TITLE OF PROJECT REPORT

A PROJECT REPORT

Submitted by

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Under the guidance of
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SRM INSTITUTE OF SCIENCE & TECHNOLOGY

(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this project report titled "**TITLE OF PROJECT RE-PORT**" is the bonafide work of " **SANDHYA. A [Reg No: 16305011], SURESH. A [Reg No: 16305015], , ** ", who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Type your abstract here.

    Abstract should be one page synopsis of the project report typed double line spacing, Font Style Times New Roman and Font Size 14.

ACKNOWLEDGEMENTS

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ABBREVIATIONS

LS   Least Square

PSO   Particle Swarm Optimization

SI   Structural Identification

LIST OF SYMBOLS

α, β	Damping constants
θ	Angle of twist, rad
ω	Angular velocity, rad/s
b	Width of the beam, m
h	Height of the beam, m
$\{f(t)\}$	force vector
$[K^e]$	Element stiffness matrix
$[M^e]$	Element mass matrix
$\{q(t)\}$	Displacement vector
$\{\dot{q}(t)\}$	Velocity vector
$\{\ddot{q}(t)\}$	Acceleration vector

CHAPTER 1

INTRODUCTION

1.1   Inverse Problem

Structural Identification (SI) is typically an inverse process whereby structural parameters such as stiffness, damping properties are identified from input excitation and output responses.

Generally, Engineering problems can be classified into forward and inverse problems (Koh et al., 2003). In forward problems, the system output responses are calculated from the known system properties and input responses as shown in Figure 1.1 whereas in inverse problems, the system parameters are identified based on the input and output responses of the system which is shown in Figure 1.2. For a structure, the
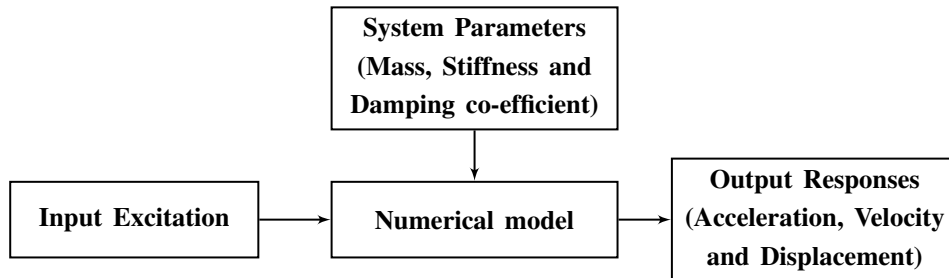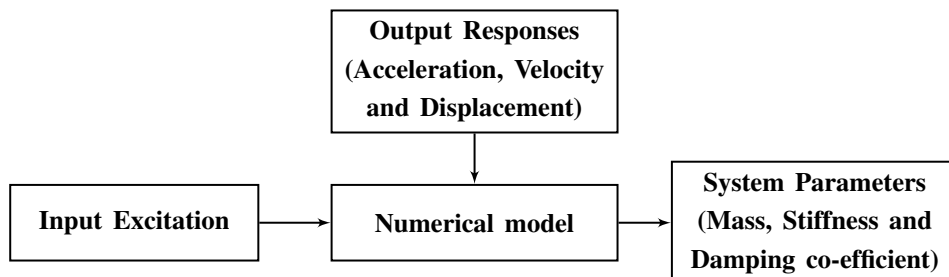

Figure 1.1: Forward problem

Figure 1.2: Inverse problem

input excitation is a periodic force and the output responses are displacement, velocity and acceleration. The input force can be measured using force transducer and the

output responses can be measured respectively using vibration pick-ups, velometer and accelerometer. Some SI algorithms require measurement of all responses or any one of the output responses. Since the input and output responses are measurable for a structure with unknown parameters, the SI problem is an inverse problem which identifies structural or damage parameters.

1.1.1   Sub sections

Sub-sections must be numbered as shown in this text.

Sub-sub sections

Sub-sections of sub section are not to be numbered and it should be in bold as shown in this text.

CHAPTER 2

LITERATURE SURVEY

2.1   Frequency Domain SI

Hearn and Testa (1989) showed that the magnitude of change in natural frequencies is a function of the severity and of the location of deterioration in structures. The modal analysis has been carried out on a welded steel frame and a wire rope with damage. Grédias and Paris (1996) proposed a direct method for determining six flexural stiffnesses of a thin anisotropic plate. In this method, natural frequencies (Meirovitch, 2001) and mode shapes have been processed using Least Square (LS) technique.

