Important Satellite Orbital Characteristics Formulas PDF

Formulas
Examples
with Units

List of 16
Important Satellite Orbital Characteristics Formulas

1) Anomalistic Period Formula

Evaluate Formula

Formula

$$T_{AP} = \frac{2 \cdot \pi}{n}$$

Example with Units

$$139.6263\,\text{s} = \frac{2 \cdot 3.1416}{0.045\,\text{rad/s}}$$

2) Julian Century Formula

Evaluate Formula

Formula

$$JC = \frac{JD - JD_{ref}}{t_{ref}}$$

Example with Units

$$300\,\text{d} = \frac{427\,\text{d} - 7\,\text{d}}{1.4}$$

3) Julian Day Formula

Evaluate Formula

Formula

$$JD = \left(t_{ref} \cdot JC\right) + JD_{ref}$$

Example with Units

$$427\,\text{d} = \left(1.4 \cdot 300\,\text{d}\right) + 7\,\text{d}$$

4) Kepler's First Law Formula

Evaluate Formula

Formula

$$e = \frac{\sqrt{\left(a_{semi}^{2} - b_{semi}^{2}\right)}}{a_{semi}}$$

Example with Units

$$0.1269 = \frac{\sqrt{\left(581.7\,\text{km}^{2} - 577\,\text{km}^{2}\right)}}{581.7\,\text{km}}$$

5) Kepler's Third Law Formula

Evaluate Formula

Formula

$$a_{semi} = \left(\frac{[GM.Earth]}{n^{2}}\right)^{\frac{1}{3}}$$

Example with Units

$$581706.9457\,\text{km} = \left(\frac{4E{+}14\,\text{m}^3/\text{s}^2}{0.045\,\text{rad/s}^{2}}\right)^{\frac{1}{3}}$$

6) Local Sidereal Time Formula

Evaluate Formula

Formula

$$LST = GST + E_{long}$$

Example with Units

$$111° = 96° + 15°$$

7) Mean Anomaly Formula

Evaluate Formula

Formula

$$M = E - e \cdot \sin(E)$$

Example with Units

$$31.9587° = 36° - 0.12 \cdot \sin(36°)$$

8) Mean Motion of Satellite Formula

Evaluate Formula

Formula

$$n = \sqrt{\frac{[GM.Earth]}{a_{semi}^3}}$$

Example with Units

$$0.045\,\text{rad/s} = \sqrt{\frac{4E{+}14\,\text{m}^3/\text{s}^2}{581.7\,\text{km}^3}}$$

9) Nominal Mean Motion Formula

Evaluate Formula

Formula

$$n_o = \sqrt{\frac{[GM.Earth]}{a_{semi}^3}}$$

Example with Units

$$0.045\,\text{rad/s} = \sqrt{\frac{4E{+}14\,\text{m}^3/\text{s}^2}{581.7\,\text{km}^3}}$$

10) Orbital Period of Satellite in Minutes Formula

Evaluate Formula

Formula

$$P_{min} = 2 \cdot \frac{\pi}{n}$$

Example with Units

$$2.3271\,\text{min} = 2 \cdot \frac{3.1416}{0.045\,\text{rad/s}}$$

11) Position Vector Formula

Evaluate Formula

Formula

$$r_{pos} = \frac{a_{major} \cdot \left(1 - e^2\right)}{1 + e \cdot \cos(v)}$$

Example with Units

$$9.6936\,\text{m} = \frac{10.75\,\text{m} \cdot \left(1 - 0.12^2\right)}{1 + 0.12 \cdot \cos(0.684\,\text{s})}$$

12) Range Vector Formula

Evaluate Formula

Formula

$$V_{range} = V_{sr} - [Earth\text{-}R]$$

Example with Units

$$1084.9912\,\text{km} = 7456\,\text{km} - 6371.0088\,\text{km}$$

13) Reference Time in Julian Centuries Formula

Evaluate Formula

Formula

$$t_{ref} = \frac{JD - JD_{ref}}{JC}$$

Example with Units

$$1.4 = \frac{427\,\text{d} - 7\,\text{d}}{300\,\text{d}}$$

14) True Anomaly Formula

Evaluate Formula

Formula

$$v = M + \left(2 \cdot e \cdot \sin(M)\right)$$

Example with Units

$$0.6848\,\text{s} = 31.958° + \left(2 \cdot 0.12 \cdot \sin(31.958°)\right)$$

15) Universal Time Formula

Evaluate Formula

Formula

$$UT_{day} = \left(\frac{1}{24}\right) \cdot \left(t_{hrs} + \left(\frac{t_{min}}{60}\right) + \left(\frac{t_{sec}}{3600}\right)\right)$$

Example with Units

$$0.2917\,\text{d} = \left(\frac{1}{24}\right) \cdot \left(168\,\text{h} + \left(\frac{20\,\text{min}}{60}\right) + \left(\frac{0.5\,\text{s}}{3600}\right)\right)$$

16) Universal Time Degree Formula

Evaluate Formula

Formula

$$UT° = \left(UT_{day} \cdot 360\right)$$

Example with Units

$$6002.3059° = \left(0.291\,\text{d} \cdot 360\right)$$

Variables used in list of Satellite Orbital Characteristics Formulas above

- a_{major} Major Axis *(Meter)*
- a_{semi} Semi Major Axis *(Kilometer)*
- b_{semi} Semi Minor Axis *(Kilometer)*
- **e** Eccentricity
- **E** Eccentric Anomaly *(Degree)*
- E_{long} East Longitude *(Degree)*
- **GST** Greenwich Sidereal Time *(Degree)*
- **JC** Julian Century *(Day)*
- **JD** Julian Day *(Day)*
- JD_{ref} Julian Day Reference *(Day)*
- **LST** Local Sidereal Time *(Degree)*
- **M** Mean Anomaly *(Degree)*
- **n** Mean Motion *(Radian per Second)*
- n_o Nominal Mean Motion *(Radian per Second)*
- P_{min} Orbital Period in Minutes *(Minute)*
- r_{pos} Position Vector *(Meter)*
- T_{AP} Anomalistic Period *(Second)*
- t_{hrs} Time in Hour *(Hour)*
- t_{min} Time in Minutes *(Minute)*
- t_{ref} Reference Time
- t_{sec} Time in Seconds *(Second)*
- UT_{day} Universal Time *(Day)*
- **UT°** Universal Time Degree *(Degree)*
- **v** True Anomaly *(Second)*
- V_{range} Range Vector *(Kilometer)*
- V_{sr} Satellite Radius Vector *(Kilometer)*

Constants, Functions, Measurements used in list of Satellite Orbital Characteristics Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- constant(s): **[Earth-R]**, 6371.0088
  Earth mean radius
- constant(s): **[GM.Earth]**, 3.986004418E+14
  Earth's Geocentric Gravitational Constant
- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Functions: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Kilometer (km), Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s), Day (d), Minute (min), Hour (h)
  Time Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion

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