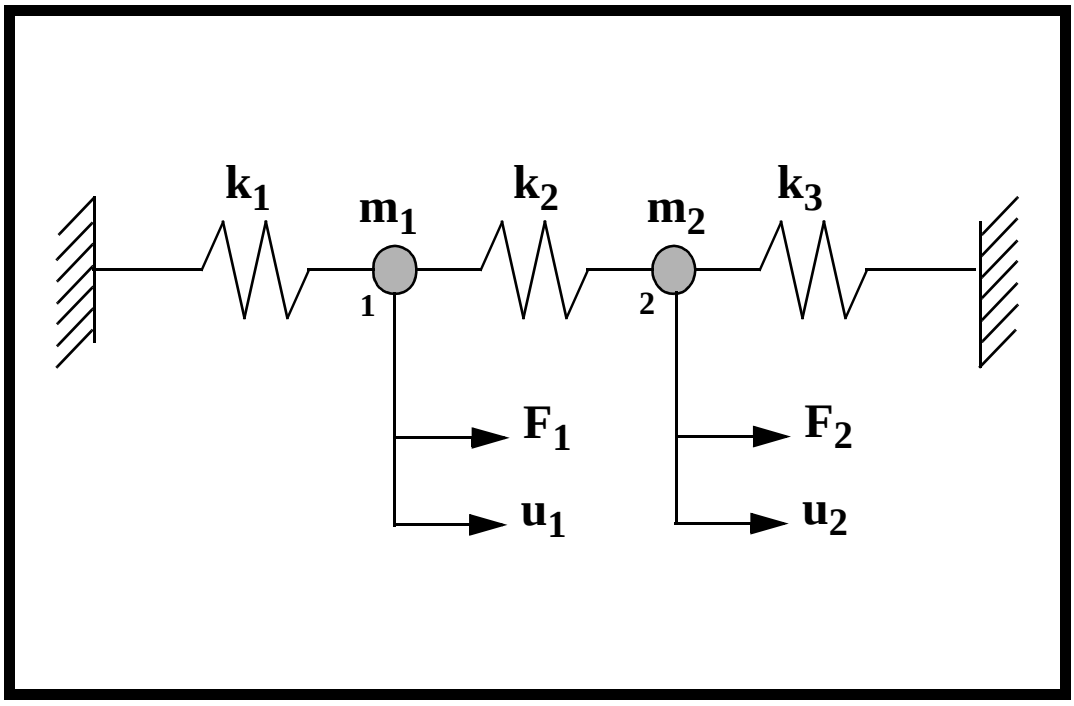
WORKSHOP 4

Objectives:

- Calculate the design sensitivity coefficients for the following spring/mass system.



Model Description:

- Design Variables - Spring constants K1, K2, K3

  .- Damping Coefficients GE1, GE2, GE3

- Constraints:

  Displacements at Grid 1 (X direction) $\leq \pm 0.2$ m

Note: In frequency rsponse, the default output is in terms of real and imaginary format. In other words, the following two case control DISP(REAL) = n are equivalent. To request the displacement output (PHASE) = n

Generating an input file for MSC.Nastran Users:

1. Generate an input file using the data from pages 4-1 through 4-3. Use the following input file as a starting point.

```
$
$    wkshp4.dat
$
TIME 5
SOL 200 $
CEND
TITLE=TWO MASS DIRECT FREQUENCY SENSITIVITY                    D108G7v
DISPL(PHASE) = ALL
$
$   ADD THE REST OF THE CASE CONTROL
$
      .
      .
$
BEGIN BULK
$
$    ANALYTICAL MODEL
$
CELAS1  20      20      1       1
CELAS1  21      21      1       1       2       1
CELAS1  22      22      2       1
CONM2   10      1               1.
CONM2   11      2               2.
DAREA     201       1         1          100.    2           1       100.
FREQ    100     4.0     6.0
GRID    1               1.      0.      0.              23456
GRID    2               2.      0.      0.              23456
MAT1    200     1.0E7           0.3     0.1
PELAS   20      1.0E3
PELAS   21      1.5E3
PELAS   22      2.0E3
RLOAD1  200     201                     210
TABLED1 210
        1.      1.      10.     1.      ENDT
$
$    ADD DESIGN MODEL BELOW
$
       .
       .
$
ENDDATA
```

