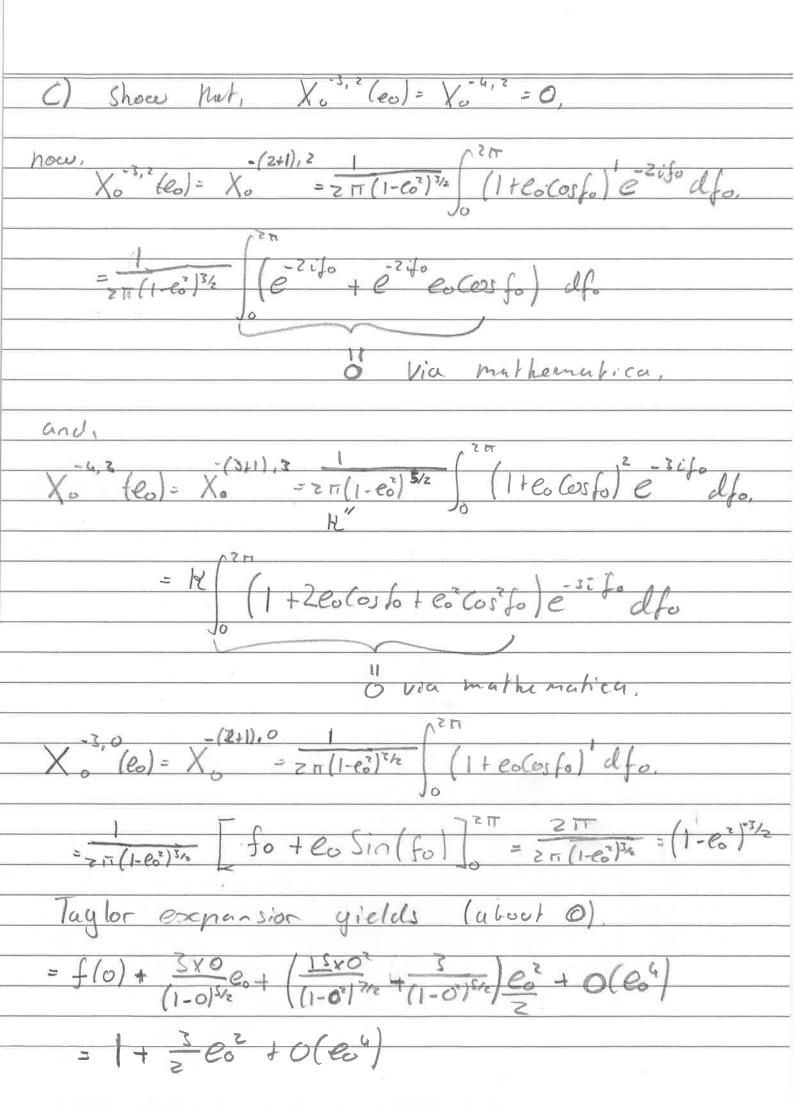
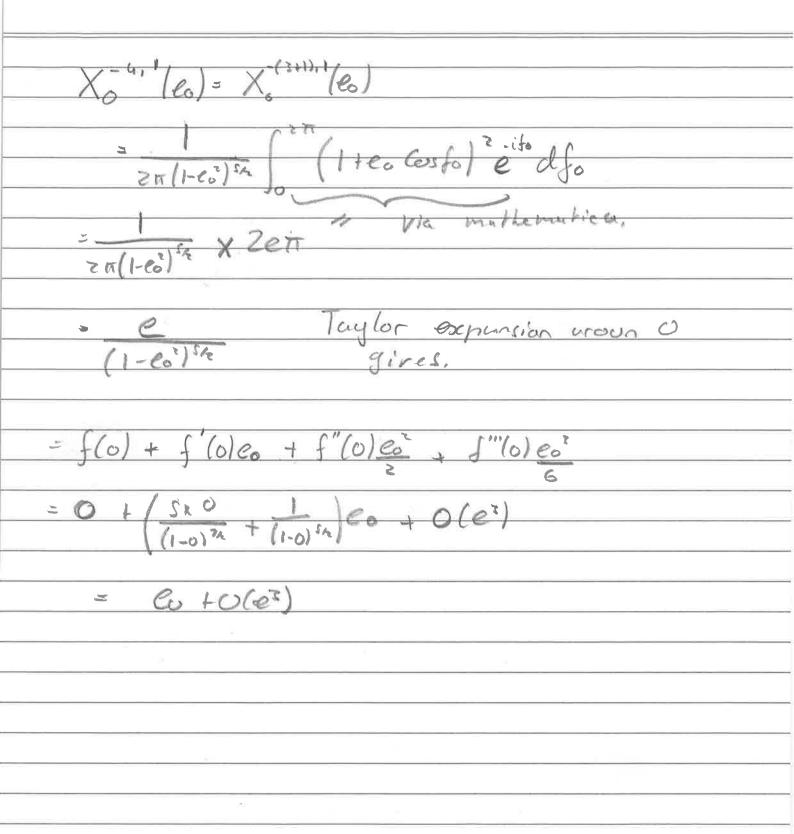
Dynamics of exoplamets Assignment Z.
94 Fourier expansions
a) (angular momentum/unit muss:
a) (angular momentum / unit muss: $h = r \hat{f} = \sqrt{G m_{12} u (1-e^2)} \Rightarrow \hat{f} = r \frac{(1+e \cos f)^2}{(1-e^2)^{3/2}}$
Xn' ((1), m(e) = 21 /21 einto ein'Mo dMo,
So X. (4+1), m(e) = zr. \(\frac{e}{R/u_0} \) \(\frac{e}{R/u_0} \
30 (1700)
R 1-6
ao Heolosfo 311 -(111)
00 1+0,000 20 -(1+1) X-(1+1),00 (lo) = 211 (1-00) -info d.M.
Jo
= zri (1-e) (1+lo cosfo) e dMo.
211 1-001
Jo
and, Mo= Vo(t-Tp) => dMo= Vodé,
and, $f = \frac{1}{1 - e_0^2} df_0 = \frac{1}{1 - e_0^2} \frac{1}{2} dt$
=> dMo = Vo (1-e)3/2 dfo
Vo (1+CoCosfo)2

