# LAPORAN PROJEK TAHUN AKHIR

KURSUS DIPLOMA LANJUTAN KEJURUTERAAN JENTERA KAJIAN KEJURUTERAAN , I.T.M. , SHAH ALAM

\*\*\*\*\*\*\*\*\*\*

MECHANICAL SYSTEM ANALYSIS

## VIBRATION APPROACH

\*\*\*\*\*\*

BY

JAFRI BIN AHEM

AND

JAMIL BIN MOHD SHAH

MAY 1986 \*\*\*\*\*

-

#### ACKNOWLEDGEMENT

We wish to express our deepest appreciations and wish to thank our Project Advisor, Encik Mohd Yusuff Mohd for his concerned and fruitful advices and moral support for making this project a sucess.

We would like to acknowledge and thank our parents for their advice, morally and financially help us throughout the course. We also would like to express sincere thank mechanical lecturers, fellow coursemates and others who have contributed suggestions and comments to improve this project.

> Jafri Ahem & Jamil Mohd Shah

CONTEN	TS.
and the second statements of the second statem	Constant .

CONTENTS	PAGE
CHAPTER 1:	
INTRODUCTION TO MECHANICAL SYSTEM ANALYSIS	
1 - 1 Defination of Mechanical System Analysis	1.
1 - 2 Newton's Law	5
1 - 3 Analysis of Motion: Eqn of Motion for Rigid Body	4 
Dynamics	6
1 - 4 Work & Energy	8
	25 20 20
CHAPTER 2:	10
KINEMATICS OF OSCILLATIONS	
2 - 1 Introduction	10
2 - 2 Simple Harmonic Motion (SHM)	10
2 - 3 Mathematical Representation of SHM	12
CHAPTER 3:	15
VIBRATORY SYSTEM	
3 - 1 Introduction	15
3 - 2 The Elastically Supported Rigid Body	16
3 - 3 Solid Continuum	19
3 - 4 Influent of Friction on vibration	21
3 - 5 The Disturbance	24
CHAPTER 4:	29
ANALYSIS OF VIBRATION SYSTEM WITH A	

SINGLE DEGREE OF FREEDOM

4 - 1 Free Oscillation (without damped) 4 - 2 Free Vibration with damped ે

36

29

(iv)	
CHAPTER 5:	<b>244</b> 22
HARMONICALLY EXCITED VIBRATION	
5 - 1 Force Harmonic Vibration	44
5 - 2 Rotating Unbalance	53
5 - 3 Support Motion	56
5 - 4 Vibration Isolation	60
CHAPTER 6:	65
TWO DEGREES OF FREEDOM SYSTEM	
6 - 1 Undamped Free Vibrations	66
6 - 2 Undamped Forced Vibrations	71
6 - 3 Free Vibrations With Viscous Damping	76
6 - 4 Forced Vibrations With Viscous Damping	80
CHAPTER 7:	82 · ·
MULTIPLE DEGREES OF FREEDOM SYSTEM	
7 1 Frequencies and Made Shares Fer Underned Systems	00
7 - 7 Frequencies and Houe Shapes for Undamped Systems	02
7-2 Normal Mode Response to Initial Conditions	89
7-3 Normal Mode Respone to Applied Actions	95
CHAPTER 8:	104
FINITE DIFFERENCE NUMERICAL COMPUTATION & CASE STUDY	
8 - 1 Basic of Numerical Analysis Method	104
8 - 2 Runge - Kutta Method	119
8 - 3 CASE STUDY : I, II, III, IV, V	103

CHAPTER 9: COMPUTER PROGRAMMING, CONCLUSION, AND DISCUSSION

148

8 ...

MECHANICAL SYSTEM ANALYSIS VIBRATION APPROACH

1

### CHAPTER 1

#### INTRODUCTION TO MECHANICAL SYSTEM ANALYSIS

1-1 Defination

Mechanical system analysis has long been an important part of the mathematical, physical engineering disciplines. A system in the engineering sense is an entity which can be modeled as a transformation from an input to an output. Problem in system analysis can therefore be classified as;

1. Determining the output if the input & system are known

Det the input if the output & system are known

3. Det the system if the input & output are known

The special class of system discussed in this project are those which can be modeled by means of vibration system.