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CMR INSTITUTE OF TECHNOLOGY	USN	CMRIT

Internal Assesment Test II – Dec 2021

Sub:	Signals and Systems							Code:	18EE54
Date:	16/12/2021	Duration:	90 mins	Max Marks:	50	Sem:	V	Section	EEE (A &B)

Note: Answer any **five FULL** Questions

Sketch neat figures wherever necessary. Answer to the point. **Good luck!**

		Marks	OBE CO	RBT
1	Determine Energy of the following signals (i) $x(t) = \begin{cases} \frac{1}{2}[1+\cos(wt)] & -\frac{\pi}{\omega} \le t \le \frac{\pi}{\omega} \\ 0 & Otherwise \end{cases}$ (ii) $x(t) = e^{-3t}u(t)$ (iii) $x[n] = n \qquad 0 \le n \le 5$	[10 M]	CO1	L3
2 (a)	A certain signal is described by the following mathematical equation. What is the energy of the signal? $x(t) = \begin{cases} 2t & 0 \le t < 1 \\ 2+\sin(2\pi t) & 1 \le t < 2 \\ 4-t & 2 \le t < 4 \\ 0 & Otherwise \end{cases}$	[7 M]	CO1	L3
2 (b)	Distinguish between Power and Energy signals	[3 M]	CO1	L1
3	Determine whether the following systems represented by input-output relations is (i) Linear (ii) Time-invariant (iii) Causal (iv) Memoryless (v) Stable (a) $y[n] = x[n]\ \ u[n+1]$ (b) $y(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$	[10 M]	CO2	L3
4(a)	Given the impulse response h[n], of an LTI system, obtain the condition which needs to be satisfied by h[n], for the system to be (i) Causal (ii) Stable.	[4 M]	CO3	L2
4(b)	Verify whether the following impulse responses are stable and causal or not. (i) $h(t) = e^{2t}u(t-1)$ (ii) $h[n] = \left(\frac{1}{2}\right)^n u[n]$	[6 M]	CO3	L3
5	Find the output y(t) of the system, for a continuous time LTI system with unit impulse response $h(t) = u(t)$ and input $x(t) = e^{-5t}u(t)$	[10 M]	CO2	L3
6	Determine the output of the following discrete time system, whose impulse response is $h[n] = (0.2)^n u[n]$ and the excitation of $x[n] = (0.6)^n u[n]$	[10 M]	CO2	L3
7 (a)	Determine the natural response for the following differential/difference equation (i) $3\frac{dy(t)}{dt} + 2y(t) = 5\frac{dx(t)}{dt}$ (ii) $y[n] - \frac{1}{3}y[n-1] + \frac{1}{2}y[n-2] = x[n] + x[n-1]$	[5 M]	CO2	L3
7(b)	Determine the forced response for the given input, $x[n] = \left(\frac{1}{2}\right)^n u[n]$ $y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = x[n] + x[n-1]$	[5M]	CO2	L3
8 (a)	Explain the cascade and parallel connection of impulse responses and write the output equation.	[5M]	CO2	L2
8 (b)	Find the output for the following sequences. $x[n] = \{1,3,0,-1,2,1\}$ and $h[n] = \{2,-1,3\}$	[5M]	CO2	L2

CI CCI HOD

IAT-2 Solution

① Determine Energy of the following signals.

(i) $x(t) = \begin{cases} \frac{1}{2}[1+\cos(\omega t)] & -\frac{\pi}{\omega} \leq t \leq \frac{\pi}{\omega} \\ 0 & \text{otherwise.} \end{cases}$

$$E = \lim_{T\to\infty} \int_{-T}^{T} |x(t)|^2 \, dt$$

$$E = \int_{-\pi/\omega}^{\pi/\omega} \left(\frac{1}{2}[1+\cos(\omega t)]\right)^2 dt$$

$$= \frac{1}{4} \int_{-\pi/\omega}^{\pi/\omega} (1+\cos\omega t)^2 \, dt = \frac{1}{4} \int_{-\pi/\omega}^{\pi/\omega} (1+\cos^2\omega t + 2\cos\omega t) \, dt$$

$$= \frac{1}{4} \int_{-\pi/\omega}^{\pi/\omega} \left[1 + \left(\frac{1+\cos 2\omega t}{2}\right) + 2\cos\omega t\right] dt$$

$$= \frac{1}{4} \int_{-\pi/\omega}^{\pi/\omega} \left[1 + \frac{1}{2} + \frac{\cos 2\omega t}{2} + 2\cos\omega t\right] dt$$

$$= \frac{1}{4} \int_{-\pi/\omega}^{\pi/\omega} \left[\frac{3}{2} + \frac{\cos 2\omega t}{2} + 2\cos\omega t\right] dt$$

$$= \frac{1}{4}\left[\int_{-\pi/\omega}^{\pi/\omega} \frac{3}{2} dt + \int_{-\pi/\omega}^{\pi/\omega} \frac{\cos 2\omega t}{2} dt + 2\int_{-\pi/\omega}^{\pi/\omega} \cos\omega t \, dt\right]$$

$$= \frac{1}{4}\left[\frac{3}{2} \cdot t \Big|_{-\pi/\omega}^{\pi/\omega} + 0 + 0\right]$$

$$= \frac{1}{4}\left(\frac{3}{\cancel{2}}\left(\frac{\cancel{2}\pi}{\omega}\right)\right) = \frac{3\pi}{4\omega}$$

