

# SELECTED TOPICS In Aerospace Engineering

EDITOR

ERWIN SULAEMAN



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INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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# TABLE OF CONTENT

---

|                                  |             |
|----------------------------------|-------------|
| <b>PREFACE.....</b>              | <b>i</b>    |
| <b>TABLE OF CONTENT.....</b>     | <b>iii</b>  |
| <b>CONTRIBUTING AUTHORS.....</b> | <b>xiii</b> |

## ***PART I***

|                                                                       |          |
|-----------------------------------------------------------------------|----------|
| <b><i>FUNDAMENTAL COMPRESSOR FOR AIRCRAFT'S TURBO<br/>ENGINES</i></b> | <b>1</b> |
|-----------------------------------------------------------------------|----------|

|                             |          |
|-----------------------------|----------|
| <b><i>NOMENCLATURE.</i></b> | <b>2</b> |
|-----------------------------|----------|

## **CHAPTER ONE**

|                                            |          |
|--------------------------------------------|----------|
| <b><i>INTRODUCTION TO COMPRESSORS.</i></b> | <b>4</b> |
|--------------------------------------------|----------|

|                  |   |
|------------------|---|
| 1.1 Introduction | 4 |
|------------------|---|

|                          |   |
|--------------------------|---|
| 1.2 Types of Compressors | 4 |
|--------------------------|---|

|                                         |   |
|-----------------------------------------|---|
| 1.2.1 Positive Displacement Compressors | 4 |
|-----------------------------------------|---|

|                           |   |
|---------------------------|---|
| 1.2.2 Dynamic Compressors | 4 |
|---------------------------|---|

|                                    |   |
|------------------------------------|---|
| 1.3 Comparison of Compressor Types | 5 |
|------------------------------------|---|

|                 |   |
|-----------------|---|
| 1.3.1 Flow rate | 5 |
|-----------------|---|

|                  |   |
|------------------|---|
| 1.3.2 Efficiency | 6 |
|------------------|---|

|                      |   |
|----------------------|---|
| 1.3.3 Pressure Ratio | 7 |
|----------------------|---|

|                             |   |
|-----------------------------|---|
| 1.3.4 Characteristic Curves | 7 |
|-----------------------------|---|

## **CHAPTER TWO**

|                                                        |    |
|--------------------------------------------------------|----|
| <b><i>TWO-DIMENSIONAL ANALYSIS OF COMPRESSORS.</i></b> | 9  |
| 2.1 Velocity diagrams of the compressor stage          | 10 |
| 2.2 Thermodynamics of the compressor stage             | 10 |
| 2.3 Stage loss and efficiency                          | 11 |
| 2.4 Reaction ratio                                     | 12 |
| 2.5 Stage loading                                      | 13 |

## **CHAPTER THREE**

|                                                          |    |
|----------------------------------------------------------|----|
| <b><i>THREE-DIMENSIONAL ANALYSIS OF COMPRESSORS.</i></b> | 15 |
| 3.1 Theory of radial equilibrium                         | 15 |
| 3.2 Free-vortex flow                                     | 16 |
| 3.3 Forced vortex                                        | 18 |
| 3.4 General whirl distribution                           | 18 |

## **CHAPTER FOUR**

|                                                      |    |
|------------------------------------------------------|----|
| <b><i>ROTATING STALL AND SURGE.</i></b>              | 20 |
| 4.1 Performance of Axial and Radial Compressors      | 20 |
| 4.2 Aerodynamic Flow Instabilities                   | 22 |
| 4.2.1 Rotating stall                                 | 23 |
| 4.2.2 Surge                                          | 24 |
| 4.2.3 Rotating Stall and Surge in Radial Compressors | 26 |

## **CHAPTER FIVE**

|                                                |    |
|------------------------------------------------|----|
| <b><i>MODELING OF COMPRESSION SYSTEMS.</i></b> | 27 |
| 5.1 Introduction                               | 27 |
| 5.2 Greitzer lumped parameter model            | 28 |

## **CHAPTER SIX**

|                                  |    |
|----------------------------------|----|
| <b><i>COMPRESSOR MODELS.</i></b> | 34 |
|----------------------------------|----|

|     |                      |    |
|-----|----------------------|----|
| 6.1 | Moore Model          | 34 |
| 6.2 | Moore-Greitzer model | 36 |

## **CHAPTER SEVEN**

### ***SURGE AND ROTATING STALL.*** 40

|     |                                     |    |
|-----|-------------------------------------|----|
| 7.1 | Stability of compression systems    | 40 |
| 7.2 | Control of Surge and Rotating Stall | 41 |
| 7.3 | Avoidance Control                   | 41 |
| 7.4 | Active Control                      | 44 |

