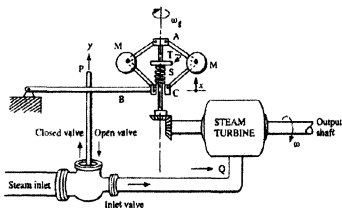


※ 考生請注意 本試題 可 不可 使用計算機

A1 A Watt's governor control system is shown below. The setpoint of the governor is ω_s . Draw a block diagram of the control system including system components and describe the operational principle by using the block diagram. (25%)



A2. For a second-order underdamped system, show that the percent overshoot, %OS, is a function of damping ratio only. (25%)

(背面仍有題目,請繼續作答)

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- B.1 What is the meaning of root locus? Why do we make a root locus for a feedback control system? (4%)
- B.2 Can describe a better performance of a fifth order dynamic feedback control system with root locus method, i.e., a shorter settling time, the damping factor about 0.7 (assume the settling time must be shorter than 0.1 second) (4%)
- B.3 If the open loop transfer function of a feedback control system is a fifth order system, which has five poles with negative real numbers, fortunately, besides, i.e. there are two zeros with negative real numbers, then, how many asymptotes of the feedback control systems? What're the degrees of the asymptotes' angle? And, what's the intersection point of the asymptotes? (7%)
- B.4 Can you describe the change of a root locus with the original second order open loop transfer function, if we put a PI controller in the feedback control system? How do you select a better performance of the control system with the parameters of PI controller for a system? The transfer function of PI controller could be $K_p + K_i 1/s$, K_p and K_i are two parameters? (Maybe, there are various changes of the root locus) (10%)

系所組別 機械工程學系戊組

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- B.5 a) What's called the bandwidth? What's the effect of the bandwidth on the dynamic response? (3%)
- b) How to explain the relative stability of a dynamic control system in frequency domain with bode diagram? (3%)
- c) The Nyquist criterion is used to judge "stable or not" of a dynamic control system, $Z = N + P$, what's the meaning of Z , N and P , respectively? (3%)
- d) Can you also define that the situation of the control system is unstable with a polar plot? Try also to explain it? (3%)
- e) For a third order dynamic control system, it happened stable or unstable, if the value of K is tuned, whether its value smaller or larger? Can you explain it with a sketch of a bode plot (3%)

B6. Can you derive the correlation between the time domain and frequency domain, if the feedback control system can be expressed as a standard second order system, please find the linear quasi-relationship between phase margin and damping ratio? (5%)

B7. If an analytical result of a dynamic control system is stable, but the actual system becomes unstable due to the time delay, how can you apply the Bode diagram to explain it? To change the system to be stable, how can you do it? (5%)