— 5M

(ii) $x(t) = e^{-3t} u(t)$

$$E = \underset{T \to \infty}{lt} \int_{-T}^{T} |x(t)|^2 dt$$

$$= \underset{T \to \infty}{lt} \int_{-T}^{T} \left(e^{-3t} u(t)\right)^2 dt$$

$$= \underset{T \to \infty}{lt} \int_{-T}^{T} e^{-6t} u(t)\, dt$$

$$= \underset{T \to \infty}{lt} \int_{-T}^{0} e^{-6t} u(t)\, dt + \underset{T \to \infty}{lt} \int_{0}^{T} e^{-6t} u(t) dt$$

$$= \underset{T \to \infty}{lt}\ 0 + \underset{T \to \infty}{lt} \int_{0}^{T} e^{-6t} dt$$

$$= \underset{T \to \infty}{lt} \int_{0}^{T} e^{-6t} dt = \underset{T \to \infty}{lt} \frac{e^{-6t}}{(-6)}\Big|_0^T = \underset{T \to \infty}{lt} \frac{e^{-6T} - e^{0}}{-6}$$

$$= \frac{e^{-\infty} - e^{0}}{-6} = \frac{-1}{-6} = 1/6 .$$

$-3M$

(iii) $x[n] = n \qquad 0 \leq n \leq 5.$

$$E = \underset{N \to \infty}{lt} \sum_{n=-\infty}^{\infty} (x[n])^2$$

$$E = \sum_{n=0}^{5} |x[n]|^2$$

$$= \sum_{n=0}^{5} n^2 = 0 + 1^2 + 2^2 + 3^2 + 4^2 + 5^2 = 55 .$$

$-2M$

10M

(2) (a) $x(t) = \begin{cases} 2t & 0 \leq t < 1 \\ 2+\sin(2\pi t) & 1 \leq t < 2 \\ 4-t & 2 \leq t < 4 \\ 0 & \text{otherwise.} \end{cases}$

$$E = \lim_{t \to \infty} \int_{-T}^{T} |x(t)|^2 dt$$

$$E = \int_0^1 (2t)^2 dt + \int_1^2 (2+\sin(2\pi t))^2 dt + \int_2^4 (4-t)^2 dt \quad \text{— 1M}$$

$$= \int_0^1 4t^2 dt + \int_1^2 (4+\sin^2 2\pi t + 4\sin(2\pi t))\,dt + \int_2^4 (16+t^2-8t)\,dt$$

$$= 4\frac{t^3}{3}\Big|_0^1 + 4\,t\Big|_1^2 + \int_1^2 \sin^2(2\pi t)\,dt + 4\int_1^2 \sin(2\pi t)\,dt + \left[16t\Big|_2^4 + \frac{t^3}{3}\Big|_2^4 - \frac{8t^2}{2}\Big|_2^4\right] \quad \text{— 2M}$$

$$= \frac{4}{3} + 4 + \int_1^2 \frac{1-\cos 4\pi t}{2}\,dt + 4\frac{(-\cos 2\pi t)}{2\pi}\Big|_1^2 + 16(2) + \frac{56}{3} - 4(12) \quad \text{— 1M}$$

$$= \frac{16}{3} + \frac{1}{2}t\Big|_1^2 - \frac{1}{2}\int_1^2 \cos 4\pi t\,dt + \frac{2}{\pi}(-\cos 4\pi + \cos 2\pi) + 32 + \frac{56}{3} - 48$$

$$= \frac{16}{3} + \frac{1}{2} - \frac{1}{2}\frac{(\sin 4\pi t)}{4\pi}\Big|_1^2 + \frac{2}{\pi}(-1+1) + \frac{8}{3} \quad \text{— 1M}$$

$$= 8 + \frac{1}{2} - \frac{1}{8\pi}(\sin 8\pi - \sin 4\pi) + 0 = \frac{17}{2} - 0$$

$$\boxed{E_{x(t)} = \frac{17}{2}} \quad \text{— 2M}$$

$$\boxed{E_{x(t)} = 8.5}$$

7 M

2 (b)

Energy Signal	Power Signal
1. The total energy is obtained using $E = \lim_{T\to\infty} \int_{-T}^{T} \lvert x(t)\rvert^2 dt$ for DTS $E = \lim_{N\to\infty} \sum_{n=-\infty}^{\infty} (x[n])^2$	1. The average power is obtained using $P = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} \lvert x(t)\rvert^2 dt$ $P = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{n} \lvert x[n]\rvert^2$.
2. for the energy signal Energy is finite $0 < E < \infty$	2. The power of a power signal is finite. $0 < P < \infty$.
3. The average power $P = 0$.	3. The energy 'E' should be infinity $E = \infty$.
4. Non-periodic signals are energy signals.	4. periodic signals are power signals. However all power signals not periodic.
5. Energy signals are not time limited.	5. Power signals exist over infinite time.

— 3M

1QM

③ ⓐ $y[n] = x[n]\, u[n+1]$

(i) Linearity : The given System is Similar to $y[n] = m\, x[n]$ form. So the System is Linear — 1M

$T[\alpha\, x_1[n] + \beta\, x_2[n]] \longrightarrow \alpha\, y_1[n] + \beta\, y_2[n]$.

(ii) Time-invariant :- In the given System, "n" exist in $x[n]$ and $u[n+1]$ terms. The System is Time-variant — 1M

$y_1[n] \neq y[n-n_0]$

(iii) Causality :- The present o/p of the system depends only on the present i/p system. So, the given system is Causal — 1M

(iv) Memoryless : The present o/p of the given System only depends on the present i/p. So the given System is static (or) Memoryless. — 1M

(v) Stable :- The given System is stable.

