

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

FIFTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.) END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: CONTROL SYSTEM COMPONENTS [ICE 3105]

Time: 3 Hours

MAX. MARKS: 50

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Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- 1A. With necessary figures and symbols, explain the working of ac servo motor and write 4 the expression for torque developed by the motor.
- **1B.** Illustrate the application of tachogenerator in the position control. **4**
- 1C. A DC motor takes a current of 110A at 480V. The armature circuit resistance is 0.2 2 ohm. The machine has 6-pole and the armature is lap connected with 864 conductors. The flux per pole is 0.05Wb. Calculate
 i. Speed ii. The gross torque developed by the armature.

2A. Explain how static, dynamic and zeroing error of a Synchro is eliminated.

- 2B. A three-phase, variable reluctance stepper motor has a phase winding resistance and 4 average inductance of 1 Ω and 30 mH, respectively. The phase winding rated current is desired to be 3 A. Design a uni-polar drive circuit for this motor with a net ON Mode and OFF Mode circuit time constants of 2 msec and 1 msec, respectively. Assume that the stepping rate is 300 steps per second.
- 2C. List the advantages of permanent magnet stepper motor over variable reluctance2 stepper motor.
- **2D.** What is the need of slip rings in the tachogenerators?
- **3A.** Describe any one application of cam and follower used in automobile industry.
- 3B. Define control valve sizing and derive the expression for valve coefficient of control 4 valve.
- 3C. An equal percentage valve has a maximum flow of 50 cm³/s and a minimum of 2 2 cm³/s. If the full travel is 3 cm, find the flow at a 1-cm opening.
- **3D.** What is the use of positioner in electro pneumatic actuator?

4A.	Derive the expression for torque of the gear train with reference to the motor shaft.	3
4B.	With neat diagram explain the operation of off-delay control valve.	3
4C.	A pressure difference of 1.1 psi occurs across a constriction in a 5-cm-diameter pipe.	2
	The constriction constant is 0.009 m ³ /s per kPa ^{$1/2$} . Find i) The flow rate in m ³ /s	
	ii) The flow velocity in m/s.	
4D.	Draw NAND and NOR pneumatic logic gates.	2
5A.	Explain the operation of non-bleed type pressure control device.	3
5B.	Describe the construction and working of a gyro scope which is used to measure yaw	4
	and roll of an air craft.	
5C.	A constant velocity CAM is designed for simple harmonic motion. If the flat faced	3
	follower displaces 2 inch for 180 ⁰ of CAM rotation and the CAM angular velocity is	
	100 RPM, determine the displacement, velocity and acceleration when the CAM	
	angle is 45 ⁰ .	