Helicopter Dynamics HW#2 **2017-23159 Byeong Uk Im**

1. **Justify the following**

   a) **The flap mode is highly damped**

   b) **In an articulated rotor blade, the rotating flap frequency was found to be less than one per revolution.**

   c) **Most of the flying rotors have fundamental flap frequencies (rotating) of less than 1.2 per revolution.**

   d) **Propeller blades have fundamental flap frequencies much higher than those of helicopter blades.**

   e) **Most of the rotors operate at one fixed rotational speed.**

   f) **Free decay vibration is not natural frequency.**

   g) **At higher rotational speeds, the fundamental flap frequency becomes rotational speed itself.**

   h) **To calculate accurately the first few modes (2 to 3), one needs only a few terms in the assumed deflection series (4 to 6), but to calculate the bending stresses at the root of the blade, one needs a large number of terms in the series.**

   i) **Frequencies calculated using Galerkin method and Rayleigh-Ritz method are always higher than exact values.**

   j) **If an assumed deflection series satisfies all the boundary conditions, will there be any difference in the results obtained using the Galerkin method and Rayleigh-Ritz method.**

   k) **The solution converges monotonically to the exact solution with the increasing number of terms in the approximate series (R-R method). For one particular series, the solution fluctuated with an increasing number of terms. Any possible source of trouble.**

   l) **The lumped parameter formulation (Myklestad) is a crude form of finite element analysis.**

   m) **To increase the polynomial distribution for displacement within a beam element one can include the continuity of the second derivative of displacement between elements, but it is never done that way.**

   n) **The beauty of finite element analysis is its adaptability to different configurations which is not possible with other approximate methods.**

   o) **A great care is taken to calculate the natural vibration characteristics (rotating) of the blade.**

   p) **For calculating the bending stresses, the force summation is preferred over the modal method.**

q) For dynamic response, the normal mode approach results in key simplification of the multi-degree system.

r) The Fourier series is quite different from the Fourier coordinate transformation.

s) One has to be careful using the Fourier series solution to transient response problems.

t) During the wind tunnel testing of a rotor, a 1/rev signal was observed from an accelerometer mounted on the top of the hub and the test was immediately stopped.

u) For multi-cyclic vibration control, the swash plate is excited at 4/rev to eliminate 3, 4 and 5/rev bending stresses at the blade root.

v) The progressive mode is quite different from the regressive mode.

w) The rotor acts as a filter for many harmonics.

x) The longitudinal and lateral TPP tilt equation are coupled in hovering flight.

y) High dynamic stresses on blades does not necessarily mean high vibration in body.

z) Finite difference method is quite commonly used for structural response problems whereas Fourier series and Floquet methods are more commonly used for blade response problems.

aa) For solving stability and response problems using Floquet theory, one needs to find the initial conditions as a first step. However, for stability calculations using the Floquet method, there is no need to find the initial conditions.

bb) The nature of the eigenvalue explains the system behaviors.

cc) For the dynamics of a blade, the mass distribution of the outermost part and the stiffness distribution of the innermost part play an important role.