$y[n] = x[n]\, u[n+1]$

$x[n] \rightarrow$ Bounded i/p

$u[n+1] \longrightarrow$ Bounded Signal (step).

$y[n] \rightarrow$ Bounded o/p.

$\therefore$ The System is stable. — 1M

5M

(b) $y(t) = \int_{-\infty}^{t} x(\tau)\,d\tau.$

(i) Linearity :- The given system consists the integrator, which is linear operator. So, the given system is linear — 1M

$$T\left[\alpha x_1(t) + \beta x_2(t)\right] = \alpha y_1(t) + \beta y_2(t).$$

(ii) Time-invariant :- In the given system, the integral limits $-\infty$ to t.

$$y_1(t) = \int_{-\infty}^{t} x(\tau - t)\,d\tau = \int_{-\infty}^{t-t_0} x(\tau)\,d\tau$$

$$y(t-t_0) = \int_{-\infty}^{t-t_0} x(\tau)$$

$$y_1(t) = y(t-t_0)$$ — 1M

$\therefore$ The given system is time-invariant.

(iii) Causality :- The given system has integral term with limits $-\infty$ to t.

The present o/p depends on past and present i/p, Then the system is Causal. — 1M.

(iv) Memoryless :- The present o/p depends on past and present i/p, the system is dynamic system (or) Memory — 1M

(v) Stable :- The given system is ~~stable~~ unstable. — 1M

$$y(t) = \int_{-\infty}^{t} x(\tau)\,d\tau.$$

let $x(\tau) = u(\tau)$, $y(t) = \int_{-\infty}^{t} u(\tau)\,d\tau = r(t).$ — 1M

$x(t) \rightarrow$ bounded signal, $y(t)$ = unbounded signal.

$\therefore$ The given system unstable system.

④ ⓐ Condition for Causality of an Impulse response of an LTI System

Sol:

If a system is said to causal, if the present o/p depends on past and present i/p.

from the definition of convolution, $y[n] = x[n] * h[n]$

$$y[n] = \sum_{K=-\infty}^{\infty} h(k)\, x(n-k) \quad \text{— 1M}$$

for a LTI system to be causal,

$$h(K) = 0 \qquad K < 0. \qquad \text{Discrete time signal.}$$

$$h(t) = 0 \qquad t < 0, \qquad \text{Continuous time signal.}$$

— 1M

Condition for stability of an impulse response of an LTI System

If a system is said to be stable, if it produces bounded output for every bounded input.

— 1M

$$y[n] = \sum_{K=-\infty}^{\infty} h(k)\, x(n-k)$$

~~y[n]~~ ~~stu~~ $x[n-k]$ is bounded input,

to make, $y[n]$ to be bounded,

$$\sum_{K=-\infty}^{\infty} |h(k)| < \infty .$$

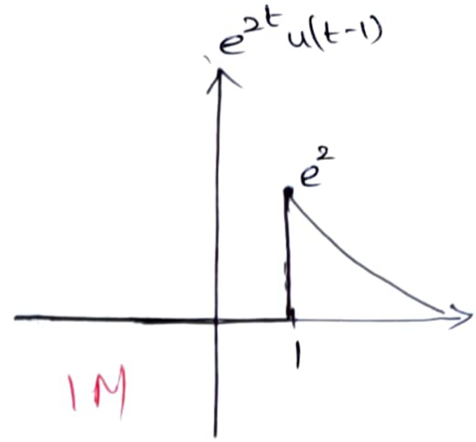
— 1M

$$\int_{-\infty}^{\infty} |h(t)|\, dt < \infty .$$

4M

(4) (b) Given impulse responses,

(i) $h(t) = e^{2t} u(t-1)$.



The given System is Causal,

$h(t) = 0, \quad t < 0.$ ← 1M

$u(t-1) = \begin{cases} 1 & t > 1 \\ 0 & t < 0. \end{cases}$

(ii) To evaluate stability,

$$\int_{-\infty}^{\infty} h(t)\,dt = \int_{-\infty}^{\infty} e^{2t} u(t-1)\,dt$$

$u(t-1) = \begin{cases} 1 & t > 1 \\ 0 & t < 1 \end{cases}$

$$= \int_{1}^{\infty} e^{2t}\,dt$$

$$= \frac{e^{2t}}{2}\Big|_{1}^{\infty} = \frac{1}{2}\left(e^{\infty} - e^{2}\right) = e^{\infty} = \infty.$$

∴ The given System is unstable ← 2M

3M.

(or)

$h(t) = e^{2t} u(t-1)$

$u(t-1) = \begin{cases} 1 & t > 1 \\ 0 & t < 1 \end{cases}$

$h(t) = e^{2t} u(t-1) = \begin{cases} e^{2t} & t > 1 \\ 0 & t < 1. \end{cases}$

∴ The given System is Causal

(ii) $h[n] = \left(\frac{1}{2}\right)^n u[n]$

$$u[n] = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0. \end{cases}$$

$$\therefore\ h[n] = \left(\tfrac{1}{2}\right)^n u[n] = \begin{cases} \left(\tfrac{1}{2}\right)^n & n \geq 0 \\ 0 & n < 0 \end{cases}$$

