Is BIBO unstable if there exists a bounded input uct) s.t. yet) is unbounded ("blow-unit of the pole o	ial Stability	3							
Is BIBO unstable if there exists a bounded input uct) s.t. yet) is unbounded ("blow-up Notes: By uct) bounded we mean there exist (3) M >0 s.t.   lu(t)  4 M. Vt >0.  Need a test that involves the model of LTI System i.e. TF model denoted by G(s)  THM 2: A LTI system with TF G(s) is BIBO stable if and only if all poles of G(s) are in OLHF system is BIBO unstable if G(s) has at least one pole in ORHP or on j-axis.  OLHP JIMO PRE(S)  BIBO stable  Example: LC circuit  G(s) = 3*+LC  Y(s) = G(s) : U(s)  TAIL  Y(s) = G(s) - U(s) = 1/LC  Poles of G(s)	Bounded In	put Bounde	d Output S	Stability					
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Need a test that involves the model of LTI System. i.e. TF model denoted by G(5)  THM 2: A LTI system with TF G(5) is BIBO stable: if and only if all poles of G(5) are in OLMP  System is BIBO unstable if G(5) has at least one pole in ORMP or on j-onis.  OLMP In(5)  Re(5)  RE(5)  RE(5)  RE(6)  RE(5)  PRE(5)  L C - 9  poles of G: p. 2 = 2 1/LC  Y(2) = G(5) · U(5)  PRE(5)  RE(6)  PRE(6)  PRE(7)  In(1)  PRE(8)  PRE(9)  PRE(9)  This is BIBO unstable.  L C circuit is BIBO unstable.  In(1)  In(1)  PRE(1)  PRE(2)  PRE(3)  PRE(4)  PRE(5)  PRE(5)  PRE(6)  PRE(6)  PRE(7)  PRE(8)  PRE(8)  PRE(8)  PRE(8)  PRE(9)  PRE(9)  PRE(9)  PRE(1)	DET: A CIT	system is	RTRO SLODIE .	t any bound	ded input i	uct), the out	put yeth is b	ounaea.	. Ine
Need a test that involves the model of LTI System. i.e. TF model denoted by Gis)  THM 2: A LTI System with TF G(s) is BIBO stable if and only if all poles of G(s) are in OLHP system is BIBO unstable if G(s) has at least one pole in ORHP or on j-anis.  OLHP a Imis)  Re(s)  **Re(s)  **Re(s)  **Re(s)  **Re(s)  **Re(s)  **Poles of G: p., 2 = 2   Vic   Re(s)  Consider U(s) = 3 + 1/10   U(s) = sin(40 t) + 1/10   U(s)    **The system is BIBO unstable.  Consider U(s) = 3 + 1/10   U(s) = sin(40 t) + 1/10   U(s)    **The system is BIBO unstable.  **Re(s)									
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Need a test that involves the model of LTI System. i.e. TF model denoted by Gis)  THM 2: A LTI system with TF Gis) is BIBO stable: if and only if all poles of Gis) are in OLMP  System is BIBO unstable if Gis) has at least one pole in ORMP or on j-oxis.  OLMP Indis)  Reis)  Reis)  Reis)  Press)  Example: LC circuit  Gis) = \$\frac{1}{5}\frac{1}{1}\frac{1}\frac{1}{1}\frac{1}{1}\frac{1}{1}\frac{1}{1}\frac{1}{1}\frac{1}									
Need a test that involves the model of LTI System. i.e. TF model denoted by Gis)  THM 2: A LTI system with TF Giss is BIBO stable: if and only if all poles of Giss are in OLHP  System is BIBO unstable if Giss has at least one pole in ORHP or on j-axis.  OLHP Imiss  Reiss  Reiss  Reiss  Poles of Giss = 3*+LC  Giss = 3*+LC  Giss = 3*+LC  Giss = 3*+LC  Yies = Giss : Uies  By THM 2: LC circuit is BIBO unstable.  Consider Uies = 3*+LC  Yies = Giss : Uies  Initial  Poles of Uies double properties  The complete RLC circuit is BIBO unstable.  Enample: RLC circuit is BIBO unstable.  Enample: RLC circuit is BIBO unstable.  Enample: RLC circuit is BIBO unstable.  By THM 2: the system is BIBO stable  Poles of Uies	Marco Du			thoma au'at	(7) 44 50		, V+ - A		
Need a test that involves the model of LTI System. i.e. TF model denoted by G(s)  THM 2: A LTI system with TF G(s) is BIBO stable: if and only if all poles of G(s) are in OLHP  system is BIBO unstable: if G(s) has at least one pole in ORHP or on j-onis.  OLHP IN(s)  Re(s)  Re(s)  DIBO stable  Example: LC circuit  G(s) = 3-1/LC  Y(s) = G(s) - U(s)  PRE(s)  PRE(s)  PRE(s)  Y(s) = G(s) - U(s)  PRE(s)  PRE(s)  Y(s) = G(s) - U(s)  PRE(s)  Y(s) = G(s) - U(s)  PRE(s)  Y(s) = G(s) - U(s)  Y(s) = G(s) - U(s)  PRE(s)  Y(s) = G(s) - U(s)  Poles of G(s)  Poles of G(s)  Poles of G(s)  PRE(s)  PRE(s)  PRE(s)	Notes : by	u(t) Dounded	we mean	mere exist	(3) M 70 3	S.T. IUCTII = P	4, Vt 30.		