### ***REFERENCE OF PART I.*** 46

## ***PART II***

### ***RIGID-BODY DYNAMICS OF AIR VEHICLE*** 48

## **CHAPTER EIGHT**

### ***AIRCRAFT RIGID-BODY EQUATION OF MOTIONS: A NONLINEAR MODEL***

|     |                               |    |
|-----|-------------------------------|----|
| 8.1 | Introduction                  | 49 |
| 8.2 | Definition of Axes and Angles | 49 |
| 8.3 | The Rigid-Body Equations      | 52 |
| 8.4 | Conclusions                   | 55 |

## **CHAPTER NINE**

### ***AIRCRAFT EQUATIONS OF MOTIONS: A NONLINEAR MODEL***

|     |                                          |    |
|-----|------------------------------------------|----|
| 9.1 | Introduction                             | 57 |
| 9.2 | Orientation and Position of the Airplane | 57 |
| 9.3 | Euler's Equations of Motion              | 59 |
| 9.4 | Effect of Spinning Rotors                | 60 |
| 9.5 | The Collected Equations                  | 61 |

|     |             |    |
|-----|-------------|----|
| 9.6 | Conclusions | 62 |
|-----|-------------|----|

## **CHAPTER TEN**

### ***AIRCRAFT EQUATIONS OF MOTION: A LINEAR MODEL***

|      |                              |    |
|------|------------------------------|----|
| 10.1 | Introduction                 | 63 |
| 10.2 | The Small-Disturbance Theory | 63 |
| 10.3 | Conclusions                  | 69 |

|  |                                    |    |
|--|------------------------------------|----|
|  | <b><i>REFERENCE OF PART II</i></b> | 70 |
|--|------------------------------------|----|

## ***PART III***

### ***DYNAMICS OF FLEXIBLE STRUCTURE OF AIR VEHICLE***

71

|  |                      |    |
|--|----------------------|----|
|  | <b>NOMENCLATURES</b> | 72 |
|--|----------------------|----|

## **CHAPTER ELEVEN**

### ***OVERVIEW OF DYNAMICS OF FLEXIBLE AIR VEHICLE***

76

|      |                                                               |    |
|------|---------------------------------------------------------------|----|
| 11.1 | Introduction                                                  | 76 |
| 11.2 | The Influence of the Structural Flexibility on Vehicle Design | 76 |
| 11.3 | Non-uniform Beam Finite Element                               | 77 |
| 11.4 | Aerodynamic Discrete Element Methods                          | 79 |
| 11.5 | The doublet lattice method (DLM)                              | 79 |
| 11.6 | The doublet point method (DPM)                                | 80 |
| 11.7 | Conclusions                                                   | 81 |

## **CHAPTER TWELVE**

### ***TRANSLATION OF AXIS PROCEDURE TO CONSTRUCT STIFFNESS MATRIX***

|      |                                   |    |
|------|-----------------------------------|----|
| 12.1 | Introduction                      | 83 |
| 12.2 | Static Equivalence Translation    | 83 |
| 12.3 | Kinematic Equivalence Translation | 84 |

|                                    |    |
|------------------------------------|----|
| 12.4 Stiffness Matrix Construction | 85 |
| 12.5 Conclusion                    | 87 |

## **CHAPTER THIRTEEN**

### **MINIMUM DENOMINATOR OF RATIONAL FUNCTION**

|                                                                            |    |
|----------------------------------------------------------------------------|----|
| 13.1 Introduction                                                          | 88 |
| 13.2 Rational Function Transformation                                      | 88 |
| 13.3 MDRF Procedure for Non-linear Variation of the Stiffness Distribution | 89 |
| 13.4 Direct Differentiation Method                                         | 90 |
| 13.5 Substitution Procedure                                                | 91 |
| 13.6 Conclusion                                                            | 93 |

## **CHAPTER FOURTEEN**

### ***TORSIONAL STIFFNESS MATRIX OF NON-PRISMATIC BEAM ELEMENTS***

|                                                |    |
|------------------------------------------------|----|
| 14.1 Introduction                              | 94 |
| 14.2 Torsional - Twist Deformation Relation    | 94 |
| 14.3 Deformation of the Cantilever Bar Problem | 95 |
| 14.4 Flexibility Matrix of the Cantilever Bar  | 97 |
| 14.5 Stiffness Matrix                          | 97 |
| 14.6 Conclusion                                | 98 |