$\therefore$ The given System is <u>Causal</u>. — 1M

To evaluate the Stability,

$$\sum_{K=-\infty}^{\infty} |h(K)| < \infty.$$

$$\boxed{\begin{aligned} &*** \\ &\sum_{K=0}^{n} \alpha^K = \frac{1-\alpha^{n+1}}{1-\alpha}. \\ &\sum_{K=0}^{\infty} \alpha^K = \frac{1}{1-\alpha} \end{aligned}}$$

$$\sum_{K=-\infty}^{\infty} h(K) = \sum_{K=-\infty}^{\infty} \left(\tfrac{1}{2}\right)^K u(K)$$

$$= \sum_{K=0}^{\infty} \left(\tfrac{1}{2}\right)^K = \frac{1}{1-\left(\frac{1}{2}\right)}$$

$$= \frac{1}{\left(1/2\right)} = 2 < \infty.$$

$\therefore$ The given system is <u>stable</u>. — 2M

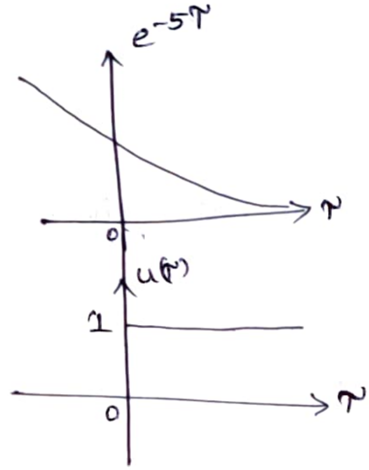
3M.

(5) input $x(t) = e^{-5t} u(t)$

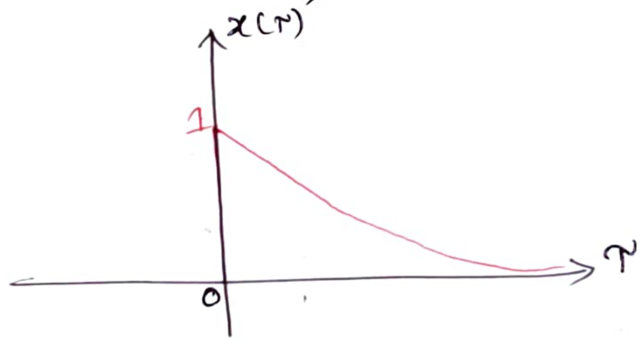
impulse response $h(t) = u(t)$.

output $y(t) = ?$

$$y(t) = x(t) * h(t) = \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau. \quad \text{— 1M}$$



Step 1 :- Draw $x(\tau)$



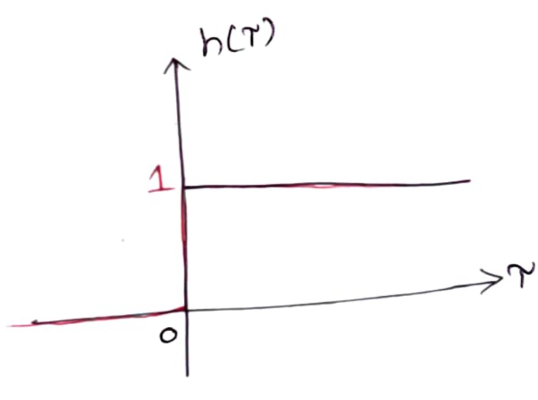
$$x(\tau) = e^{-5\tau} u(\tau)$$

$$= e^{-5\tau} \begin{cases} 1 & \tau > 0 \\ 0 & \tau < 0 \end{cases}$$

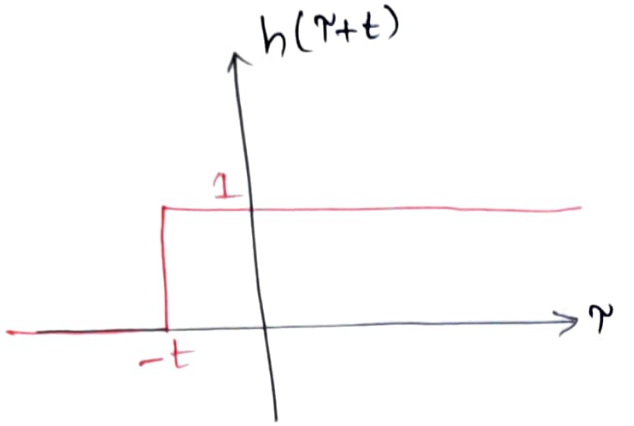
$$x(\tau) = \begin{cases} e^{-5\tau} & \tau > 0 \\ 0 & \tau < 0 \end{cases} \quad \text{— 1M}$$

Step 2 :- $h(t-\tau) = h(-\tau + t)$

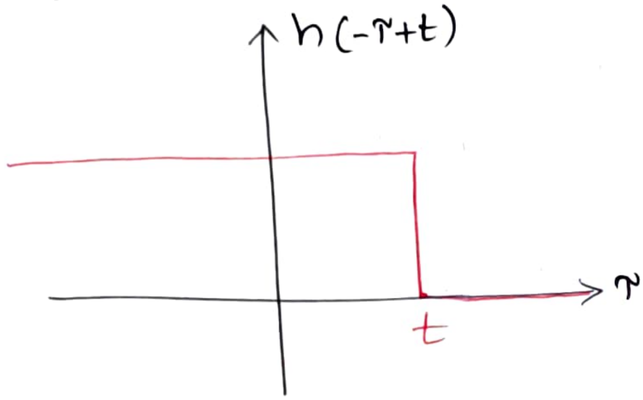
Draw $h(\tau) = u(\tau) = \begin{cases} 1 & \tau > 0 \\ 0 & \tau < 0 \end{cases}$