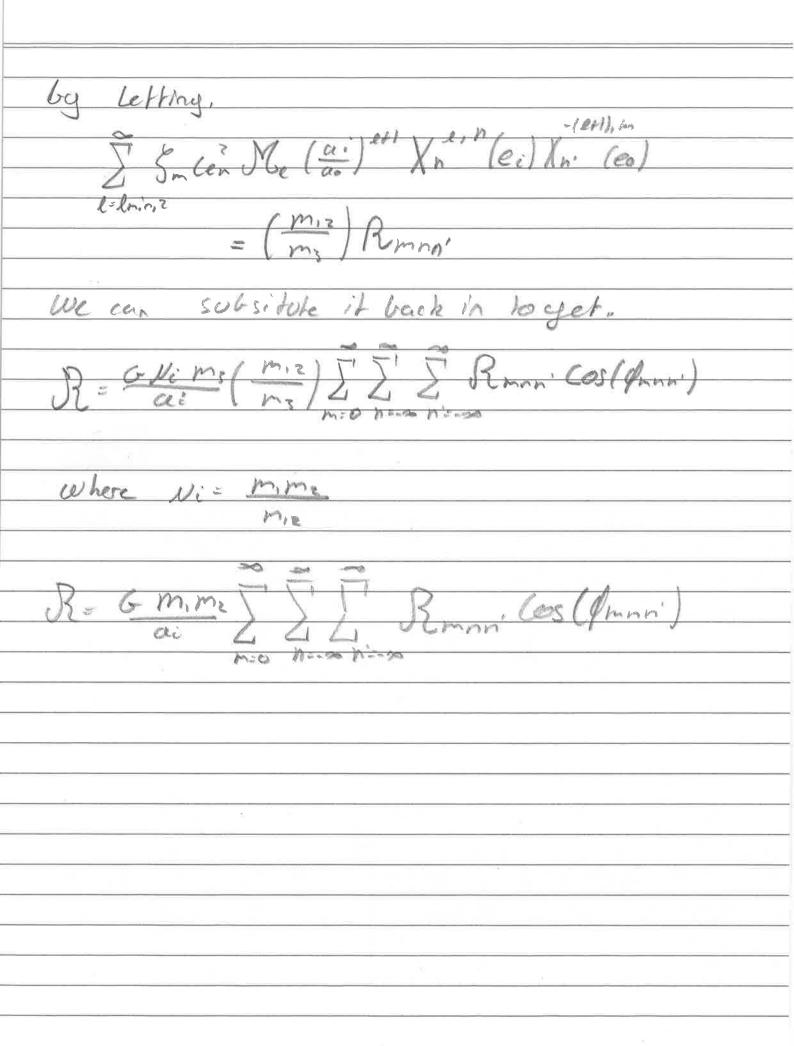
So (d+1), m(e) = = 1 (1-e) (1-= = (1-e3)3/2 (1+eo(osfo) = imfo dfo, = ZTT (1-e3) (2TT (1+e0 Cosfo) 1-1 e-info dfo, 6) Looking at Xo (dol), m(e) We realise Mut the real Port in the intergral (I reaces fo) is an even function while the imaginary part, e-info is an odd function. So that who intergrating, from (0,217) the over all intergrals will be