2. The completed MSC.Nastran input file is shown below:

```
$
$    soln4.dat
$
TIME 5
SOL 200 $
CEND
TITLE=TWO MASS DIRECT FREQUENCY SENSITIVITY                    D108G7v
DISPL(PHASE) = ALL
SUBCASE 2
DESSUB = 2
   ANALYSIS =  DFREQ
   FREQ  = 100
   DLOAD = 200
   dsaprt(end=sens) = all
BEGIN BULK
$
CELAS1  20      20      1       1
CELAS1  21      21      1       1       2       1
CELAS1  22      22      2       1
CONM2   10      1               1.
CONM2   11      2               2.
DAREA   201     1       1       100.    2       1       100.
DCONSTR 2       10      -2.0E-1 -2.0E-1
DESVAR  1       K1      1.0E3   1.0E2   1.0E4
DESVAR  2       K2      1.5E3   1.5E2   1.5E4
DESVAR  3       K3      2.0E3   2.0E2   2.0E4
DESVAR  4       GE1     .1      .05     .15
DESVAR  5       GE2     .1      .05     .15
DESVAR  6       GE3     .1      .05     .15
DRESP1  10      U1      FRDISP                  1               1
        2
DVPREL1 1       PELAS   20      3       1.0E3
        1       1.0
DVPREL1 2       PELAS   21      3       1.5E3
        2       1.0
DVPREL1 3       PELAS   22      3       2.0E3
        3       1.0
DVPREL1 4       PELAS   20      4       .05
        4       1.0
DVPREL1 5       PELAS   21      4       .05
        5       1.0
DVPREL1 6       PELAS   22      4       .05
        6       1.0
FREQ    100     4.0     6.0
GRID    1               1.      0.      0.              23456
GRID    2               2.      0.      0.              23456
MAT1    200     1.0E7           0.3     0.1
PELAS   20      1.0E3
PELAS   21      1.5E3
PELAS   22      2.0E3
```

```
RLOAD1  200     201                     210
TABLED1 210
        1.      1.      10.     1.      ENDT
ENDDATA
```

3. Submit the input file to MSC.Nastran for analysis.

   To submit the MSC.Nastran **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran wkshp4 scr=yes**. Monitor the run using the UNIX **ps** command.

4. When the run is completed, edit the **wkshp4.f06** file and search for the word **FATAL**. If no matches exist, search for the word **WARNING**. Determine whether existing WARNING messages indicate modeling errors.

   4a. While still editing **wkshp4.f06**, search for the word:

   M A T R I X

5. Peform a finite difference check of the results by:

   5a. Change the value of DESVAR 1 to 1.1E3

   5b. Set PARAM, OPTEXIT, 3 to exit after finite element analysis and constraint evaluation.

   5c. Submit the run and determine the response at f = 4.0 hz, grid 1, component 1. Let's call this RPERT

   5d. Compute a finite difference sensitivity

$$\frac{RPERT - RBASE}{\Delta X(=1.1\text{E}3 - 1.0\text{E}3)}$$

   5e. Compare with the computed sensitivity.

6. Repeat step 5 by setting DESVAR 1 to 1.01E3

Comparison of Results:

7. Compare the results obtained in the **.f06** file with the following:

```
*****************************************************************************
*                                                                           *
*   D E S I G N   S E N S I T I V I T Y   M A T R I X   O U T P U T         *
*                                                                           *
*                                                                           *
*   R E S P O N S E   S E N S I T I V I T Y   C O E F F I C I E N T S       *
*                                                                           *
*****************************************************************************

--------------------------------------------------------------------------------------------------------------------------------
DRESP1 ID=       10           RESPONSE TYPE=   FRDISP     GRID ID=         1     COMP NO=       1        SEID=         0
SUBCASE  RESP VALUE  FREQ/TIME   DESIGN  VARIABLE  COEFFICIENT   DESIGN  VARIABLE  COEFFICIENT   DESIGN  VARIABLE  COEFFICIENT
--------------------------------------------------------------------------------------------------------------------------------
      2  1.8718E-01   4.0000E+00      1  K1        -2.0951E-04        2  K2        -7.1772E-06        3  K3        -1.2402E-04
                                      4  GE1       -4.8650E-02        5  GE2        9.2470E-05        6  GE3       -7.5393E-02
      2  1.3771E-01   6.0000E+00      1  K1         5.1171E-05        2  K2         1.2517E-05        3  K3         1.5027E-04
                                      4  GE1       -3.3135E-02        5  GE2        1.2923E-02        6  GE3       -2.5227E-02

--------------------------------------------------------------------------------------------------------------------------------
DRESP1 ID=       10           RESPONSE TYPE=   FRDISP     GRID ID=         2     COMP NO=       1        SEID=         0
SUBCASE  RESP VALUE  FREQ/TIME   DESIGN  VARIABLE  COEFFICIENT   DESIGN  VARIABLE  COEFFICIENT   DESIGN  VARIABLE  COEFFICIENT
--------------------------------------------------------------------------------------------------------------------------------
      2  1.6842E-01   4.0000E+00      1  K1        -1.3863E-04        2  K2         3.5824E-06        3  K3        -1.5645E-04
                                      4  GE1       -3.7918E-02        5  GE2       -1.2604E-04        6  GE3       -7.9682E-02
      2  1.6226E-01   6.0000E+00      1  K1         1.2268E-04        2  K2        -6.5162E-06        3  K3         1.0405E-04
                                      4  GE1       -2.9513E-02        5  GE2       -5.7992E-03        6  GE3       -6.2802E-02
```