2.2   Particle Swarm Optimization

A basic variant of the Particle Swarm Optimization (PSO) (James and Eberhart, 1995) algorithm works by having a population (called a swarm) of candidate solutions (called particles). These particles are moved around in the search-space according to a few simple formulae. The movements of the particles are guided by their own best known position in the search-space as well as the entire swarm's best known position. When improved positions are being discovered these will then come to guide the movements of the swarm. The process is repeated and by doing so it is hoped, but not guaranteed, that a satisfactory solution will eventually be discovered.

CHAPTER 3

SYSTEM ANALYSIS

All the symbols used in the text must be listed out in the list of symbols page in alphabetic order, and explained with units. Equations must be written with central alignment and numbered with section number . equation number.

$$[M^e]\{\ddot{q}(t)\} + [C^e]\{\dot{q}(t)\} + [K^e]\{q(t)\} = \{f(t)\} \tag{3.1}$$

the element stiffness matrix is

$$[K^e] = \frac{EI}{l_e^3} \begin{bmatrix} 12 & 6l_e & -12 & 6l_e \\ 6l_e & 4l_e^2 & -6l_e & 2l_e^2 \\ -12 & -6l_e & 12 & -6l_e \\ 6l_e & 2l_e^2 & -6l_e & 4l_e^2 \end{bmatrix} \tag{3.2}$$

and the element consistent mass matrix is

$$[M^e] = \frac{\rho A l_e}{420} \begin{pmatrix} 156 & 22l_e & 54 & -13l_e \\ 22l_e & 4l_e^2 & 13l_e & -3l_e^2 \\ 54 & 13l_e & 156 & -22l_e \\ -13l_e & -3l_e^2 & -22l_e & 4l_e^2 \end{pmatrix} \tag{3.3}$$

$$[C] = \alpha[M] + \beta[K] \tag{3.4}$$

A matrix equation with square matrices and vectors,

$$\begin{Bmatrix} -M_1(t) \\ -V_1(t) \\ M_2(t) \\ V_2(t) \end{Bmatrix} = \begin{bmatrix} D_{11} & D_{12} & D_{13} & D_{14} \\ D_{21} & D_{22} & D_{23} & D_{24} \\ D_{31} & D_{32} & D_{33} & D_{34} \\ D_{41} & D_{42} & D_{43} & D_{44} \end{bmatrix} \begin{Bmatrix} v_1(t) \\ \theta_1(t) \\ v_2(t) \\ \theta_2(t) \end{Bmatrix} \tag{3.5}$$

CHAPTER 4

SYSTEM DESIGN

4.1 Tables and Figures

By the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non-verbal materials used in the body of the project work and appendices such as charts, graphs, maps, photographs and diagrams may be designated as figures[1]. The format for tables is given below. The table must referred in the text as Table. (4.1). The title of the table with table number should be written at the top of the table with center aligned as shown below.[2].

Table 4.1: Error in identified parameters

Exact parameter		Identified crack location (% of error)			
		Complete measurement		Incomplete measurement	
Depth(ξ)	Location(λ)	Noise free	5% Noise	Noise free	5% Noise
0.067	0.5	0.501(0.2%)	0.503(0.6%)	0.501(0.2%)	0.496(-0.8%)
0.50	0.5	0.498(-0.4%)	0.506(1.2%)	0.498(-0.4%)	0.508(1.6%)

Figures must be drawn at the appropriate places and must be referred in the same page in the text. Figures should be referred in the text as Figure 4.1. Title of figures
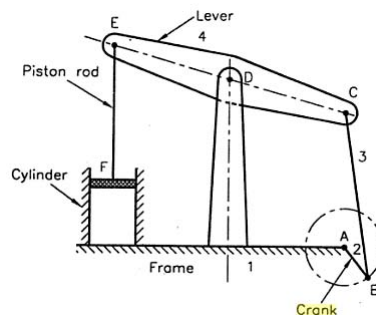

Figure 4.1: Beam engine

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[1] type footnote here
[2] An example footnote.

must be center aligned and should be displayed at the bottom of the figure as shown.
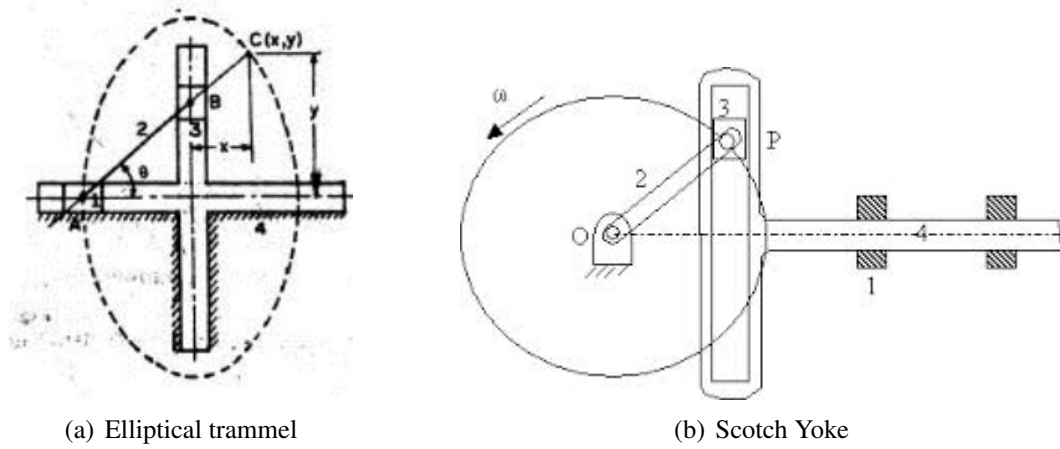

