Objectives:

- Define a frequency-varying excitation.
- Define load set power spectral density functions.
- Produce a MSC.Nastran input file from a dynamic math model created in Workshop 1.
- Submit the file for random analysis in MSC.Nastran.
- Compute nodal displacements for desired frequency domain.
Model Description:

For the plate model, enforce a base motion in the z-direction described by the following power spectral density, (PSD).

Use the modal method with a large mass attached to the edge with an RBE2 entry.

Below is a finite element representation of the flat plate. It also contains the loads and boundary constraints.

Determine:

- The response displacement and acceleration PSD at the drive location, (the large mass).
- The displacement PSD at the corner and center of the free edge, (Grids 33 and 55).
- Use modal solution.
- Assume a constant critical damping ratio of 3% across the whole frequency range.
Suggested Exercise Steps:

- Reference a previously created dynamic math model, *plate.bdf*, by using the INCLUDE statement.
- Attach the large mass to the edge of the plate (CONM2 and RBE2).
- Specify modal damping as a tabular function of natural frequency (TABDMP1).
- Define the frequency-varying tip load (DAREA and RLOAD2).
- Define a set of frequencies to be used in the solution (FREQ, FREQ1, and FREQ 4).
- Specify Spectral Density (RANDPS and TABRND1).
- Prepare the model for a direct transient analysis (SOL 111).
- Request acceleration responses at base, tip center, and opposite corner.
- Generate an input file and submit it to the MSC.Nastran solver for direct transient analysis.
- Review the results.
ID SEMINAR, PROB10

CEND
BEGIN BULK

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| ENDDATA
Generating an input file for MSC.Nastran Users:

MSC.Nastran users can generate an input file using the data from pages 10-3 (general model description). The result should be similar to the output below.

1. MSC.Nastran input file: `prob10.dat`.

```
ID SEMINAR, PROB10
SOL 111
TIME 30
CEND
TITLE= RANDOM ANALYSIS - BASE EXCITATION
SUBTITLE= USING THE MODAL METHOD WITH LANCZOS
ECHO= UNSORTED
SPC= 101
SET 111= 33, 55, 9999
ACCELERATION(SORT2, PHASE)= 111
METHOD= 100
FREQUENCY= 100
SDAMPING= 100
RANDOM= 100
DLOAD= 100
$
OUTPUT(XYPLOT)
XTGRID= YES
YTGRID= YES
XBGRID= YES
YBGRID= YES
YTLOG= YES
XTITLE= FREQUENCY
YTITLE= ACCEL RESPONSE BASE, MAGNITUDE
YBTITLE= ACCEL RESPONSE AT BASE, PHASE
XYPLOT ACCEL RESPONSE / 9999 (T3RM, T3IP)
YTITLE= ACCEL RESPONSE AT TIP CENTER, MAGNITUDE
YBTITLE= ACCEL RESPONSE AT TIP CENTER, PHASE
XYPLOT ACCEL RESPONSE / 33 (T3RM, T3IP)
YTITLE= ACCEL RESPONSE AT OPPOSITE CORNER, MAGNITUDE
YBTITLE= ACCEL RESPONSE AT OPPOSITE CORNER, PHASE
XYPLOT ACCEL RESPONSE / 55 (T3RM, T3IP)
$
$ PLOT OUTPUT IS ONLY MEANS OF VIEWING PSD DATA
$
XGRID= YES
YGRID= YES
```
XLOG= YES
YLOG= YES
YTITLE= ACCEL P S D AT LOADED CORNER
XYPLOT ACCEL PSDF / 9999(T3)
YTITLE= ACCEL P S D AT TIP CENTER
XYPLOT ACCEL PSDF / 33(T3)
YTITLE= ACCEL P S D AT OPPOSITE CORNER
XYPLOT ACCEL PSDF / 55(T3)
$BEGIN BULK
PARAM,COUPMASS,1
PARAM,WTMASS,0.00259
$
INCLUDE 'plate.bdf'
$
GRID, 9999, , 0., 0., 0.
$
RBE2, 101, 9999, 12345, 1, 12, 23, 34, 45
$
SPC1, 101, 12456, 9999
$
CONM2, 6000, 9999, , 1.0E8
$
$ EIGENVALUE EXTRACTION PARAMETERS
$
EIGRL, 100 , , 2000.
$
$ SPECIFY MODAL DAMPING
$
TABDMP1, 100, CRIT,
+, 0., .03, 10., .03, ENDT
$
$ POINT LOADING AT TIP CENTER
$
RLOAD2, 100, 600, , , 310
$
TABLED1, 310,
+, 10., 1., 1000., 1., ENDT
$
DAREA, 600, 9999, 3, 1.E8
$
$ SPECIFY FREQUENCY STEPS
$
FREQ,100,30.
FREQ1,100,20.,20.,50
FREQ4,100,20.,1000.,.03,5
$
$ SPECIFY SPECTRAL DENSITY
$
RANDPS, 100, 1, 1, 1., 0., 111
$
$ TABRND1, 111, LOG, LOG
+ 20., 0.1, 30., 1., 100., 1., 500., .1,
+ 1000., .1, ENDT
$
ENDDATA
Submitting the input file:

2. 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 prob10 scr=yes`. Monitor the run using the UNIX `ps` command.

3. When the run is completed, use `plotps` utility to create a postscript file, `prob10.ps`, from the binary plot file `prob10.plt`. The nonlinear force and displacement plots are shown on the following pages.

4. When the run is completed, edit the `prob10.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.
Comparison of Results

5. Compare the plot made from the exercise with the plots on the following pages.
Figure 10.5