AE-641A (Space Dynamics-I)

Quiz No. 3

Quiz Procedure

(i) Clearly write out your solution to the quiz problems within the specified time on blank sheets of paper. (Marks will be given only for complete calculation/derivation steps.)

(ii) Take *low-resolution* pictures of your solution, convert them into a single PDF file (about 1MB), and send it to me by email (ashtew@iitk.ac.in) from your *registered* email account.

(iii) Submit your solution only *once*. In case of multiple submissions, only the *earliest* one will be accepted.

(iv) The time limit will be *strictly enforced*, and late submissions will *not* be accepted. The deadline includes extra ten minutes to submit your solution.

Quiz No. 3 (Time: 60 min; Total Marks: 60)
(Marks for each problem are indicated in parentheses.)

1. The orientation of a frame $(\mathbf{i}, \mathbf{j}, \mathbf{k})$ relative to a reference frame $(\mathbf{I}, \mathbf{J}, \mathbf{K})$ is described by a positive elementary rotation of $30°$ about the first axis $\mathbf{I}$, followed by a positive elementary rotation of $330°$ about the second axis of the intermediate frame $(\mathbf{I'}, \mathbf{J'}, \mathbf{K'})$. Determine the Euler angles Ω, i, ω corresponding to the sequence $(\Omega_3, i_1, \omega_3)$ for the given orientation.

   (20)

2. For an orbit around the Earth $(\mu = 398600.4 \text{ km}^3/\text{s}^2)$ with $a = 7500$ km, $e = 0.1$, $\Omega = 30°$, $\omega = 180°$, $i = 90°$, determine the position and velocity vectors in the geocentric celestial reference frame 10 min. after reaching the radius of 8250 km.

   (25)

3. An Earth-orbiting spacecraft is observed to have the following geocentric position and velocity vectors in a celestial reference frame:

$$\mathbf{r} = -6000\mathbf{I} + 4000\mathbf{J} \text{ (km)}$$
$$\mathbf{v} = 2\mathbf{I} + 7.5\mathbf{K} \text{ (km/s)}$$

   Determine the following at the given point:

   (a) Declination.
   (b) Right ascension.
   (c) Flight-path angle.
   (d) Velocity azimuth.

   (15)

Please send your solution to me (ashtew@iitk.ac.in) before 01:10 p.m. today.