 2:*** Experiment 1

***Session 3:*** Experiment 3 (Available until 31st August only)

***Session 4:*** Experiment 2

***Session 5:*** Experiment 4

***Session 6:*** Experiment 5

***Session 7:*** Experiments 6, 8

***Session* 8:** Experiment 7

# ORIENTATION

**(1) Watch theory video:**

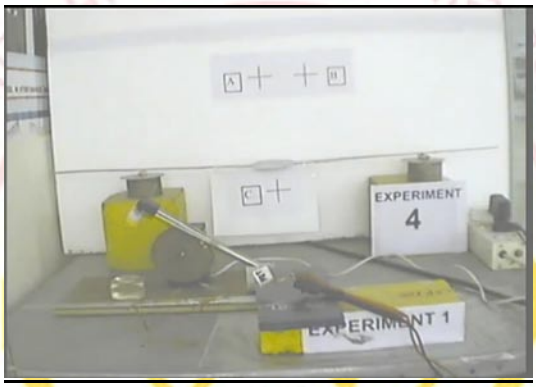
https://www.youtube.com/watch?v=b5lPJeCDEPw

**(2) Watch "Orientation for new VSSDL users"**

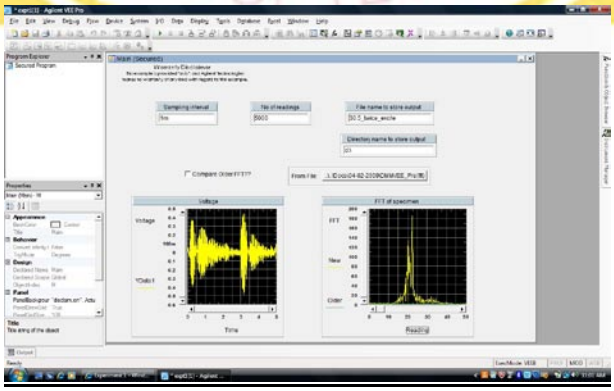
https://www.youtube.com/timedtext_video?ppub_lang=en-GB&v=cGLp17ANQTM&smsg=15&video_referrer=watch

# EXPERIMENT 1

1. **Go to homepage: http://ssdl.iitd.ac.in/vssdl/home.html**
2. **Watch "theory" video http://www.youtube.com/watch?v=b5IPJeCDEPw**
3. **Watch practical related video: https://www.youtube.com/watch?v=8P-1DksBgAE**
4. **Download and install the software recommended at http://ssdl.iitd.ac.in/vssdl/exp1.html**
5. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp1.html**
6. **Open camera and see the experiment in real time by clicking appropriate link in http://ssdl.iitd.ac.in/vssdl/exp1.html (Avoid similar sounding link inside the INTERNAL ACCESS BOX, Internet Explorer will give better view)**



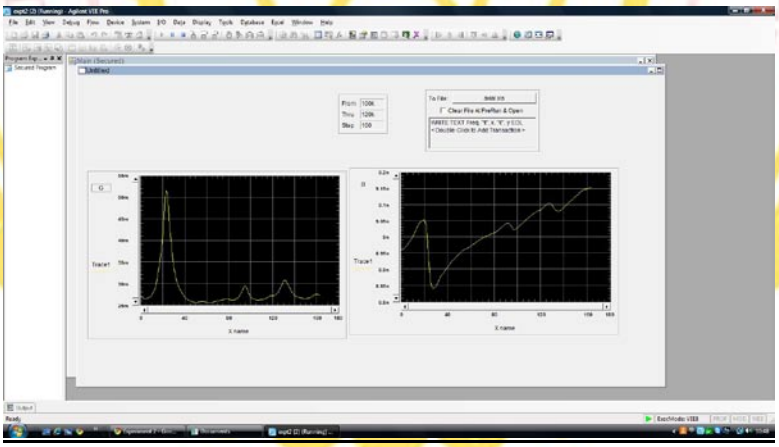

7. **Attempt pre-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp1.html**
8. **Perform experiment by clicking appropriate link at http://ssdl.iitd.ac.in/vssdl/exp1.html (Choose sampling interval 1m (1 milli second) and number of readings as 5000 when a dialog box similar to the one shown below appears) (Avoid similar sounding link inside the INTERNAL ACCESS BOX)**



