

**Question 1:** Convert geodetic position 290 deg Long 42 deg latitude ellipsoidal height 0 m into Cartesian and geocentric coordinates. What would be the error in position if geocentric coordinates were confused with geodetic coordinates at this latitude?

**Question 2:** A broadcast ephemeris file for Jan 16, 2002 is given below. All of the GPS satellites are given. For at least the set of PRN's 4, 7, 11, 26, 27, 28 compute

- (1) A 3-D plot of the trajectories of the motions of the satellites in
  - (a) Inertial space. Produce plots for 4 orbits of the satellites. Comment on the how closely the satellite tracks overlap.
  - (b) Earth fixed frame. Plots for 2 orbits of the satellites.
- (2) A ground track plot (i.e., the track of the satellite position radially projected to the surface of the sphere). OPTIONAL: Extra credit for also showing projection on an ellipsoid (Projection of ground normal to the satellite).
- (3) A sky map for geocentric location 244.5 deg Long, 35.8 deg latitude. A sky map shows azimuth and elevation as a radial plot with zenith distance scaled to a convenient distance unit.

The full definition of the RINEX standard can be found at:

<ftp://igsceb.jpl.nasa.gov/igsceb/data/format/rinex2.txt>

RINEX Navigation message file:

The following is a RINEX format dump of the Ephemeris sub frames. The messages from all satellites are merged into the one file. The format of the data entries is:

The first three lines are comments. The rest of the file is made up of groups of seven lines per satellite. The format of these lines is:

prn	yy	mm	dd	hh	mm	sec	af0	af1	af2	
							aode	crs	dn	MO
							cuc	ecc	cus	art
							toe	cic	om0	cis
							i0	crc	w	omd
							idt	cflg12	weekno	pflg12
							svaccuracy	svhealth	tgd	aodc
							transmit	spare	spare	spare

where prn is the PRN number of satellite

yy mm dd hh mm sec is the epoch to which the clock parameters follow apply

af0, af1, af2 are the clock offset(sec), rate (sec/sec) and

acceleration (sec/sec^2).

adoe age of ephemeris entry (sec) i.e, how long ago was it  
 uploaded  
 crs,crc radius corrections (m)  
 dn correction to mean motion (radian/sec)  
 M0 Mean anomaly(radians)  
 cuc,cus correction to argument in latitude (rad)  
 ecc eccentricity  
 art square root of semi-major axis (m^.5)  
 toe time of ephemeris  
 cic,cis corrections to inclination  
 om0 longitude of the ascending node (rad) (Capital omega)  
 i0 inclination (rads)  
 w argument of perigee (rad) (lower case omega)  
 omd time derivative of longitude of the ascending node  
 (rad/sec)  
 idt time derivative of inclination (rads/sec)  
 cflg12, pflg12 Flags (whose meaning is not clear)  
 weekno GPS Week Number  
 svaccuracy range accuracy (m)  
 svhealth satellite health flag  
 tgd Group delay L2 bias(word 7 subframe 1)  
 aodc age of clock parameter upload(sec)  
 transmit Transmission time seconds of GPS week  
 spare Un-used positions.

The navigation file is linked as brdc0160.02n and is listed below:

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      2                NAVIGATION DATA                RINEX VERSION / TYPE
CCRINEXN V1.6.0 UX  CDDIS                16-JAN-00 20:32  PGM / RUN BY / DATE
IGS BROADCAST EPHEMERISFILE                COMMENT
  0.2980D-07 0.2980D-07 -0.1192D-06 0.0000D+00        ION ALPHA
  0.1516D+06 -0.1638D+06  0.0000D+00 0.6554D+05        ION BETA
  0.838190317154D-08 0.222044604925D-13  503808      1149 DELTA-UTC: A0,A1,T,W
  13                                                LEAP SECONDS
                                                END OF HEADER
1 02  1 1616  0  0.0 0.211737118661D-03 0.147792889038D-11 0.000000000000D+00
  0.160000000000D+03-0.923125000000D+020.448090093322D-08-0.150005755213D+01
-0.460073351860D-05 0.528647471219D-020.406056642532D-05 0.515370207596D+04
  0.316800000000D+060.614672899246D-07-0.423702392951D+00 0.162050127983D-06
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  0.280000000000D+01 0.000000000000D+00-0.325962901115D-080.160000000000D+03
  0.309618000000D+06 0.400000000000D+010.000000000000D+00 0.000000000000D+00
2 02  1 1616  0  0.0-0.137686729431D-03-0.591171556152D-11 0.000000000000D+00
  0.214000000000D+03 0.210937500000D+020.529950646000D-08 0.278231117489D+01
  0.983476638794D-06 0.221078646136D-010.651739537716D-05 0.515197328186D+04
  0.316800000000D+06 0.121071934700D-060.156776431936D+01-0.320374965668D-06
  0.932175348525D+000.231125000000D+03-0.198206892071D+01-0.799533303771D-08
  0.265368196508D-09 0.100000000000D+010.114900000000D+04 0.000000000000D+00
  0.280000000000D+010.000000000000D+00-0.186264514923D-08 0.214000000000D+03
  0.309618000000D+06 0.400000000000D+010.000000000000D+00 0.000000000000D+00
3 02  1 1616  0  0.0 0.101216137409D-03 0.306954461848D-11 0.000000000000D+00
  
```

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0.316800000000D+06 0.186264514923D-070.264603319628D+01 0.726431608200D-07  
0.934485296172D+00 0.240250000000D+030.543602714001D+00-0.842927968476D-08  
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0.309618000000D+06 0.000000000000D+000.000000000000D+00 0.000000000000D+00  
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0.200000000000D+01 0.000000000000D+00-0.745058059692D-08 0.320000000000D+02  
0.309618000000D+06 0.000000000000D+00 0.000000000000D+00 0.000000000000D+00  
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0.400000000000D+01 0.000000000000D+00-0.651925802231D-08 0.440000000000D+02  
0.309618000000D+06 0.000000000000D+00 0.000000000000D+00 0.000000000000D+00  
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