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THM 2: A LTI system with TF G(S) is BIBO stable if and only if all poles of G(S) are in OLHP  system is BIBO unstable if G(S) has at least one pole in ORHP or on j-axis.  DLHP Im(S)  Ress)  Ress)  Ress)  PROMPIE: LC circuit  G(S) = \$\frac{1}{16\text{LC}}\$ Yes = G(S) \( U(S) \)  Ress)  PROMPIE: LC circuit is BIBO unstable.  In(S)  Ress)  Poles of G: p.,2 = \$\frac{1}{17\text{LC}}\$ \text{Poles of U(S)} = \frac{1}{17\text{LC}}\$ \text{Poles of U(S)} P		STADIE			MISTADIE				
THM 2: A LTI system with TF G(S) is BIBO stable if and only if all poles of G(S) are in OLHP  system is BIBO unstable if G(S) has at least one pole in ORHP or on j-onis.  DLHP Im(S)  RetS)  RetS)  RetS)  EXAMPle: LC circuit  \$\frac{1}{2} \text{ poles of G} \text{ p.12.2.2.1} \text{ poles of U(S)} \text{ another poles of U(S) = \$\frac{1}{2}\text{ poles of U(S)} \text{ poles of U(S) = \$\frac{1}{2}\text{ poles of U(S)} \text{ poles of G(S)} \text{ poles of U(S)}  poles of U(S)									
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system is BIBO unstable if G(s) has at least one pole in ORHP or on j-axis.  Into orthorized by the system is BIBO stable  Example: LC circuit  G(s) = \$\frac{1}{2} \frac{1}{2} \frac{1}{2					3		J		
system is BIBO unstable if G(s) has at least one pole in ORHP or on J-oxis.  DLHP Im(s)  Re(s)  Re(s)  Re(s)  Re(s)  Property of G(s) = 3*+LC  Re(s)  Property of G(s) = 3*+LC  Consider U(s) = 3*+LC  U(t) = sin(\(\frac{1}{1\text{LC}}\) to \(\frac{1}{1\text{LC}}\) to \(\frac{1}{1\tex				5-55					
Resonable: LC circuit $ \begin{array}{cccccccccccccccccccccccccccccccccc$	THM 2: A L	11 system wi	th It GCD is	s RIBO stab	le it and o	nly it all p	oles of G(s)	are in	OLHP
Resonable: LC circuit $ \begin{array}{cccccccccccccccccccccccccccccccccc$									
Resonable: LC circuit $ \begin{array}{cccccccccccccccccccccccccccccccccc$	suster	n is RIBO W	nstable if Go	s has at le	ast one or	ole in ORHP	or on i-axis		
Resonable: LC circuit $ \begin{array}{cccccccccccccccccccccccccccccccccc$	3	OLHP To			Im(s) ORL	IP	J. 07, J C		
Example: LC circuit  G(s) = 3*+LC  Y(s) = G(s) · U(s)  poles of G: p.,2 = 1/LC  Consider U(s) = 3*+1/LC  V(s) = G(s) · U(s)  Poles of U(s) · U(s)  Poles of U(s) · U(s)  Ress  By THM 2: LC circuit is BIBO unstable.  Int(s)  Poles of U(s) · U(s)  Ress  Ress  By THM 2: LC circuit is BIBO unstable.  Int(s)  Poles of U(s) · U(s)  Ress  Ress  Poles of U(s) · U(s)  Ress  Ress  Ress  Poles of U(s) · U(s)  Ress			2)						
Example: LC circuit  ### G(s) = \$\frac{1}{16}C\$  ### G(s)						Detex			
Example: RLC circuit    C		* >	Re(S)		**************************************	KEG)			
Example: LC circuit $ \begin{array}{c}                                     $			<b>4</b> 0		BTDD unetob	40			
$G(S) = \frac{1}{S^2 + LC} \qquad Y(S) = G(S) \cdot U(S)$ $V(S) = G(S) \cdot U(S)$ $V(S) = \frac{1}{S^2 + 1} = \frac{1}{LC} \qquad Y(S) = \frac{1}{LC} \qquad $		BLO SIU			PTPO mistor	AL .			