9. **Identify the natural frequency of the cantilever from the frequency domain plot (second figure)**
10. **Calculate the natural frequency theoretically (refer manual of experiment) http://ssdl.iitd.ac.in/vssdl/manual_expt1.pdf.**
11. **Attempt post experiment quiz http://ssdl.iitd.ac.in/vssdl/exp1.html.**

# EXPERIMENT 2

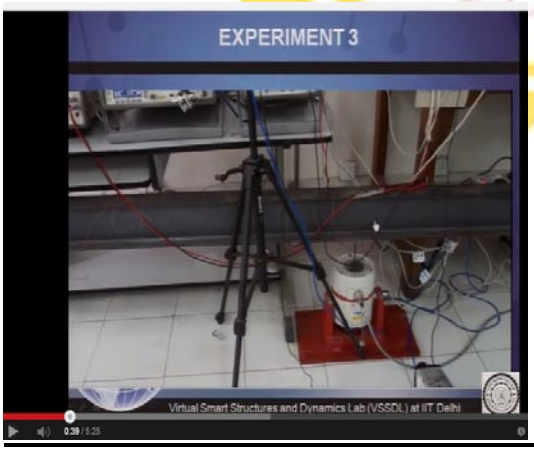
1. **Go to homepage: http://ssdl.iitd.ac.in/vssdl/home.html.**
2. **Watch "theory" video https://www.youtube.com/watch?v=qSRAxx9cvlk.**
3. **Watch practical related video. https://www.youtube.com/watch?v=bU8AHRxWYsY.**
4. **Download and install the software recommended at http://ssdl.iitd.ac.in/vssdl/exp2.html (You don't need to do this if you have already installed the software for experiment 1, except the ivi driver of E4980 LCR meter)**
5. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp2.html.**
6. **Open camera and see the experiment in real time by clicking appropriate link in http://ssdl.iitd.ac.in/vssdl/exp2.html (Avoid similar sounding link inside the INTERNAL ACCESS BOX, use internet explorer for best view).**
7. **Attempt pre-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp2.html.**
8. **Perform experiment by clicking appropriate link at http://ssdl.iitd.ac.in/vssdl/exp2.html (Choose a frequency range of 100 to 120 kHz and an interval of 0.1 kHz) (Avoid similar sounding link inside the INTERNAL ACCESS BOX).**

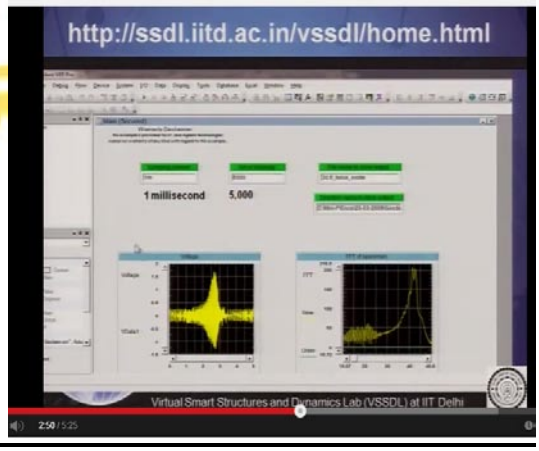


9. **Identify the natural frequency of the cantilever from the G vs frequency plot.**
10. **Calculate the natural frequency theoretically (refer manual of experiment). The experimental frequency is nth natural frequency. What is the value of "n"?**
11. **Attempt post experiment quiz http://ssdl.iitd.ac.in/vssdl/exp2.html.**

# EXPERIMENT 3

1. **Go to homepage: http://ssdl.iitd.ac.in/vssdl/home.html**
2. **Watch "theory" video: https://www.youtube.com/watch?v=luTqsz0H268&list=UUia-qjHoFLEgivMXSKQeXtQ**
3. **Watch practical related video:**
4. **https://www.youtube.com/watch?v=S5AxXdRYYrY**
5. **Download and install the software recommended at http://ssdl.iitd.ac.in/vssdl/exp2.html (You don't need to do this if you have already installed the software for Experiment 1)**
6. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp3.html**
7. **Attempt pre-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp3.html**
8. **Open camera and see the experiment in real time by clicking appropriate link in http://ssdl.iitd.ac.in/vssdl/exp3.html (Avoid similar sounding link inside the INTERNAL ACCESS BOX, use internet explorer for best view)**
9. **Capture the image by clicking the button highlighted in the figure below and save it using the button 'Save'.**
10. **Perform experiment by clicking appropriate link at http://ssdl.iitd.ac.in/vssdl/exp3.html (Choose sampling interval 1m (1 milli second) and number of readings as 5000 when a dialog box similar to the one shown below appears) (Avoid similar sounding link inside the INTERNAL ACCESS BOX)**
11. **Identify the natural frequency of the beam from response vs frequency plot.**
12. **Calculate the natural frequency theoretically (refer manual of experiment).**
13. **Attempt post experiment quiz http://ssdl.iitd.ac.in/vssdl/exp3.html.**