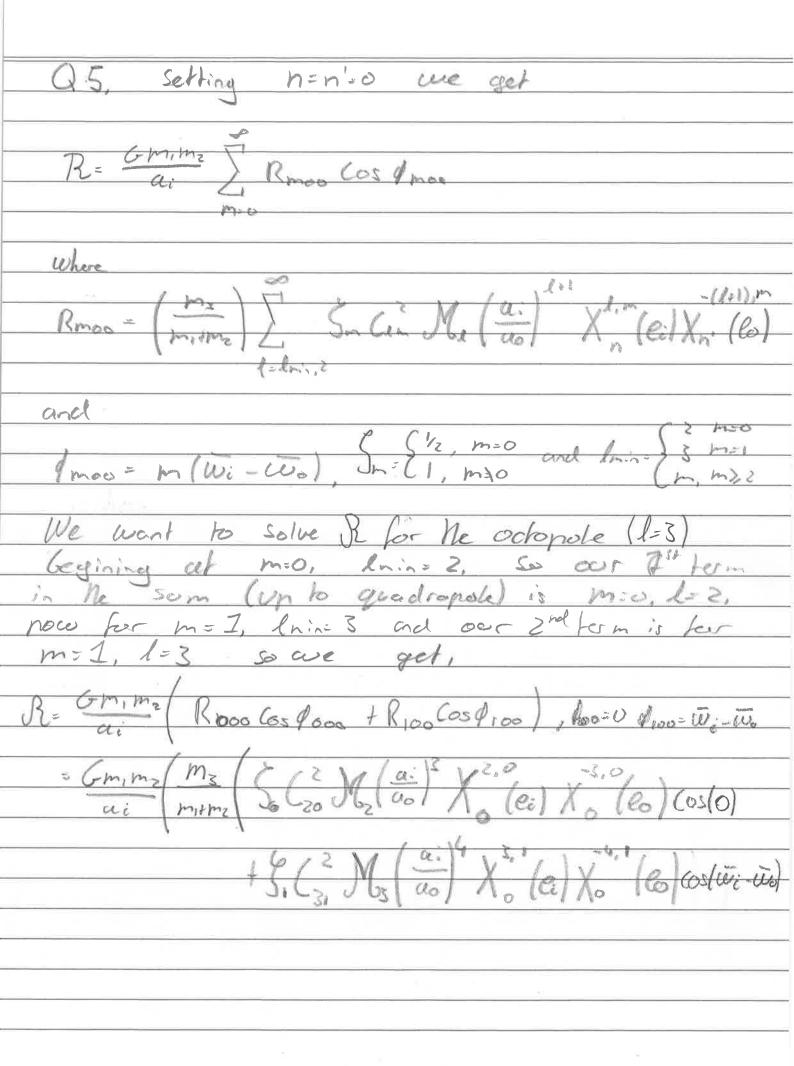


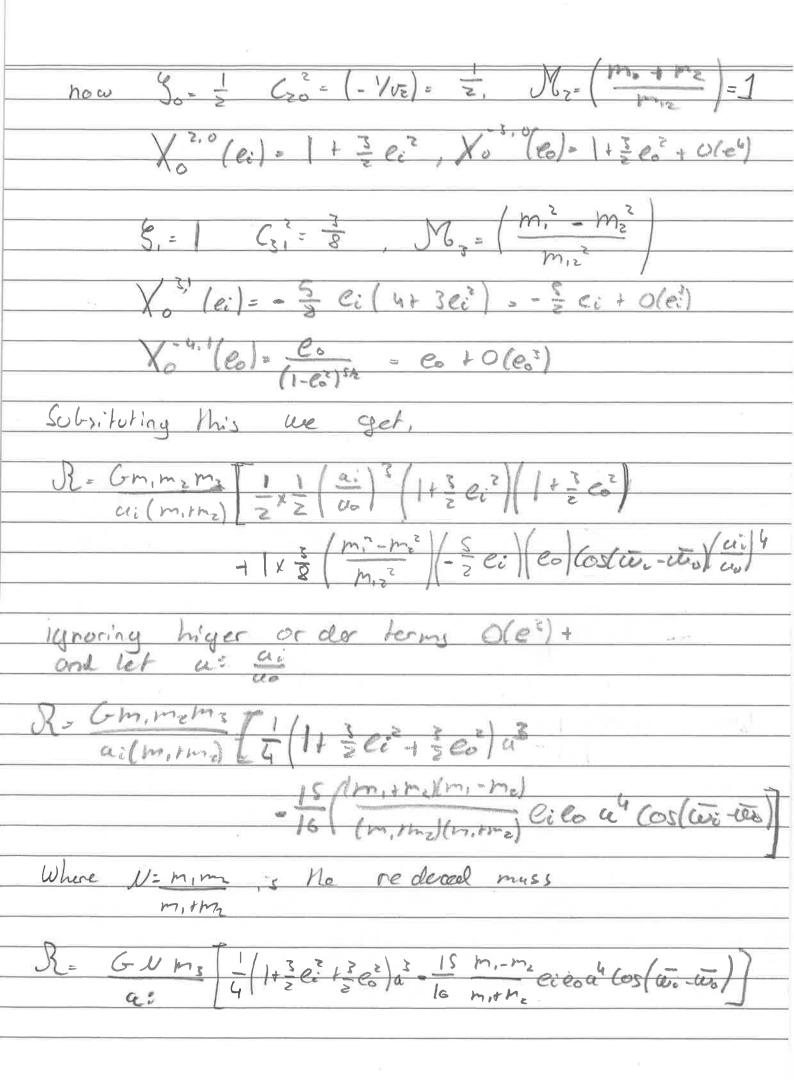


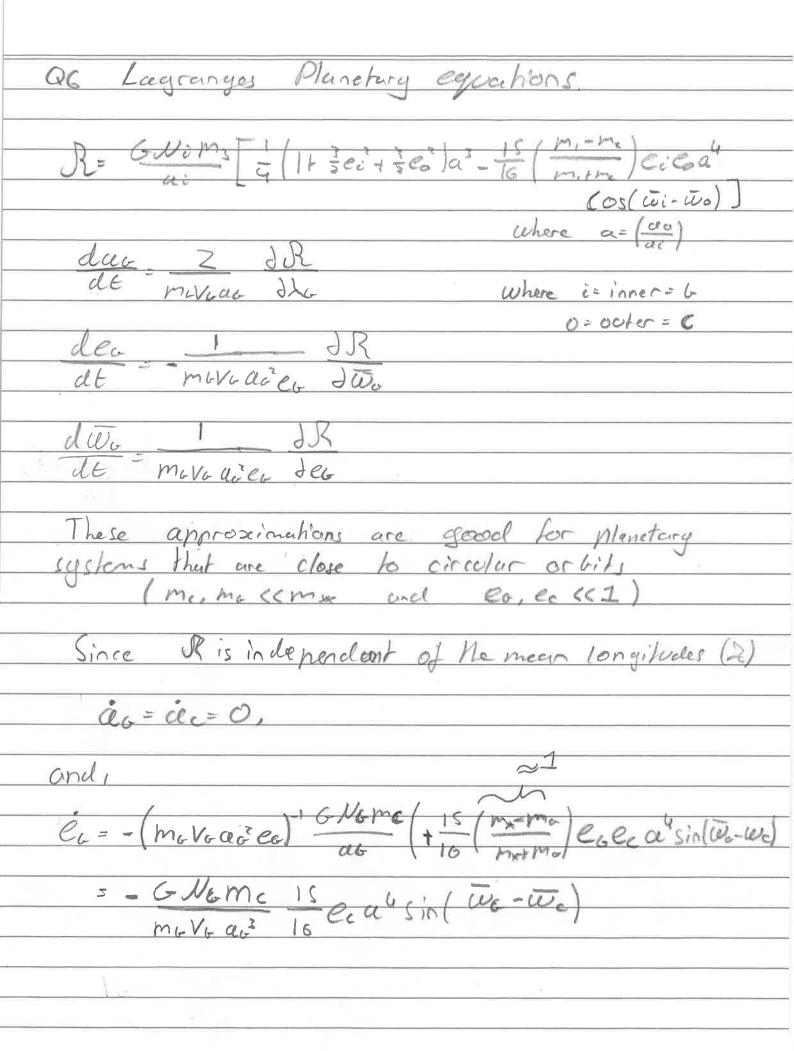
f) Begining with.
R= Guim3 5 1 1 (ai) (ai) (in (
Cle 23
[[Vaileinfi][Rladen]
[lail e] [TR/adeil]
We can substitute.
(E) l'einfi = E Xn (ei) e
n:-30
and
(Report) - Xn (le) e
(R/ao)en / L Xn (lo)e
to get,
R- Gums II I Z Cam Melai Xn (ei) Xn (eu)
lez m:-l,2 n'=-no neso im(wi-wo) in Mi -in'Mo
emlui wo) in Mi in Mo
ei (m(wi-wo) + nMi=n'Mo) = ei Amni
where france nMi - n'Mo + m (wi - wo)
50 - (A)
R. Guins E E Ecen Me (ai) (m) (ei) X, led
1:2 M:-6.2 n:-00 n:00
Xe



