Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SECOND SEMESTER M.TECH. (AEROSPACE ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL/MAY 2017

SUBJECT: SPACECRAFT DYNAMICS AND CONTROL (ICE 5201)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Prove that for any given free body, the rotational kinetic energy and momentum are ellipsoid. **4**

1B. With necessary equations explain gravity gradient stabilization with active damping. **4**

1C. Determine the image of point (1, -1, 2) under the rotation by an angle of 60 ° about an axis in YZ plane (about X axis) that is inclined at an angle 60 ° to the positive Y axis. **2**

2A. With reference to the equation given below, describe how the transformation of frame is considered. $w_{BI} = w_{BR} + w_{RI}$, in which B-Body frame; I-Inertial frame, R-Local Reference frame. Also derive the expression for the angular velocity vector w_{RI}. **5**

2B. What is meant by Active Nutation Control. Derive the expression for the mass of fuel needed to denutate the satellite. **3**

2C. Differentiate between single spin and dual spin stabilization of spacecraft. **2**

3A. Describe the function of basic model of momentum exchange device with neat block diagram. Also explain momentum accumulation and its dumping. **5**

3B. Derive necessary equations of control command law using the direction cosine error matrix. **3**

3C. Assume the satellite with I_Z =200 kgm^2 , $w_z(0)$=5rad/s, I_{sp}=200s and torque arm is 1m acted by a force of 5N. Find the mass of fuel consumed during de spinning phase of a satellite which has 2 thrusters for the purpose. **2**

4A. With neat figure elaborate roll-yaw control of a spacecraft with two momentum wheels. **5**

4B.	Brief about how active control is achieved without yaw measurement in momentum biased spacecraft.	**3**
4C.	Explain attitude control using solar torques.	**2**
5A.	How torque components are calculated for a single reaction thruster. Discuss the transformation of torque commands into thruster activation time.	**5**
5B.	With the block diagram explain PWPF modulation used in reaction thruster attitude control.	**3**
5C.	Mention different parts of ADC and DAC. Explain sample and hold circuit	**2**

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