Step 3:- $h(\tau+t)$

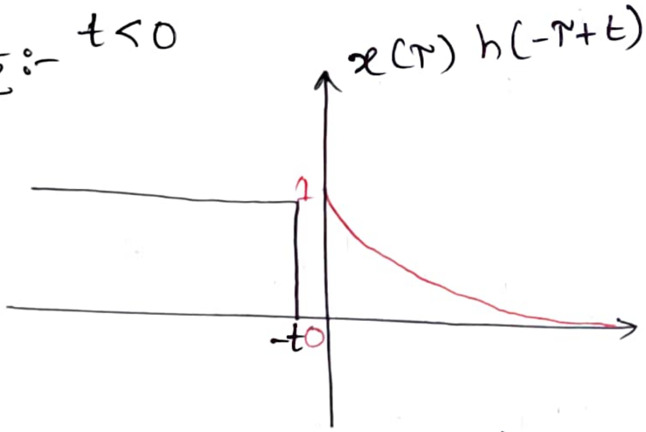


Step 4:- Draw $h(-\tau+t)$



— 1M

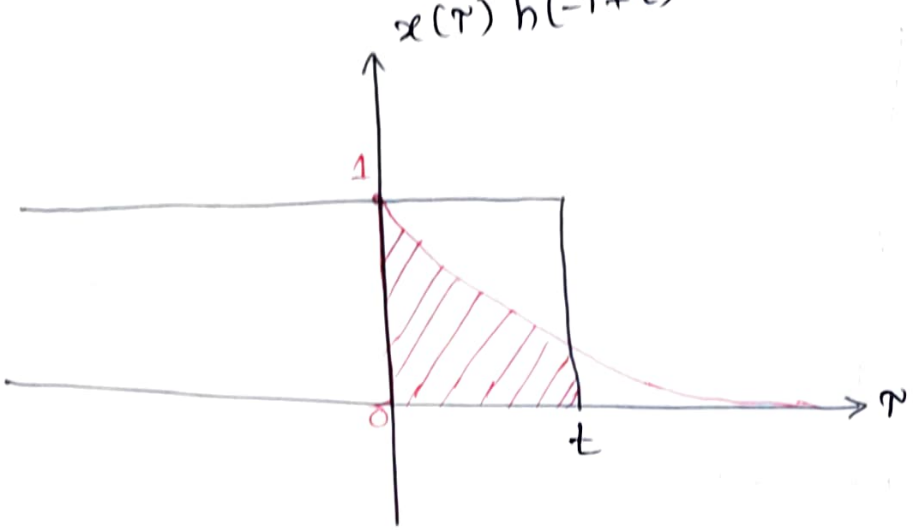
Step 5:- $t<0$



$$y(t) = x(t) * h(t) = \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau$$ — 1M

$$= 0$$ (No common Area).

Step 6 :- $t > 0$.



$$y(t) = x(t) * h(t) = \int_0^t x(\tau)\, h(t-\tau)\, d\tau$$

$$= \int_0^t e^{-5\tau} d\tau$$

$$= \frac{e^{-5\tau}}{-5} \Big|_0^t$$

$$= \left(\frac{e^{-5t} - e^{0}}{-5}\right)$$

$$= \frac{1}{5}\left(1 - e^{-5t}\right), \quad t > 0.$$

$$\therefore \ y(t) = \begin{cases} \frac{1}{5}(1-e^{-5t}) & t > 0 \\ 0 & t < 0. \end{cases}$$ — 5M

$$\therefore \ y(t) = \frac{1}{5}\left(1-e^{-5t}\right) u(t)$$ — 1M

10M

6) Given data,

input $x[n] = (0.6)^n \, u[n]$

impulse response $h[n] = (0.2)^n \, u[n]$

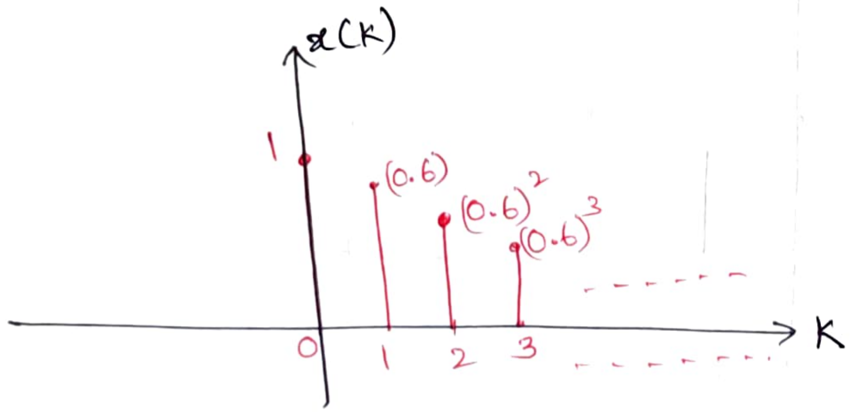
output $y[n] = \, ?$

$$y[n] = x[n] * h[n] = \sum_{K=-\infty}^{\infty} x(K)\, h(n-K) \qquad \longleftarrow \text{1M}$$

Step 1 :- Draw $x(K) = (0.6)^K u(K)$.

