Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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A Constituent Institution of Manipal University

FIRST SEMESTER M.TECH. (CONTROL SYSTEMS)

END SEMESTER EXAMINATIONS, NOV - 2017

SUBJECT: NAVIGATION GUIDANCE AND CONTROL [ICE 5124]

Duration: 3 Hour — Max. Marks:50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A	Differentiate the terms 'Altitude hold mode' and 'Mach hold mode'.	2
1B	With necessary block diagram explain 'Pitch orientational control system.	3
1C	The aerodynamic coefficients of an aircraft longitudinal dynamics is given by $\frac{Z_\alpha}{v}=-1,\ \frac{Z_E}{v}=-0.1,\ M_q=-0.5,\ M_\alpha=-5,\ M_e=-9,\ \frac{X_\alpha}{v}=-14,\ \frac{X_e}{v}=-1$. Other coefficients are assumed to be zero. Find the open loop poles (short period and phugoid mode) of the aircraft. Also find the transfer function of the aircraft δ_E *to* u.	5
2A	What is the primary difference between 'homing guidance' and 'command guidance'?	2
2B	Draw the schematic of a typical missile and explain its major components.	3
2C	A representative set of numerical values of the pitch dynamics for a hypothetical highly maneuverable missile is given by the following aerodynamic constants. V= 400 m/s, $Z_\alpha=-1200\ m/s^2$, $Z_\delta=-350\ m/s^2$, $M_\delta=-600\,rad/s^2$, $M_\alpha=-250\ rad/\sec^2$. The output is normal acceleration a_N. If the actuator time constant $\tau=0.01s$ Sketch the root locus for the actuator missile system and for what values of gain this system will become unstable	5
3A	Differentiate the terms Integrated navigation and Inertial navigation	2
3B	Consider a radar with following characteristics: power radiated is 100 Mw. Wave length of the transmitted energy is 0.05m, minimum detectable energy is 10^{-14} watts, radar cross section is 25 cm^2.If the target is located at 150 Kms from the radar, what should be the minimum antenna gain, so that the radar will detect the target.	3

3C Consider a missile target engagement geometry shown in figure Q3C below. Find the following (i) Closing velocity (ii) Rate of change of LOS length (iii) Estimated time to go. 5

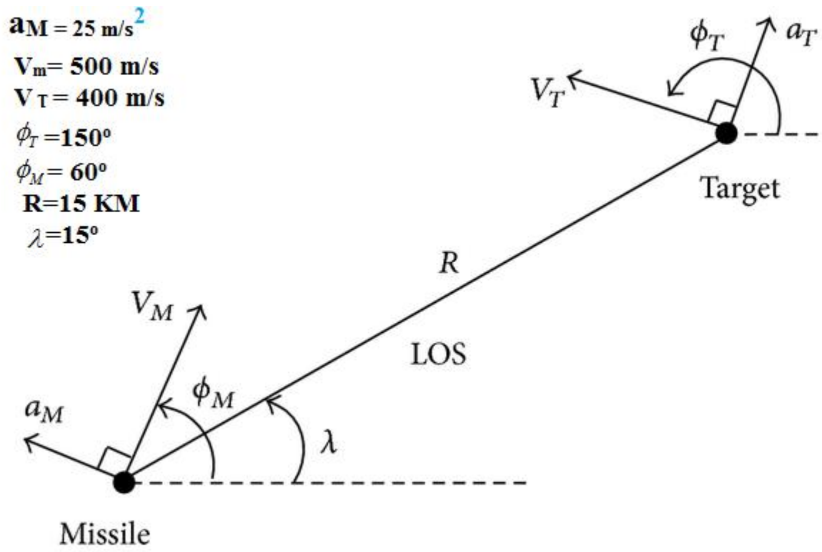

Figure Q3C

4A Differentiate the term 'celestial navigation' and 'terrestrial navigation' 2

4B Starting from fundamentals derive RADAR equation 3

4C In a FM-CW radar, transmitting at an average frequency of 400 MHz, the rate of the triangular frequency is 10 Hz and peak to peak frequency variation is 100KHz. Calculate the beat frequencies during increasing and decreasing portions of the FM cycle. The radar target configuration is shown in figure Q.4C. 5

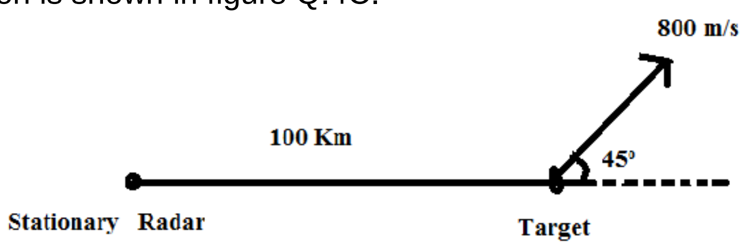

Figure Q.4C.

5A With neat diagrams explain PID controllers 2

5B A single axis attitude control system for a satellite can be modelled as follows $\begin{bmatrix} \dot{\theta} \\ \dot{q} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \theta \\ q \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{l}{I} \end{bmatrix} T$. Where θ is Pitch angle of the satellite, q is Pitch rate of the satellite 3

T is The Thrust of the control thrusters, l is The distance of the thrusters from satellite center of gravity

I is Mass moment inertia about the axis of rotation and $\frac{l}{I}$ = 50. Determine the state feedback gains (K), so that the closed loop system has the following performance $\omega_n = 20\ rad/s$ and $\xi = 0.707$.

5C A first order system is described by the differential equation $\dot{x}(t) = 10x(t) + u(t)$. It is desired to find the control law that minimizes the performance index $J = \frac{1}{2}\left[\int_0^{t_1} (24\ x^2 + \frac{1}{4}u^2)\, dt\right]$. Also t_1 is specified. 5

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