## **CHAPTER FIFTEEN**

### ***BENDING STIFFNESS MATRIX OF NON-PRISMATIC BEAM ELEMENTS***

|                                                |     |
|------------------------------------------------|-----|
| 15.1 Introduction                              | 99  |
| 15.2 Load - Displacement Relation              | 99  |
| 15.3 Displacement of a Cantilever Bar Problem  | 100 |
| 15.4 Flexibility Matrix of the Cantilever Beam | 103 |
| 15.5 Stiffness Matrix                          | 104 |
| 15.6 Conclusion                                | 104 |



## **CHAPTER SIXTEEN**

### ***FORMULATION OF KERNEL FUNCTION FOR AERODYNAMIC LOADING ON AIR VEHICLE***

|                                                      |     |
|------------------------------------------------------|-----|
| 16.1 Introduction                                    | 105 |
| 16.2 Formulations of the Kernel Function             | 105 |
| 16.3 The formulation of Watkins, Runyan and Woolston | 106 |
| 16.4 Formulations of Laschka                         | 107 |
| 16.5 Formulations of Yates                           | 109 |
| 16.6 Formulations of Landahl                         | 109 |
| 16.7 Conclusion                                      | 110 |

## **CHAPTER SEVENTEEN**

### ***UNSTEADY AERODYNAMIC THEORY OF LIFTING SURFACE***

|                                      |     |
|--------------------------------------|-----|
| 17.1 Introduction                    | 111 |
| 17.2 Assumptions                     | 111 |
| 17.3 Basic Concept                   | 111 |
| 17.4 Boundary Conditions             | 113 |
| 17.5 Kernel Function                 | 113 |
| 17.6 Incomplete Cylindrical Function | 115 |
| 17.7 Conclusion                      | 115 |

## **CHAPTER EIGHTEEN**

### ***NUMERICAL EVALUATIONS OF HYPERGEOMETRIC CYLINDRICAL FUNCTIONS***

|                                                             |     |
|-------------------------------------------------------------|-----|
| 18.1 Introduction                                           | 117 |
| 18.2 Kernel Integral Function                               | 117 |
| 18.3 Modified Bessel Function of the First Kind of Order 0  | 118 |
| 18.4 Modified Bessel Function of the First Kind of Order 1  | 119 |
| 18.5 Modified Bessel Function of the Second Kind of Order 0 | 120 |
| 18.6 Modified Bessel Function of the Second Kind of Order 1 | 121 |
| 18.7 Modified Struve Function                               | 121 |
| 18.8 Conclusion                                             | 122 |

## **CHAPTER NINETEEN**

### ***ANALYTICAL DERIVATION OF THE INCOMPLETE CYLINDRICAL FUNCTIONS: REAL PARTS***

|                                               |     |
|-----------------------------------------------|-----|
| 19.1 Introduction                             | 123 |
| 19.2 The finite subinterval of the integral   | 123 |
| 19.3 The Infinite Subinterval of the Integral | 125 |
| 19.4 Conclusion                               | 129 |

## **CHAPTER TWENTY**

### ***ANALYTICAL DERIVATION OF THE INCOMPLETE CYLINDRICAL FUNCTIONS: IMAGINARY PARTS***

|                                               |     |
|-----------------------------------------------|-----|
| 20.1 Introduction                             | 130 |
| 20.2 The finite subinterval of the integral   | 130 |
| 20.3 The Infinite Subinterval of the Integral | 132 |
| 20.4 Conclusion                               | 134 |

## **CHAPTER TWENTY ONE**

### ***ALTERNATE EXPANSION SERIES FOR THE INCOMPLETE CYLINDRICAL FUNCTION***

|                                                   |     |
|---------------------------------------------------|-----|
| 21.1 Introduction                                 | 135 |
| 21.2 Separation of Real and Imaginary Functions   | 135 |
| 21.3 Separation of Regular and Singular Functions | 138 |
| 21.4 Conclusion                                   | 139 |

## **CHAPTER TWENTY TWO**

### ***EXPANSION SERIES OF CONTINUOUS FUNCTION USING ANALYTICAL INTEGRATION OF LEAST SQUARE REGRESSION***

|                   |     |
|-------------------|-----|
| 22.1 Introduction | 140 |
|-------------------|-----|

|                                                                                 |     |
|---------------------------------------------------------------------------------|-----|
| 22.2 Taylor and Maclaurin expansion series                                      | 140 |
| 22.3 Present Least Square Expansion Series                                      | 141 |
| 22.4 Application of the Present Approach to the Incomplete Cylindrical Function | 143 |
| 22.4 Conclusion                                                                 | 145 |

