Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SECOND SEMESTER M.Tech. (ASE/CS) DEGREE END SEMESTER EXAMINATION
May/June 2016
SUBJECT: NAVIGATION GUIDANCE AND CONTROL (ICE -522)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Explain the terms (i) Navigation (ii) Guidance (iii) Control

1B. With block diagrams explain a Jet transport aircraft model.

1C. Flying at a height of 10000 m and mach no. 0.84, a fighter aircraft has a transfer function

$$\frac{q(s)}{\delta_E(s)} = \frac{-17.8(s+0.014)(s+0.43)s}{(s^2+1.2s+12.11)(s^2+0.01s+0.0026)}$$ Find the damping ratio of phugoid mode and short period mode. Is the aircraft is stable.

(2+3+5)

2A. The representative set of numerical values of the pitch dynamics, for a highly hypothetical, highly maneuverable missile are given by the following aerodynamic constants:- V=382m/sec, $Z_\alpha = -1270\, m/\sec$, $Z_\delta = -340\, m/\sec$, $M_\delta = -662\, rad/\sec$, $M_\alpha = -248\ rad/\sec^2$. Output is normal acceleration a_N. If the actuator time constant $\tau = 0.01\sec$. Sketch the root locus for the actuator- missile system, and at what values of gain this system become unstable. Derive the formula used.

2B. With neat block diagrams explain the yaw orientational auto pilot with all four loops.

(6+4)

3A. What is the primary difference between command guidance and homing guidance?

3B. Explain with block diagrams how the sign of radial velocity of the target is determined in a CW Radar

3C. Consider a Radar with following characteristics; Power radiated is 120 MHz, the wave length of transmitted energy is 0.05 m. The Minimum detectable energy $10^{-14} Watts$, the radar cross section is $25cm^2$ If the target located at 150 Kms from the Radar. What should be the minimum antenna gain? So that radar will detect the target.

. (2+3+5)

4A. Differentiate the terms (i) Altitude hold mode (ii) Mach hold mode

4B Starting From fundamental derive Radar equation?

4C Explain with block diagrams differentiate FM- CW Radar and Pulse Radar.

(2+3+5)

5A. An Aerospace system is given by the state model $\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -1 & -1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u.$ Design a state feedback controller that place the closed loop pols at -1+j2 and -3. Verify the result by Ackermann's formula.

5B. Consider a Radar with a maximum range of 200Kms. Suppose due to some modifications made in the system components (i) The wave length of the transmitted energy doubles while the antenna gain becomes half. (ii) The antenna effective aperture becomes half while the antenna gain triples. (iii) The antenna effective aperture doubles while the wave length of the transmitted energy remains constant.

(6+4)

6A. Consider the Control System shown in figure Q.6A where the plant transfer function $\frac{1}{s(s+1)}$ and T = 0.2 sec. Design a lead compensator. Given $\xi = 0.5$, $\omega_n = 4 rad/\sec$

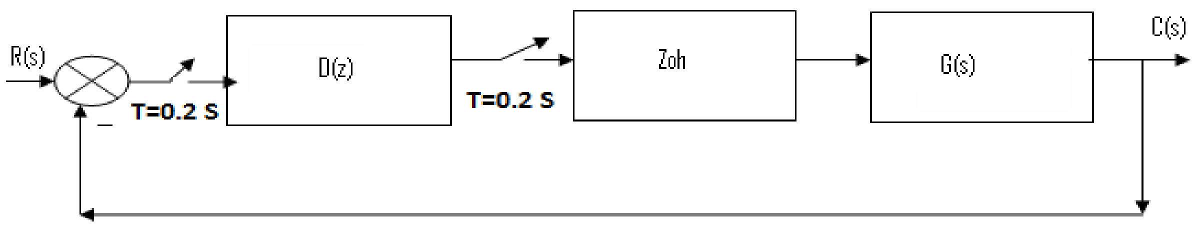

Figure Q.6A

6B. With necessary diagrams explain (i) Terrestial Navigation (ii) Celestial Navigation (iii) Satellite Navigation.

(5+5)