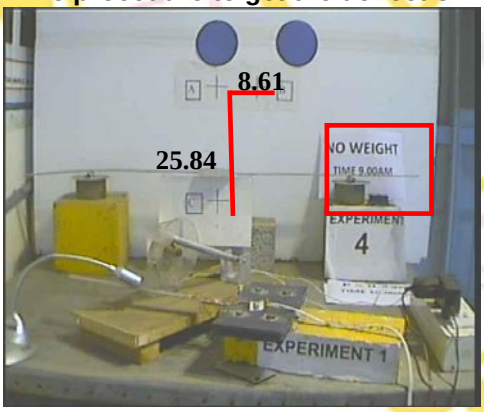


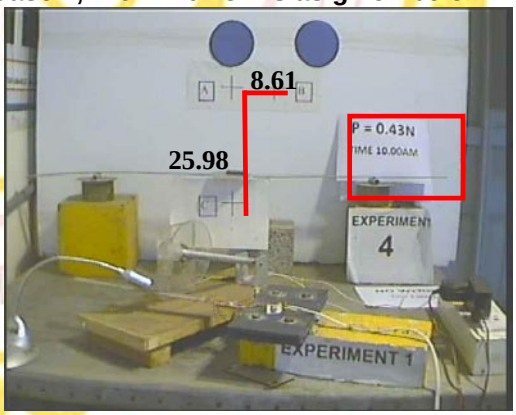



# EXPERIMENT 4

1. Go to homepage: http://ssdl.iitd.ac.in/vssdl/home.html.
2. Watch "theory" and "practical" related video https://www.youtube.com/watch?v=AdsHGbUSMh0.
3. Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp4.html.
4. Attempt pre-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp4.html.
5. Open camera and see the experiment in real time by clicking appropriate link in http://ssdl.iitd.ac.in/vssdl/exp4.html (Use INTERNET EXPLORER for browsing).
6. Capture the image by clicking the button highlighted in the figure below and save it using the button 'Save'.


7. The procedure to get the deflection for Case 2, with P=0.43N is as given below




**Case 1:No Weight**

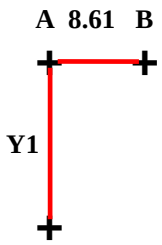
**Case 2: P = 0.43 N**

**Assuming, 8.61 units is equivalent to 100mm**

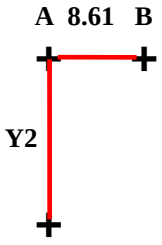
**Using unitary method**
**Y1(mm) =100/8.61) x 25.84;**

**Y2(mm) = (100/8.61) x 25.98;**

**Deflection, ΔY = Y2 - Y1**




**Case 1: No Weight**




**Case 2: P = 0.43 N**

8. **Different loads (in Newton's) will be placed on the beam at an interval of one hour, resulting in its deflection. Repeat the above process (Step-6 and 7) of saving the image for following five loading conditions:**

| Case | Loading Condition | Time of Loading |
|---|---|---|
| Case1 | No Weight | 09.00 A.M. / 02.00 PM |
| Case 2 | 0.43 N | 10.00 A.M. / 03.00PM |
| Case 3 | 0.87 N | 11.00 A.M. / 04.00 PM |
| Case 4 | 1.334 N | 12.00 A.M. / 05.00PM |

