Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov/Dec– 2017**

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| **Code :** | **15MA3015** | **Duration :** | **3hrs** |
| **Sub. Name :** | **CONTROL THEORY** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Prove that the observed linear system ,  is observable on  if there are distinct points such that , where . | CO1 | 10 |
| b. | Show that the second order differential equation  with the observation  is observable on . | CO1 | 10 |
| (OR) | | | | |
| 2. |  | Prove that , where  is a scalar positive constant is globally i) observable at time  ii) Completely observable or (iii) differentially observable if the following conditions holds:  (a)There exists a constant such that  (b)There exists a positive constant  satisfies .  i)for some  in the case of observable system at time  ii) for all  and for some  in the case of completely observable system.  iii) for all  and for some  in the case of differentially observable system. | CO1 | 20 |
|  |  |  |  |  |
| 3. | a. | Prove that the system is controllable on  if and only if the adjoint linear observed system is observable on . | CO2 | 10 |
|  | b. | Derive the desired control variable for the control harmonic oscillator which steers from to during the time interval . | CO2 | 10 |
| (OR) | | | | |
| 4. |  | Suppose the system  is completely controllable and the continuous function is bounded locally in and satisfies the following condition  i)  uniformly in  ii) for each , there exists a constant such that for every , , , we have . Then prove that the system  is completely controllable. | CO2 | 20 |
|  |  |  |  |  |
| 5. | a. | Let  be a fundamental matrix of where is a continuous  matrix on . Then   1. Prove that the system is stable if and only if there exists a constant with  1. Prove that the system is uniformly stable if and only if there exists a constant with . | CO1 | 12 |
|  | b. | If and are non-negative continuous functions for  and be a constant, then prove that the inequality | CO1 | 8 |
| (OR) | | | | |
| 6. | a. | If is a fundamental matrix of the system  such that  for , where is a constant and let  with then prove that the zero solutions of the system is asymptotically stable. | CO1 | 15 |
|  | b. | Determine whether the solutions of the differential equations      are asymptotically stable. | CO1 | 5 |
|  |  |  |  |  |
| 7. | a. | Prove that the system  is controllable then it is stabilizable. | CO1 | 10 |
|  | b. | Stabilize the system using the Bass method. | CO1 | 10 |
| (OR) | | | | |
| 8. | a. | If  is stabilizable and  is detectable, then prove that there exists matrices  of dimensions  and  respectively such that the matrix in the system  is a stability matrix. | CO1 | 12 |
|  | b. | Verify the stabilizability of two identical mass spring system  . | CO1 | 8 |
|  | | **Compulsory:** |  |  |
| 9. |  | Find the optimal control from the nonlinear scalar system  with cost functional | CO3 | 20 |

ALL THE BEST