$G(S) = \frac{1}{S^2 + LC} \qquad Y(S) = G(S) \cdot U(S)$ $V(S) = G(S) \cdot U(S)$ $V(S) = \frac{1}{S^2 + 1} = \frac{1}{LC} \qquad Y(S) = \frac{1}{LC} \qquad $									
$u \stackrel{\text{(2)}}{=} C \stackrel{\text{(3)}}{=} y$ $\Rightarrow \text{ poles of } G: p_{1/2} = \pm j\sqrt{LC}$ $\text{Ress.}  \text{By Thm 2: LC circuit is BIBO unstable.}$ $\text{Consider } U(s) = \frac{1/(LC)}{s^2 + 1/LC} \stackrel{\text{(4)}}{\Rightarrow} u(t) = \sin(\frac{1}{4LC}t) \cdot \text{fl(t)}$ $\text{Y(s)} = G(s) \cdot U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^2 + 1/LC)^2} \stackrel{\text{(4)}}{\Rightarrow} u(t) = t \cdot \sin(\frac{1}{4LC}t) \cdot \text{fl(t)}$ $\text{Example: RLC circuit}}$ $\text{Example: RLC circuit}$ $\text{G(s)} = \frac{1/LC}{s^2 + (R/L)s + 1/LC}  \text{poles: p_{1/2} are in OLHP for any R.L.C.} \Rightarrow \text{poles of U(s)}$ $\text{By Thm 2: the system is BIBO stable}$ $\text{poles of U(s)}$ $\text{Poles of U(s)}$ $\text{Poles of U(s)}$	Example: L	C circuit							
$u \stackrel{\text{(2)}}{=} C \stackrel{\text{(3)}}{=} y$ $\Rightarrow \text{ poles of } G: p_{1/2} = \pm j\sqrt{LC}$ $\text{Ress.}  \text{By Thm 2: LC circuit is BIBO unstable.}$ $\text{Consider } U(s) = \frac{1/(LC)}{s^2 + 1/LC} \stackrel{\text{(4)}}{\Rightarrow} u(t) = \sin(\frac{1}{4LC}t) \cdot \text{fl(t)}$ $\text{Y(s)} = G(s) \cdot U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^2 + 1/LC)^2} \stackrel{\text{(4)}}{\Rightarrow} u(t) = t \cdot \sin(\frac{1}{4LC}t) \cdot \text{fl(t)}$ $\text{Example: RLC circuit}}$ $\text{Example: RLC circuit}$ $\text{G(s)} = \frac{1/LC}{s^2 + (R/L)s + 1/LC}  \text{poles: p_{1/2} are in OLHP for any R.L.C.} \Rightarrow \text{poles of U(s)}$ $\text{By Thm 2: the system is BIBO stable}$ $\text{poles of U(s)}$ $\text{Poles of U(s)}$ $\text{Poles of U(s)}$			<u>.</u>						
$u \stackrel{\text{(2)}}{=} C \stackrel{\text{(3)}}{=} y$ $\Rightarrow \text{ poles of } G: p_{1/2} = \pm j\sqrt{LC}$ $\text{Ress.}  \text{By Thm 2: LC circuit is BIBO unstable.}$ $\text{Consider } U(s) = \frac{1/(LC)}{s^2 + 1/LC} \stackrel{\text{(4)}}{\Rightarrow} u(t) = \sin(\frac{1}{4LC}t) \cdot \text{fl(t)}$ $\text{Y(s)} = G(s) \cdot U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^2 + 1/LC)^2} \stackrel{\text{(4)}}{\Rightarrow} u(t) = t \cdot \sin(\frac{1}{4LC}t) \cdot \text{fl(t)}$ $\text{Example: RLC circuit}}$ $\text{Example: RLC circuit}$ $\text{G(s)} = \frac{1/LC}{s^2 + (R/L)s + 1/LC}  \text{poles: p_{1/2} are in OLHP for any R.L.C.} \Rightarrow \text{poles of U(s)}$ $\text{By Thm 2: the system is BIBO stable}$ $\text{poles of U(s)}$ $\text{Poles of U(s)}$ $\text{Poles of U(s)}$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	n	$\frac{\overline{LC}}{e^2 + \overline{LC}}$	Y(8) = G	es al lees				
