Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

# II SEMESTER M.TECH. (AUTOMOBILE ENGINEERING)

### END SEMESTER EXAMINATIONS, APR/MAY 2018

### SUBJECT: AUTOMOTIVE CONTROL SYSTEM [AAE 5232]

#### REVISED CREDIT SYSTEM (27/04/2018)

Time: 3 Hours

#### MAX. MARKS: 50

05

03

#### **Instructions to Candidates:**

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- **1A.** Determine the transfer function of the following signal flow graph



**1B.** Consider the system shown below. Assume  $\zeta = 0.6$  and  $\omega_h = 5$  Rad/sec. **03** determine the  $t_r$ ,  $t_p$ , maximum overshoot and  $t_s$  when subjected to a unit step input.



**1C** A unity feed-back system has an open loop transfer function of **02**  $G(s) = \frac{25(s+4)}{s(s+0.5)(s+2)}$ . Determine the steady state error for a unit ramp

input.

- **2A.** Determine if the following system is stable using Routh-Hurwitz criterion. **03**  $2s^6 + 4s^5 + s^4 - 32s^3 + 51s^2 + 3s + 15 = 0$
- 2B. Derive the kinematic model of lateral vehicle Motion
- **2C.** Consider a vehicle travelling at a speed of 30 m/s and is negotiating a curve of radius 1250 m. Find out the lateral steady state error. The mass of the vehicle is 1500 kgs.  $I_z$  -2450,  $I_z$ =1.2 m and  $I_r$ = 1.4 m take the corner stiffness values as 85700 each at front and rear tire. Find out the steady state yaw angle error. Also find the velocity at which zero angle error is possible. AAE 5232 Page 1 of 2

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Determine the steady state steering angle.

- **3A.** Derive the relation to calculate the normal tire force with respect to **03** longitudinal dynamics
- **3B.** Explain the benefits of Adaptive cruise control and Automated highway **02** systems
- **3C.** Explain the principles of upper level controller for cruise control **05**
- **4A.** Derive the relation for determining the net engine torque to be utilized for **05** controlling the throttle input lower level controller for cruise control.
- **4B.** Determine the natural frequencies and mode shapes of the quarter car **05** model.
- **5A.** Explain the influence of sensor location on Performance variation for lateral **02** dynamics control
- **5B.** How to calculate the effective tire radius for dynamics modeling? **03**
- **5C.** Do a comparison between unsprung model and sprung model approximation **05** in a quarter car model