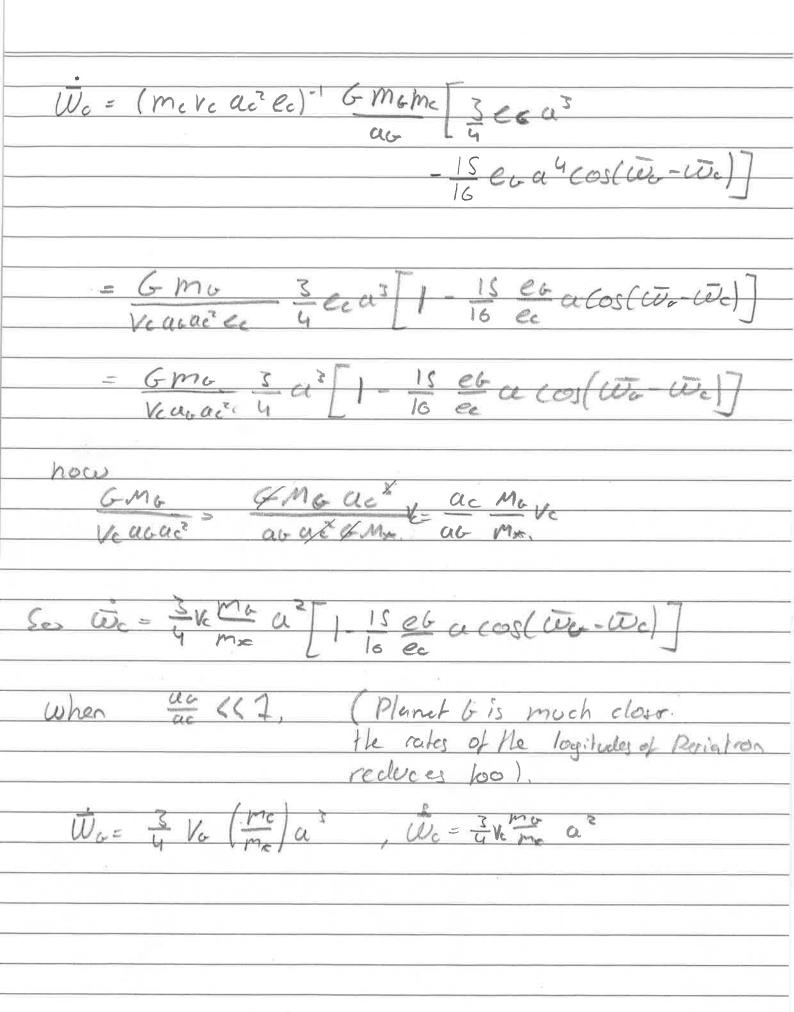




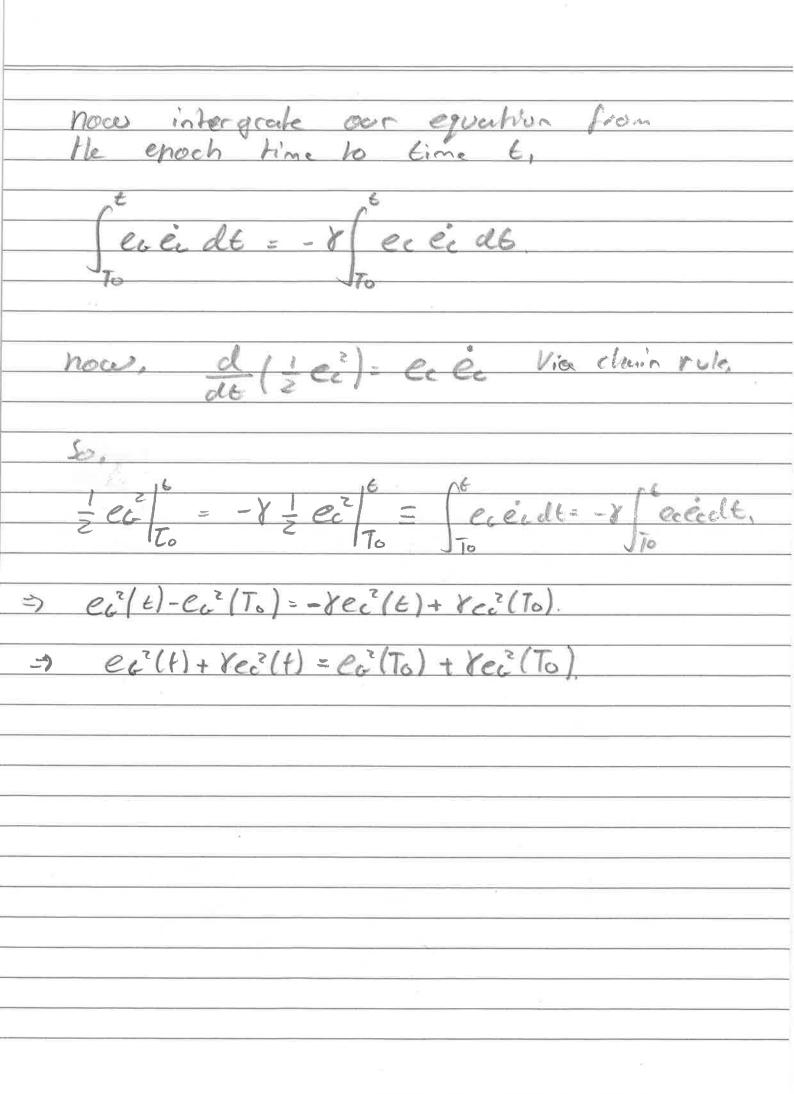




ic = - (me Ve (lèce) de de We= (me Ve de el de so éc=-(mevacée) GName - 15 evec a sin(wo-we) - GNo IS et a sin(worde) noce Ve= Tome No= Mo. So GNG GMG VE GMG QE AG ME UG So éc = Muy ac 15 ec (uc) sin (Wa- we) 15 = 15 Ve mo ac ec sin (Wo-les)



eu = - 15 VI (me) (uc) le sin(wa-we) er = 15 Ve (me) (ac) ei sin(wo cere) => Bo Vi me de ec = - 15 mi (de) Sin (wo- we) => - Cc Vi mi ei = - 15 m= (ac) sin(Wa-We) such that we can expecte the 2 expressions. Vemela ar Vimor Cb = Vo mc ec av éc Ve avista lacista = (ac) 1/2 (ac) - / Mc ecec = (ac) me ec ec = 8 ec ec der et - Ver de



d). ea(+)= (ea) + Sea, ea(+)= (ea) + dea Substituting into ego 62,65. Co = - 15 Vo (mc) (ac) (Ce) +dec) Sin(Wo-We) ec = 15 ve (ma) (ua)? ((ea) +dea) sin(tua-tere)

e) The sector Period, of variation of the ercentricities would be.

Pour 2tt =
$$\frac{1}{4} V_1^{-1} \left(\frac{m_*}{m_*} \right) \left(\frac{a_*}{a_*} \right)^{\frac{1}{4}} \frac{8}{8-1}$$