$$= (0.6)^K \begin{cases} 1 & K \geq 0 \\ 0 & K < 0 \end{cases}$$

$$x(K) = \begin{cases} (0.6)^K & K \geq 0 \\ 0 & K < 0 \end{cases}$$

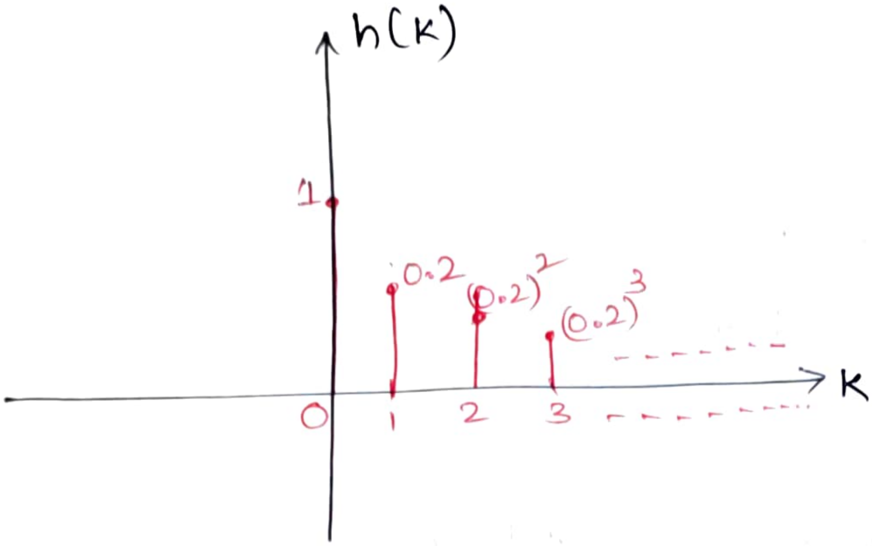


$\longleftarrow$ 1M

Step 2 :- $h(n-K) = h(-K+n)$

Draw $h(K) = (0.2)^K u(K)$

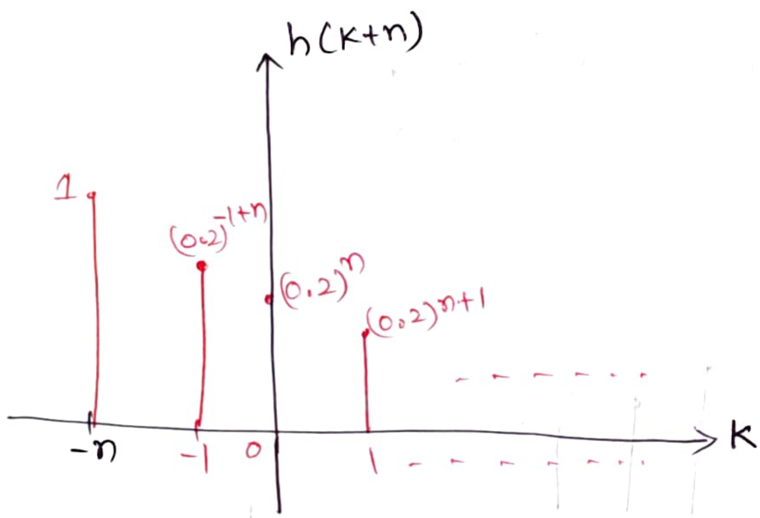
$$h(K) = \begin{cases} (0.2)^K & K \geq 0 \\ 0 & K < 0 \end{cases}$$



Step 3:- Draw $h(k+n)$

$$h(k+n) = (0.2)^{k+n} \, u(k+n)$$

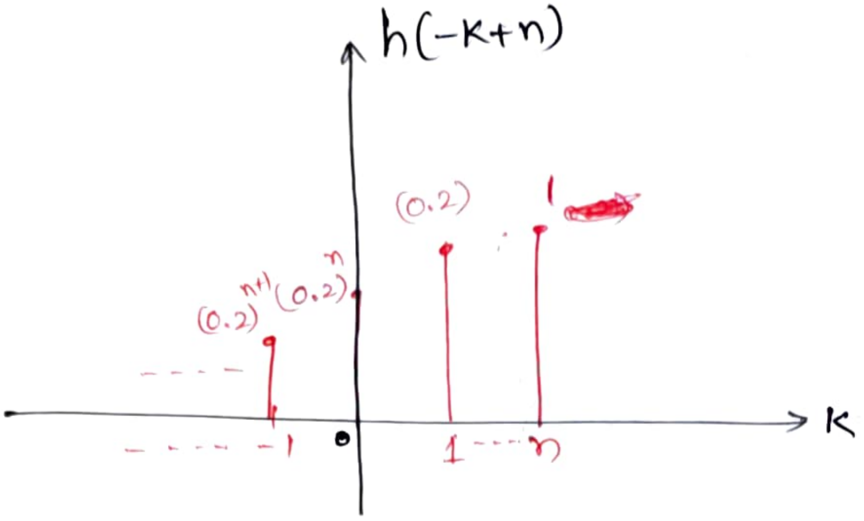
$$= \begin{cases} (0.2)^{k+n} & k \geq -n \\ 0 & k < -n \end{cases}$$



