**Registration No :**

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**Total Number of Pages : 02** **B.Tech**

**PEEC5414**

**7th Semester Back Examination 2018-19**

**ADVANCED CONTROL SYSTEMS**

**BRANCH : AEIE, ECE, EEE, EIE, ELECTRICAL, ETC, IEE**

**Time : 3 Hours**

**Max Marks : 70**

**Q.CODE : E269**

**Answer Question No.1 which is compulsory and any Five from the rest.**

**The figures in the right hand margin indicate marks.**

**Q1** **Answer the following questions :** **(2 x 10)**

**a)** Differentiate between linear and non-linear control system.

**b)** Write down the relation between continuous and discrete state equation.

**c)** What do you mean by pole-zero cancellation in transfer function ?

**d)** Why aliasing occurs in digital control system and how to compensate it.

**e)** Write down Sylvester's expansion theorem.

**f)** If a 3rd order system matrix A is in companion form & its eigen values are $\lambda_1, \lambda_1, \lambda_3$, then write down the modified Vander monde matrix for A.

**g)** Define direct method Liapunov stability.

**h)** Explain how a point in the Z-plane corresponds to an infinite no of points in the S-plane.

**i)** Distinguish between the absolute stability, conditional stability and marginal stability.

**j)** What are the phenomena exhibited by a non-linear system that are not found in a linear system?

**Q2** **a)** Calculate $\phi(\mathrm{k},\mathrm{m})$ for the system $\phi(\mathrm{k}+1)=\begin{pmatrix}-1 & 2\\ 0 & 1\end{pmatrix}x(k)$ using z-transform. **(5)**

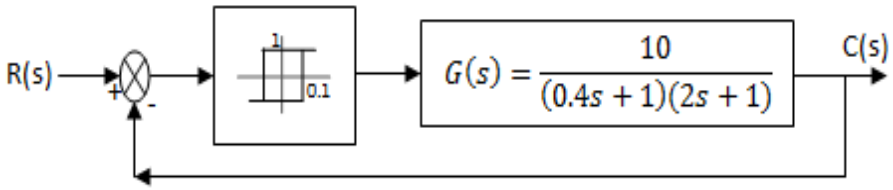
**b)** State Liapunov's theorem for asymptotic stability of the system $\dot{x}$=A x **(5)**
Hence show the following linear autonomous model

$$\dot{x}=\begin{bmatrix}0 & 1\\ -k & -a\end{bmatrix}x$$

Is asymptotically stable if a>0, k>0.

**Q3** **a)** Find $\phi(\mathrm{t},\tau)$ and forced response of the system $t^2\ddot{\eta}+t\dot{\eta}+\eta=\rho(\mathrm{t})$ **(5)**
with $\eta(\mathrm{t}_0)=\eta_0$ and $\dot{\eta}(\mathrm{t}_0)=\dot{\eta}_0$

**b)** For the non-linear system shown, determine the amplitude and frequency of limit cycle. **(5)**



**Q4** **a)** Check the controllability and observability for the following system. **(5)**

$$\dot{x} = \begin{pmatrix} 0 & 0 \\ 0 & -1 \end{pmatrix} x + \begin{pmatrix} 1 \\ e^{-t} \end{pmatrix} u \qquad y = \begin{pmatrix} 0 & e^{-t} \end{pmatrix} x$$

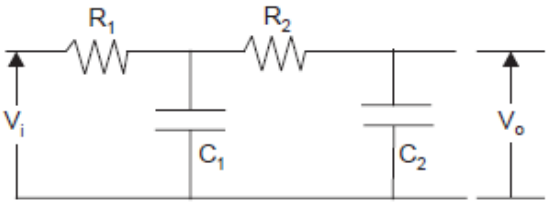
**b)** Solve the following difference equation by the use of Z-Transform method **(5)**

$$x(k+2) + 3x(k+1) + 2x(k) = 0, \quad x(0) = 0, \; x(1) = 1$$

**Q5** **a)** A unity feedback computer control system has an open loop pulse transfer function $G(Z) = \dfrac{0.426K(z+0.847)}{z^2 - 1.607z + 0.607}$. Determine the value of K at the unit circle crossover points using Jury test. **(5)**

**b)** Obtain the state variable representation for the following differential equation, with phase variables as state variables: $\dfrac{d^2y}{dt^2} + 2\dfrac{dy}{dt} + 26y = 26u(t)$ Also find resolvent and state transition matrix. **(5)**

**Q6** **a)** With $R_1 = 5M\Omega, \; R_2 = 10M\Omega, \; C_1 = 0.5\mu F, \quad C_2 = 0.1\mu F$ represent the system in state space form. **(5)**




**b)** Find $A^{-1}$ using the Cayley-Hamilton theorem for the state matrix $A = \begin{pmatrix} 3 & 2 \\ 1 & 4 \end{pmatrix}$. **(5)**

**Q7** Consider a second order autonomous system. For each of the following typrs of equilibrium points, classify whether the equilibrium point is stable, unstable or asymptotically stable: (a) stable node (b) unstable node (c) stable focus (d) unstable focus (e) center (f) saddle
Justify your answer using phase portraits **(10)**

**Q8** **Write short answer on any TWO :** **(5 x 2)**

**a)** Bilinear transformation of stability analysis
**b)** Liapunov's stability criterion
**c)** State observer
**d)** Jump resonance