## **CHAPTER TWENTY THREE**

### ***ALTERNATE APPROXIMATE FUNCTION FOR KERNEL FUNCTION OF PLANAR OSCILLATING LIFTING SURFACES***

|                                               |     |
|-----------------------------------------------|-----|
| 23.1 Introduction                             | 146 |
| 23.2 Epstein's Approach                       | 146 |
| 23.3 Present Approach for Near Field Region   | 147 |
| 23.4 Present Approach for Middle Field Region | 150 |
| 23.5 Present Approach for Far Field Region    | 151 |
| 23.6 Conclusion                               | 151 |

## **CHAPTER TWENTY FOUR**

### ***APPROXIMATE FUNCTION FOR NEAR-FIELD KERNEL FUNCTION OF NON-PLANAR LIFTING SURFACES***

|                                   |     |
|-----------------------------------|-----|
| 24.1 Introduction                 | 152 |
| 24.2 Kernel Function Equation     | 152 |
| 24.3 Present Approximate Function | 154 |
| 24.4 Conclusion                   | 157 |

## **CHAPTER TWENTY FIVE**

### ***APPROXIMATE FUNCTION FOR FAR-FIELD KERNEL FUNCTION OF OSCILLATING NON-PLANAR LIFTING SURFACES***

|                                          |     |
|------------------------------------------|-----|
| 25.1 Introduction                        | 158 |
| 25.2 Landahl's Kernel Function Equation  | 158 |
| 25.3 Present Kernel Function Formulation | 159 |
| 25.4 Conclusion                          | 161 |

## **CHAPTER TWENTY SIX**

### ***IMPROVED VORTEX LATTICE METHOD***

|                                    |     |
|------------------------------------|-----|
| 26.1 Introduction                  | 162 |
| 26.2 Present Vortex Lattice Method | 162 |
| 26.3 Conclusion                    | 167 |

## **CHAPTER TWENTY SEVEN**

### ***IMPROVED DOUBLET POINT METHOD***

|                                                  |     |
|--------------------------------------------------|-----|
| 27.1 Introduction                                | 168 |
| 27.2 Present DPM for Planar Lifting Surfaces     | 168 |
| 27.3 Present DPM for Non-Planar Lifting Surfaces | 170 |
| 27.4 Conclusion                                  | 174 |

## **CHAPTER TWENTY EIGHT**

### ***IMPROVED DOUBLET LATTICE METHOD***

|                                              |     |
|----------------------------------------------|-----|
| 28.1 Introduction                            | 176 |
| 28.2 Present DLM for Planar Lifting Surfaces | 176 |
| 28.3 Conclusion                              | 179 |

## **CHAPTER TWENTY NINE**

### ***APPLICATION OF THE AERODYNAMIC DISCRETE ELEMENT METHODS***

|                                       |     |
|---------------------------------------|-----|
| 29.1 Introduction                     | 180 |
| 29.2 Delta Wing with AR=2             | 180 |
| 29.3 Cropped-Double-Delta Wing        | 182 |
| 29.4 Sweptback Wing with Partial Flap | 183 |
| 29.5 AGARD Wing-Horizontal Tail       | 184 |
| 29.6 Conclusion                       | 186 |

## **CHAPTER THIRTY**

### ***AEROELASTIC STABILITY PROBLEM OF AIR VEHICLE***

|                   |     |
|-------------------|-----|
| 30.1 Introduction | 187 |
|-------------------|-----|

|                                                  |     |
|--------------------------------------------------|-----|
| 30.2 The Flutter Solution Method                 | 187 |
| 30.3 Validation of the present flutter procedure | 191 |
| 30.4 Conclusion                                  | 193 |
| <b><i>REFERENCES OF PART III</i></b>             | 195 |

*UNSTEADY AERODYNAMIC THEORY OF LIFTING  
SURFACE*

**17.1. Introduction**

**M**ost of formulations to construct stiffness matrix in the finite element method are based on the so-called stiffness approach. However, for special type of element, such as a beam element with arbitrary variation of its stiffness, another approach based on a flexibility approach may give a more accurate result as reported by many articles. The drawback of using the flexibility method is usually on the need to transform the resulting flexibility matrix into the stiffness matrix to form a standard finite element equation. A direct approach to perform a matrix invert operation, even though it looks simple in the formulation, may reduce the accuracy of the solution in addition to increasing computational time.

**17.2. Assumptions**

The basic lifting surface theory assumes that the flow is inviscid, isentropic, subsonic, and has no flow separation. The thickness of the surface is neglected and the angle of attack is small such that the small-disturbance potential flow approach may be used to linearize the mixed boundary value problem. The compressibility effect is taken into account in the aerodynamic governing equation using the Prandtl-Glauert transformation.

**17.3. Basic Concept**