(a) Elliptical trammel   (b) Scotch Yoke

Figure 4.2: Inversions of double slider crank chain

Multiple figures with same caption can be arranged as shown in Figure 4.2 and they are referred in text such as Figure 4.2(a) and Figure 4.2(b). The graphs should be drawn at appropriate places with center alignment and it should be referred in text.
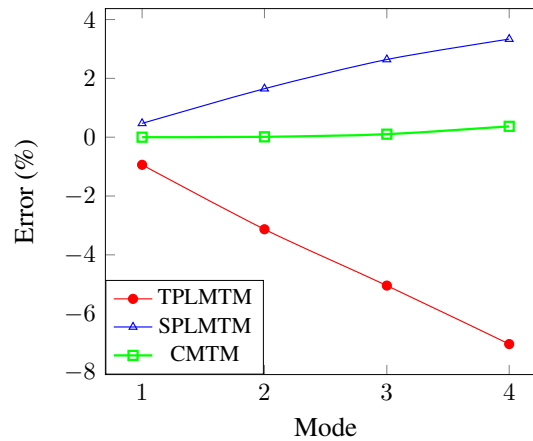

Figure 4.3: Error in natural frequencies

CHAPTER 5

CODING, TESTING

In this chapter, the program coding related to your work using MATLAB™or C can be presented here. Numbered list can be typeset in LaTex as follows.

1. **Online LaTex editors** Such as **Share LaTex**, **Write LaTex**, **Papeeria** are also available which do not require any installation.

2. Documents can be typeset or edited in the online LaTex and output file can be down loaded.

3. The LaTex template can generally be down loaded from the University/publisher's/ conference website. (.tex file)

4. Type the document in the respective template and run the program like C or MAT-LAB.

5. The output document is formatted as .pdf or .ps and saved in the same file name and same folder.

6. Some Standard LaTex templates are *IEEE*, <u>ASCE</u>, ASME, Elsevier etc.

Bullet points are generated in LaTex as follows:

✳ Requires installation of two packages.

✳ **MiKTeX** is a distribution of the typesetting system.

✳ MiKTeX provides the tools necessary to prepare documents using the TeX/LaTeX markup language.

✳ **TeXstudio** is a cross-platform open source LaTeX editor with an interface.

✳ Some other cross-platforms are Texmaker, Technic center, Winedt etc.,

✳ Install MiKTex first and TeXstudio at last.

CHAPTER 6

CONCLUSION

The Entire Project Document should have a **maximum of 80 Pages** (from cover to cover).

The Project Document along with Application Software should be submitted in a Soft Copy (CD)

N.B.: Number of Copies to be submitted: Guide - 1 hard copy, Department Library -1 hard copy & Each Candidate -1 hard copy and Soft Copy (in CD)- 2 copies

CHAPTER 7

FUTURE ENHANCEMENT

APPENDIX A

VECTOR ALGEBRA

A.1   Product of Two Vectors

The product of two vectors are may be a scalar product or vector product. The scalar product of two vectors is also called as dot product. It is defined as $\vec{a}.\vec{b} = |\vec{a}||\vec{b}|cos\theta$ where θ is the angle between the two vectors $\vec{a}$ and $\vec{b}$

the cross product or vector product is a binary operation on two vectors in three-dimensional space and is denoted by the symbol $\times$. The cross product $\vec{a} \times \vec{b}$ of two linearly independent vectors $\vec{a}$ and $\vec{b}$ is a vector that is perpendicular to both and therefore normal to the plane containing them.

APPENDIX B

MATRIX ALGEBRA

B.1 Matrix Multiplication

Matrix multiplication is a binary operation that takes a pair of matrices, and produces another matrix. Numbers such as the real or complex numbers can be multiplied according to elementary arithmetic. On the other hand, matrices are arrays of numbers, so there is no unique way to define multiplication of matrices. As such, in general the term "matrix multiplication" refers to a number of different ways to multiply matrices.

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