Consider U(s) = \( \frac{1}{\lambda \cdot			30/ - 3 TLL	1,0,0,0	_ Im(s)				
Consider $U(s) = \frac{1/\sqrt{LC}}{s^2 + 1/LC}$ $U(t) = \sin(\sqrt{LC} t) \cdot 1/(Ct)$ $U(t) = \cos(\sqrt{LC} t)$	4(2)	CT-8			Reiss				
Consider $U(s) = \frac{1/\sqrt{LC}}{s^2 + 1/LC}$ $U(t) = \sin(\sqrt{LC} t) \cdot 1/(Ct)$ $U(t) = \cos(\sqrt{LC} t)$			poles of G:	>2: ±j\tc	1	By THM2: LC	circuit is BIBO	unstable	
$Y(s) = G_{R}(s) \cdot U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = G_{R}(s) \cdot U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = G_{R}(s) \cdot U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = \frac{1/(LC)^{\frac{1}{2}}}{(s^{2}+1/LC)^{2}} \xrightarrow{f} y(t) = t \cdot sin(\sqrt{LC} \ t) \ 11(t)$ $U(s) = 1/($									
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Y(s) = (x(s)·U(s) = \frac{1/(LC)^2}{(s^2+1/LC)^2} \frac{1}{y(t)} = t \cdot sin(\frac{1}{LC} t) \frac{1}{U}(t)  \text{unbounded}  \text{poles of G(s)}  \text{Poles of G(s)}  \text{Poles of U(s)}   \text{Poles of U(s)}   \text{Poles of U(s)}   \text{Poles of U(s)}    \text{Poles of U(s)}   \text{Poles of U(s)}   \q	Conside	T U(S)= 5-+1/	LC - U(4):	= BIU(4FC £). IFC4				C	# 均低
Example: RLC circuit  ### C			1/4(2)2 1-1					→Reus)	
Example: RLC circuit  ### C		Y(s) = G(s) · U(s) =	(S'+1/LC)2 - u	(t)= t-sin(([C t)	II(t)	inbounded	* poles	of Gus	
G(s) = 5°+1R/LIS+1/LC poles: p <sub>1/2</sub> are in OLHP for any R.L.C >0  In(s)  By THM 2: the system is BIBO stable  Recs)									
G(s) = 5°+1R/LIS+1/LC poles: p <sub>1/2</sub> are in OLHP for any R.L.C >0  In(s)  By THM 2: the system is BIBO stable  Recs)									
By THM 2: the system is BIBO stable  ** poles of U(s)  Re(s)	Example: RLC	eircuit							
By THM 2: the system is BIBO stable  ** poles of U(s)  Re(s)									
By THM 2: the system is BIBO stable  ** poles of U(s)  Re(s)	u 🖭 🖰	T-9 Grass	ALDU ISALAC D	oles. D Ove	n OI HD for o	DICSD			
⇒By THM 2: the system is BIBO stable Poles of Uss >Recs)		] (4.7-3	**************************************	oles: pliz are i	N OLAP IOF C	Inco			
Recs)						<b>*</b>			
Re(S)		Dy THE	12: the system	is BIBO stable		× * pok	es of U(s)		
							→ Re(S)		
K: dissipates energy, stablize the system poles of G(s)						×			
		R: dissip	octes energy, s	tablize the sy	stem	# * pole	is of GC)		