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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FIRST SEMESTER M.TECH. (AEROSPACE ENGG.)

END SEMESTER DEGREE EXAMINATIONS, NOVEMBER - 2019

SUBJECT: AEROSPACE SYSTEM MODELLING [ICE5171]

TIME: 3 HOURS MAX. MARKS: 50

Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.*

1A Define Profile drag. How are the contributing factors for the same affected with the type of boundary layer?

1B Derive the frequency domain model of an armature controlled DC servomotor representing $\frac{\theta(s)}{E_a(s)}$, where $\theta(s)$ armature position and Ea(s) is armature applied voltage.

1C Define state variables. What are the advantages of state variable modelling compared to frequency domain modelling? Obtain State variable model for the electrical circuit shown in Fig. Q1C.

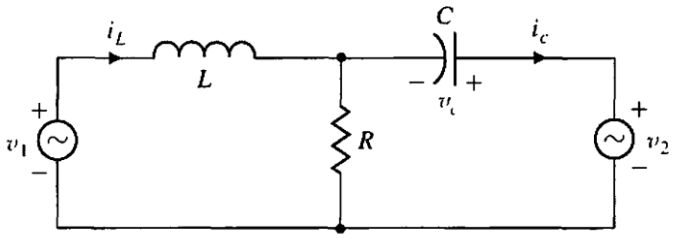

Fig. Q1C

(2+3+5)

2A Derive hydrostatic equation.

2B Illustrate what is meant by pressure, temperature and density altitude.

2C For an airfoil draw lift curve, drag polar and comment on moment coefficient Vs. lift coefficient characteristics.

(2+3+5)

3A Briefly specify the types of missile propulsion motors.

3B What are the three primary control derivatives in an aircraft? Define and specify their significance.

3C With standard notations, derive an expression for time rate of change of angular momentum vector with respect to inertial space represented in aircraft body axis system. Given the angular momentum for an aircraft as $\vec{H}_B = (PI_{xx} - RI_{xz})\hat{i} + QI_{yy}\hat{j} + (RI_{zz} - PI_{xz})\hat{k}$.

(2+3+5)

4A Write about classification of Missiles.

4B Derive complete translational EOM of a Quadrotor.

4C Derive the contributing applied forces expressed in body fixed frame of reference on a missile system in along x, y, and z axis and complete translational equation of motion.

(2+3+5)

5A Draw a representative schematic of a Quadrotor and explain how Roll, Pitch and Yaw moments are produced?

5B Explain the basic flight mechanism in a conventional helicopter defining all applied force and moments with appropriate coefficients.

5C Derive the dimensional rotor moments L_R, M_R, N_R acting on the CG of helicopter.

(2+3+5)

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