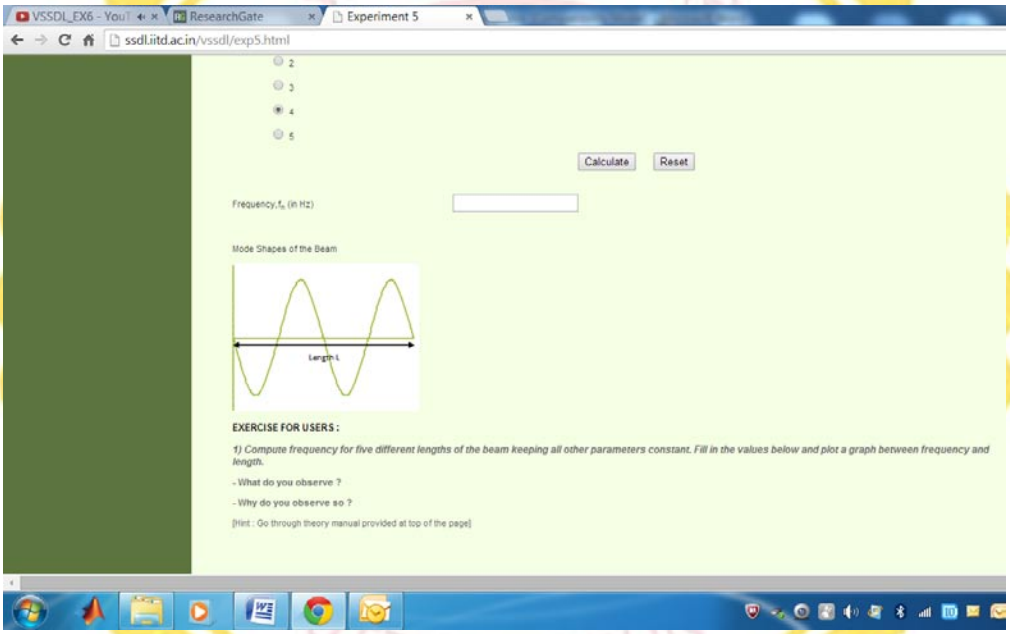
9. **Analyse the images for above mentioned four cases using MS paint or MS word using the fact that the real distance between points A and B is 100 mm and hence converting the length of normal drawn from C to A into deflections of C in mm.**

10. **Plot the load versus deflection values.**

11. **Attempt post experiment quiz http://ssdl.iitd.ac.in/vssdl/exp4.html.**

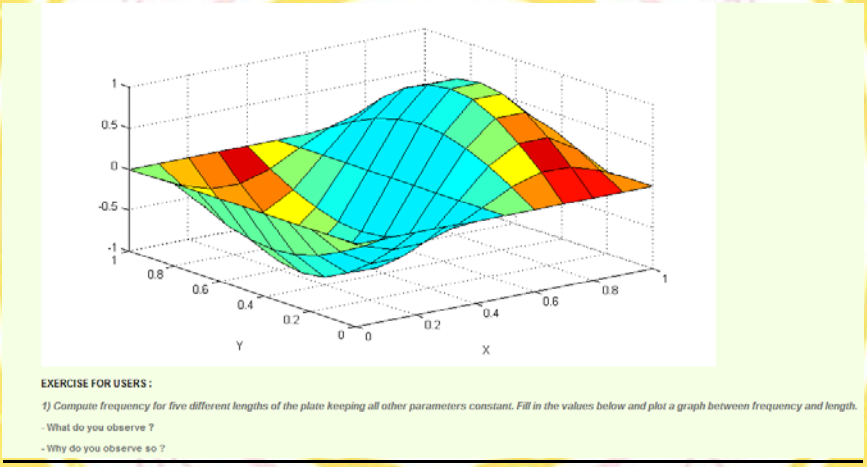
# EXPERIMENT 5

1. **Go to experiment page: http://ssdl.iitd.ac.in/vssdl/exp5.html**
2. **Watch "theory" and "practical" video at: https://www.youtube.com/watch?v=Kj7VumHUlM4**
3. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp5.html**
4. **Attempt pre experimental quiz http://ssdl.iitd.ac.in/vssdl/exp5.html**
5. **Choose suitable dimensions of a beam and perform simulation as suggested in the website (self explanatory) for n = 1, 2, 3, 4, 5.**
6. **Complete Exercises 1 and 2.**
7. **Attempt Post experimental quiz http://ssdl.iitd.ac.in/vssdl/exp5.html**