Step 4:- Draw $h(-k+n)$

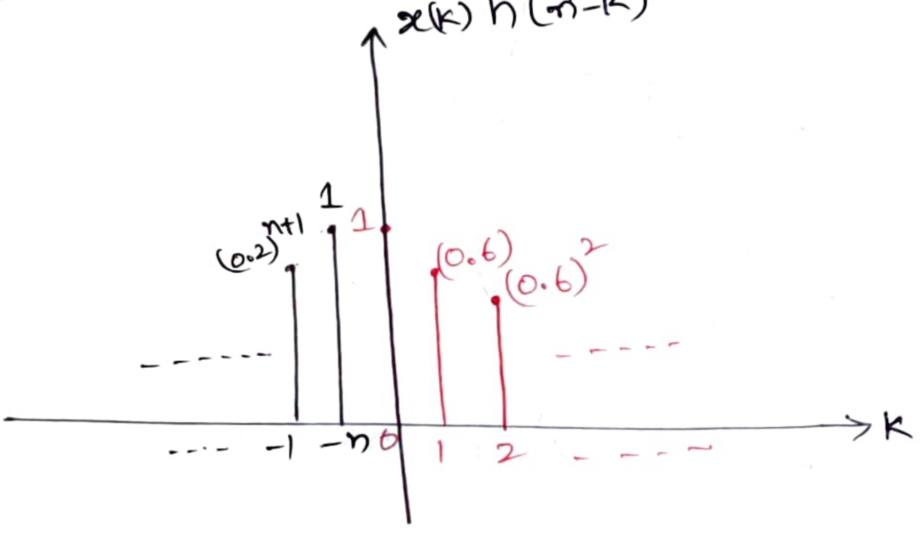
$$h(-k+n) = (0.2)^{-k+n} \, u(-k+n)$$

$$= \begin{cases} (0.2)^{-k+n} & k \leq n \\ 0 & k > 0 \end{cases}$$



— 1M

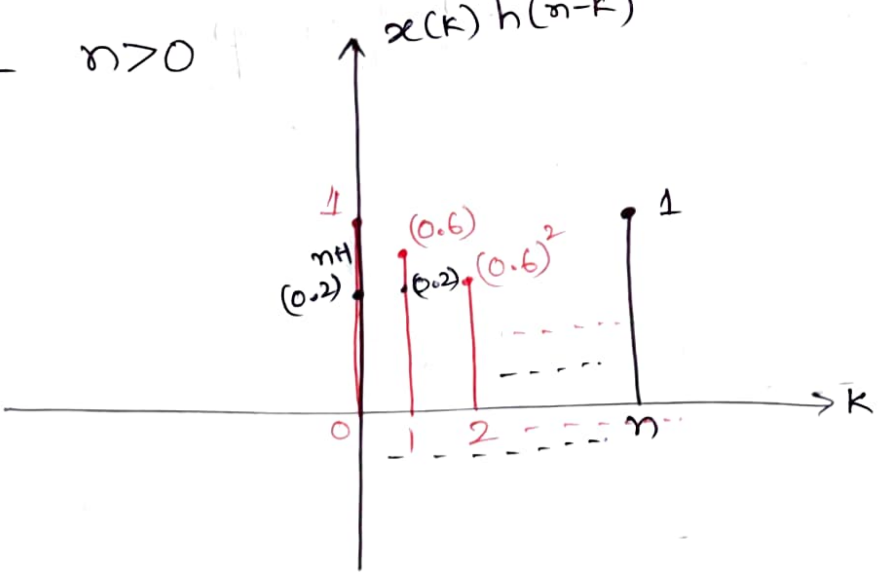
Step5 :- $n < 0$



— 1M

$y[n] = 0 \qquad n < 0.$

step 6 :- $n > 0$



$$y[n] = \sum_{k=0}^{n} (0.6)^k (0.2)^{n-k}$$

$$= \sum_{k=0}^{n} (0.6)^k \frac{(0.2)^n}{(0.2)^k}$$

$$= (0.2)^n \sum_{k=0}^{n} \left(\frac{0.6}{0.2}\right)^k$$

$$= (0.2)^n \sum_{k=0}^{n} 3^k$$

$$= (0.2)^n \left(\frac{1-3^{n+1}}{1-3}\right)$$

$$= (0.2)^n \left(\frac{1-3^{n+1}}{-2}\right)$$

$$= (0.2)^n \left(\frac{3^{n+1}-1}{2}\right) \quad n>0. \quad \text{—— 5M}$$

$$\therefore y[n] = \begin{cases} (0.2)^n \left(\frac{3^{n+1}-1}{2}\right), & n>0 \\ 0, & n<0 \end{cases}$$

$$y[n] = (0.2)^n \left(\frac{3^{n+1}-1}{2}\right) u[n] \quad \text{—— 1M}$$

$$\overline{10M}$$

7 (a) (i) $3\frac{dy(t)}{dt} + 2\,y(t) = 5\,\frac{dx(t)}{dt}$

<u>Step 1</u> :- To find natural response, $x(t) = 0$.

$$3\frac{dy(t)}{dt} + 2\,y(t) = 0 .$$

<u>Step 2</u> :- find the characteristic equation, $\frac{d^k y(t)}{dt^k} = r^k$

$$3r + 2 = 0 \qquad \text{— 1M}$$

$$r = -2/3 .$$

Step 3 :- natural response (or) homogeneous Solution.

$$y^{(h)}(t) = C_1 e^{rt} \qquad \text{— 1M}$$

$$y^{(h)}(t) = C\,e^{-2t/3}$$

2M

(ii) $y[n] - \frac{1}{3}y[n-1] + \frac{1}{2}y[n-2] = x[n] + x[n-1]$.

