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| **Scheme of Valuation/Answer Key**  (Scheme of evaluation (marks in brackets) and answers of problems/key) | | | | | |
| **APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018 | | | | | |
| **Course Code: EE303** | | | | | |
| **Course Name: LINEAR CONTROL SYSTEMS** | | | | | |
| Max. Marks: 100 | | |  | Duration: 3 Hours | |
| **PART A** | | | | | |
|  |  | ***Answer all questions, each carries5 marks.*** | | | Marks |
| 1 |  | Block diagram of closed loop system(2)+derivation(3) | | | ( 5) |
| 2 |  | Mechanical equation(1) +Force-voltage analogy(2)+force -current analogy(2) | | | ( 5) |
| 3 |  | Necessary condition check(1)+ Routh’s array (special case) (3)+ unstable(1) | | | (5) |
| 4 |  | Angle criterion(1)+magnitude criterion(1)+ condition checking(2) +comment(1) | | | (5) |
| 5 |  | Definition of any three specifications (3)+ figure/equations(2) | | | (5) |
| 6 |  | Explanation to check stability using Bode plot(3)+ condition for stability(2) | | | (5) |
| 7 |  | Statement (2)+explanation(2) + equation (1) | | | (5) |
| 8 |  | Polar plot(marks may also be given if polar plot is correctly drawn without any steps ie from knowing the starting point (type) and terminating point (order)) | | | (5) |
| **PART B** | | | | | |
| ***Answer any two full questions, each carries10 marks.*** | | | | | |
| 9 | a) | Steps(4) +final answer(1) [Marks may be given for each steps] | | | ( 5) |
|  | b) | Differential equations(2) + anyone transfer function(3) | | | (5) |
| 10 | a) | Deriving the expression (4) | | | (4 ) |
|  | b) | Closed loop transfer function(2) + damping ratio =1(1) + natural frequency=5 rad/sec(2) + k = 25 (1) | | | (6) |
| 11 | a) | Error in question (The given function is closed loop transfer function not open loop transfer function).sketch(1) + maximum overshoot(2) + peak time(2). Proportionate marks may be given for positive approach to answer the question. | | | (5) |
|  | b) | Forward path gain(1) +individual loops(1) +Two non-touching loop gain (1) + + delta calculation(1) + transfer function(1) | | | (5) |
| **PART C** | | | | | |
| ***Answer any two full questions, each carries10 marks.*** | | | | | |
| 12 | a) | Velocity error and error constant equation(2) +calculation of k (3) | | | ( 5) |
|  | b) | Routh’s array formation(2) +value of k for stable condition(1) +unstable condition (1)+marginally stable condition (1) | | | ( 5) |
| 13 |  | Pole - zero marking on graph sheet(1) +existence on real axis(1)+ angle of asymptote(1)+ centroid(1)+ point of intersection on imaginary axis (2)+ final plot (3) + finding k (1) | | | (10) |
| 14 | a) | Error transfer function(1) +calculation of dynamic error coefficients k1,k2,k3,k4 (2) + steady state error calculation (2) | | | (5) |
|  | b) | Explanation of the effect of adding poles using root locus diagram(2.5) + effect of adding zeros using root locus diagram (2.5) | | | (5) |
| **PART D** | | | | | |
| ***Answer any two full questions, each carries 10 marks.*** | | | | | |
| 15 |  | Sketch of magnitude plot with k=1 (2) + phase angle plot( 2) + gain margin(2) + phase margin(2) + value of k (2) | | | (10 ) |
| 16 | a) | calculation of phase cross over frequency and gain margin(analytically or from graph)(3) + calculation of gain cross over frequency and phase margin (analytically or from graph)(3) +polar plot sketch (3) +comment on stability(1) | | | (10) |
| 17 | a) | Explanation with equation (e-st) (4) | | | (4) |
|  | b) | Sketch of magnitude plot(3) + phase angle plot( 2) + comment on stability (1) | | | (6) |
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