where $8 = \left(\frac{m_*}{m_*} \right) \left(\frac{a_*}{a_*} \right)^{\frac{1}{4}}$

Pi = 11.87 yr

Ms = 0.0003 mj = 0.001

Ms = $9.54 a_0$,

 $a_1 = 5.2 a_0$
 $a_2 = 9.54 a_0$,

 $a_3 = 9.54 a_0$,

 $a_4 = 9.54 a_0$,

 $a_5 = 9.$

F) Setting
$$C_{e} = C_{o} = 0$$
 we get

$$C_{o} = C : \frac{15}{16} \text{ Vo } \left(\frac{mc}{m\pi}\right) \left(\frac{uo}{oc}\right)^{4} \text{ ec sin} \left(\overline{uo} - \overline{uc}\right)$$

"constant

Sin $\left(\overline{uo} - \overline{uo}\right) = 0 \Rightarrow \overline{uo} - \overline{uo} = \pm \pi$,

and for no secolar variations in eccentricity

$$\overline{uo} - \overline{uc} = 0$$

$$= \frac{3}{4} \left(\frac{ac}{ac}\right)^{2} \frac{1}{mc} \left(\frac{ac}{ac}\right) \left(\frac{c}{ac}\right) \left(\frac{c}{ac}\right) \left(\frac{cc}{cc}\right) \left(\frac{cc}{cc$$

for the case where cos(-ti) =-1 (ec) - (Vome (ac)-Vcmg)= 5 (Ub) 2/6 mc + (Vamelac)-Vema)2 + 25/00)3 Vave Mama = (ac) VLMC This leaves us with 4 equations/exeptions for the ratio- of eccentricities where there is no secular evolution,