Step 1 :- To find natural response, $x[n]=0$, $x[n-1]=0$.

$$y[n] - \frac{1}{3}y[n-1] + \frac{1}{2}y[n-2] = 0.$$ — 1M

Step 2 :- characteristic equation, $y(n-k) = \frac{1}{r^k}$

$$1 - \frac{1}{3r} + \frac{1}{2r^2} = 0$$

$$\frac{6r^2 - 2r + 3}{\cancel{6}r^2} = 0$$

$$6r^2 - 2r + 3 = 0.$$

roots, $r = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{2 \pm \sqrt{4-72}}{12}$

$$= \frac{2 \pm \sqrt{-68}}{12} = \frac{2 \pm \sqrt{68}j}{12}$$

$$= \frac{2 \pm j2\sqrt{17}}{12}$$ — 1M

$$= \frac{1 \pm j\sqrt{17}}{6} = \frac{1+j\sqrt{17}}{6}, \frac{1-j\sqrt{17}}{6}$$

Step 3 :- homogenous Solution,

$$y^{(h)}(t) = c_1 e^{\left(\frac{1+j\sqrt{17}}{6}\right)t} + c_2 e^{\left(\frac{1-j\sqrt{17}}{6}\right)t}.$$ — 1M

3M

7 (b)

$y[n] - \frac{1}{4} y[n-1] - \frac{1}{8} y[n-2] = x[n] + x[n-1]$.

Step 1 :- To find forced response, Given input

$$x[n] = \left(\frac{1}{2}\right)^n u[n].$$

$$y^{(p)}[n] = K \left(\frac{1}{2}\right)^n u[n].$$ — 1M

Step 2 :- $y[n] = K\left(\frac{1}{2}\right)^n$

$$y[n-1] = K\left(\frac{1}{2}\right)^{n-1} = 2K\left(\frac{1}{2}\right)^n$$

$$y[n-2] = K\left(\frac{1}{2}\right)^{n-2} = 4K\left(\frac{1}{2}\right)^n$$ — 1M

$$y[n] - \frac{1}{4} y[n-1] - \frac{1}{8} y[n-2] = x[n] + x[n-1]$$

$$K\left(\frac{1}{2}\right)^n - \frac{1}{4}\, 2K\left(\frac{1}{2}\right)^n - \frac{1}{8}\, 4K\left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^n + \left(\frac{1}{2}\right)^{n-1}.$$

$$= \left(\frac{1}{2}\right)^n + 2\left(\frac{1}{2}\right)^n$$ — 1M

$$K\left(\frac{1}{2}\right)^n \left[1 - \frac{1}{2} - \frac{1}{2}\right] = 3\left(\frac{1}{2}\right)^n$$

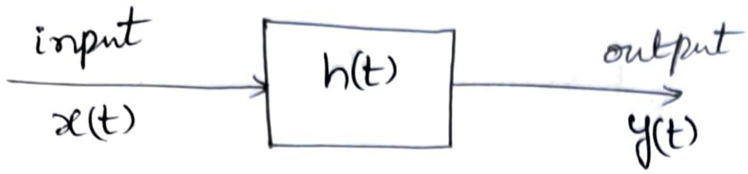
K = undefined (or) $K = \infty$.

$\therefore$ The given System is unstable System.

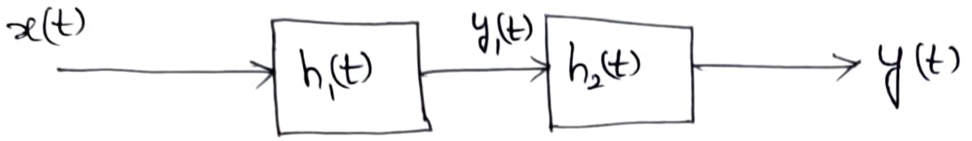
forced response is not determind (or) Not exist for given Input. — 2M

5M

(8) (a) Cascade connection of impulse responses.



$$y(t) = x(t) * h(t)$$



1M

$$y_1(t) = x(t) * h_1(t)$$

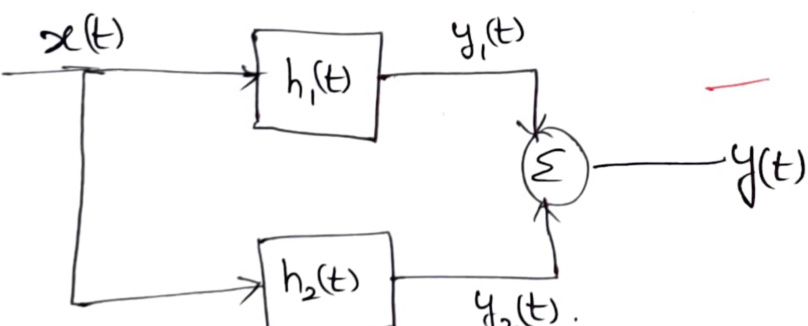
$$y(t) = y_1(t) * h_2(t)$$

$$y(t) = (x(t) * h_1(t)) * h_2(t)$$

$$\boxed{y(t) = x(t) * (h_1(t) * h_2(t))}$$

2M

Parallel connection of impulse responses.



1M

$$y_1(t) = x(t) * h_1(t)$$

$$y_2(t) = x(t) * h_2(t)$$

$$y(t) = y_1(t) + y_2(t)$$

$$y(t) = x(t) * h_1(t) + x(t) * h_2(t)$$

$$\boxed{y(t) = x(t) * (h_1(t) + h_2(t))}$$

1M

5M

8 (b) $x[n] = \{1, 3, 0, -1, 2, 1\}$

$h[n] = \{2, -1, 3\}$.

$y[n] = x[n] * h[n]$

$$
= \begin{array}{c|cccccc|}
 & 1 & 3 & 0 & -1 & 2 & 1 \\
\hline
2 & 2 & 6 & 0 & -2 & 4 & 2 \\
-1 & -1 & -3 & 0 & 1 & -2 & -1 \\
3 & 3 & 9 & 0 & -3 & 6 & 3 \\
\hline
\end{array}
\quad \text{— 4M}
$$

$y[n] = \{2, 5, 0, 7, 5, -3, 5, 3\}$. — 1M

5M.