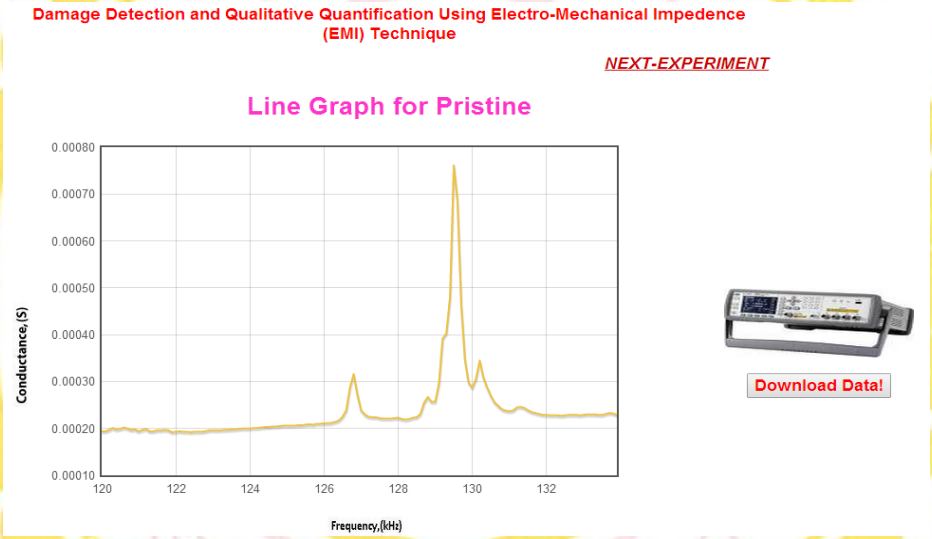
# EXPERIMENT 6

1. **Go to experiment page: http://ssdl.iitd.ac.in/vssdl/exp6.html.**
2. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp6.html.**
3. **Watch "theory" and "practical" video at: https://www.youtube.com/watch?v=PSmiEv5fAs0.**
4. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp6.html.**
5. **Attempt pre experimental quiz http://ssdl.iitd.ac.in/vssdl/exp6.html.**
6. **Choose suitable dimensions of a plate and perform simulation as suggested in the website (self explanatory) for all combinations of "m" and "n".**
7. **Complete Exercises 1 and 2.**
8. **Attempt Post experimental quiz http://ssdl.iitd.ac.in/vssdl/exp5.html.**



# EXPERIMENT 7

1. **Go to experiment page: http://ssdl.iitd.ac.in/vssdl/exp7.html**
2. **Read the basic theory from: http://ssdl.iitd.ac.in/vssdl/piezo.pdf**
3. **Watch "theory" and "practical" video https://www.youtube.com/watch?v=HQfJlrQhVKA**
4. **Read experiment's manual at http://ssdl.iitd.ac.in/vssdl/exp7.html**
5. **Attempt pre-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp7.html**
6. **Acquire the signature in Pristine stage using the link 'Aquire Signature ' available at http://ssdl.iitd.ac.in/vssdl/exp7.html (Choose a frequency range of (115 to 134kHz)**
7. **After acquiring the data for complete range of frequency, download the data and proceed for damaged case by using the link "next experiment".**




8. **'Induce damage' and download the data for three levels of damage (incipient, moderate and severe) as explained in Step 7 (for pristine stage)**
9. **Compare the conductance signature of pristine and damage stages in excel (for the chosen range of frequency)**
10. **Plot a histogram of RMSD (refer manual of Experiment) for various damaged states.**
11. **Attempt post experiment quiz at http://ssdl.iitd.ac.in/vssdl/exp7.html**

# EXPERIMENT 8

## NOTE: This experiment is self explanatory and no manual is required

1. **Go to experiment page: http://ssdl.iitd.ac.in/vssdl/exp8.html**
2. **Watch the video: https://www.youtube.com/watch?v=j-zczJXSxnw**
3. **Watch the "theory" and "practical" video at: https://www.youtube.com/watch?v=qto2hIa9wns**
4. **Read "Disclaimer" and "Description of bridge".**
5. **Attempt pre-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp8.html**
6. **View 10 mode shapes of the bridge.**
7. **Which of these is closest to the failure mode of the "Tacoma Narrows" bridge**
8. **Attempt post-experimental quiz http://ssdl.iitd.ac.in/vssdl/exp8.html**