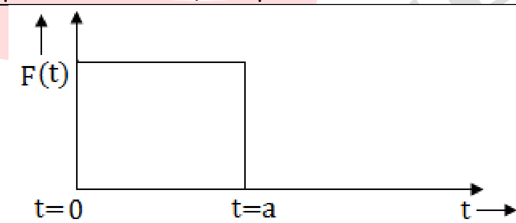
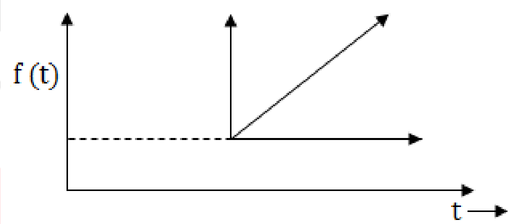
Assignment questions for PDC

1) Define
(a) Process Dynamics
(b) Forcing Functions
(c) Bounded Functions
(d) Observation Time
(e) First order system
(f) Transfer function
(g) Response function
(h) Steady state Gain
(i) Time Constant of the process

2)

Input Changes	Laplace Transform/ Graph
(a) Pulse Change	 1.
(b) Ramp Change	2. $\left(\frac{1-e^{-As}}{As}\right)$
(c) Step Change	 3.
(d) Sinusoidal Change	4. $\frac{10}{s^2+6}$

3) Prove that the Laplace Transform of Impulse function is unity.

4) A process is initially at steady State.
Its input x = 5 and corresponding output y =10.
The input is suddenly changed to 10 at the observation time. The output response becomes Linear with a slope of 5. The transfer function of the process is?

5) Impulse input change is bounded because
(a) Area under the curve of impulse is unity.
(b) Ideal impulse is not possible.
(c) Its Laplace transform is unity.
(d) The initial value of the impulse change is finite
(e) None of these

6) Advantage of studying process dynamics is
(a) It helps us to stabilize the process.
(b) It allows us to control/ Regulate the process.
(c) It allows us to understand the process.
(d) All of the above.

7) The Hot and the cold Junction of the thermo couple are placed in a bath at 100°C & 20°C respectively. The corresponding emf data for this caliberation is 3.46 (mv) and (1.20)(mv) respectively.
(a) Determine Sensitivity of the system.
(b) Determine change in the emf, If for the same caliberation, cold Junction in shifted to 40°C
(c) If thermocouple measures temperatures only between 40°C to 60°C, then determine the proportional band of temperature range.
(d) If proportional band of output range is 50% and for input is 80%, then determine the corresponding emf value at 50°C.
(e) If sensitivity is doubled, keeping the temperature range same, then calculate the corresponding emf.

8) The closed loop poles of a stable first order system could be
(a) both real and positive
(b) both real and negative
(c) Complex conjugate
(d) Always real and Negative
(e) Always real but positive or may be negative

9) A first order system with a steady state gain of 5 units and time constant of 10 units is subjected to a sinusoidal input of frequency same as reciprocal of time constant. Determine.
(a) Amplitude ratio.
(b) phase Lag
(c) phase angle
(d) Linear frequency
(e) Lag time
(g) ultimate value of Response
(h) output Amplitude

10) The frequency response of a first order system has a phase shift with lower and higher frequency bounds is given by ___________.

11) Match the following

Response function	Time domain Responses
(a) Step Response	1. $y(t) = 10 + 5t - 5\tau_p$
(b) Impulse Response	2. $y(t) = 50 + 5\,k_p(1 - e^{-t})$
(c) Ramp Response	3. $y(t) = 10 + 10\,e^{-2t}$
(d) Sinusoid Response	4. $y(t) = 10 \sin(5t + 10)$

12) Match the following

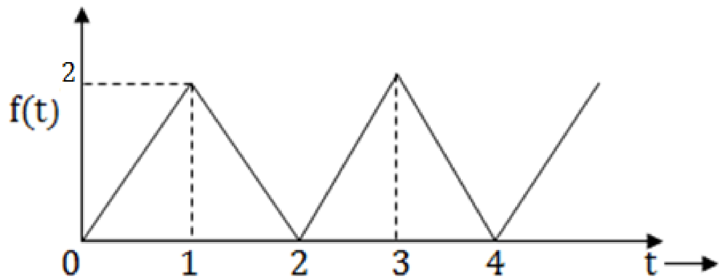
Time domain Responses	Response function
(a) $Y(t) = A\,k_p t - Ak_p\,\tau_p\,(1 - e^{-t/\tau p})$	1. $\dfrac{AK_p\omega}{(\tau_\rho s+1)(s^2+\omega^2)}$

(b) Y(t) = $\dfrac{Ak_p}{\sqrt{1+(\tau_p\omega)^2}}\text{Sin}(\omega t-\phi)$ 2. $\dfrac{AK_p}{(\tau_\rho s+1)(s^2)}$

(c) Y(t) = $Mk_p\,(1-e^{-t/\tau_p})$ 3. $\dfrac{AK_p}{s(\tau_\rho s+1)}$

(d) Y(t) = $\dfrac{K_p}{\tau_p}e^{-t/\tau_p}$ 4. $\dfrac{K_p}{\tau_\rho s+1}$

13) Determine the Laplace Transform of the following.



14) For the time domain function f(t) = $\dfrac{e^{-t}\,\text{Sin}\,t}{t}$, the Laplace transform of $\int_0^t f(t)\,dt$ is given by _____.

15) In the step Response of tank system $\bar{h}(t)=M\,K_p\left(1-e^{-t/\tau_p}\right)$

Match the following

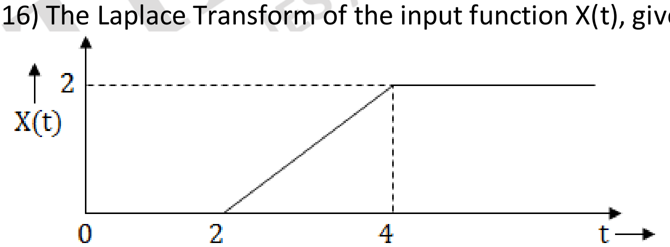
(a) h(t) 1. Defined as the product of capacity of the tank and the Resistance offered by the tank.

(b) M 2. Defined as the Difference between the inlet flow rate at a time ‘t’ with the inlet flow rate at the steady State.

(c) τ_p 3. Defined as the Condition of overflow and used to determine the domain of tank system under which it is stable.

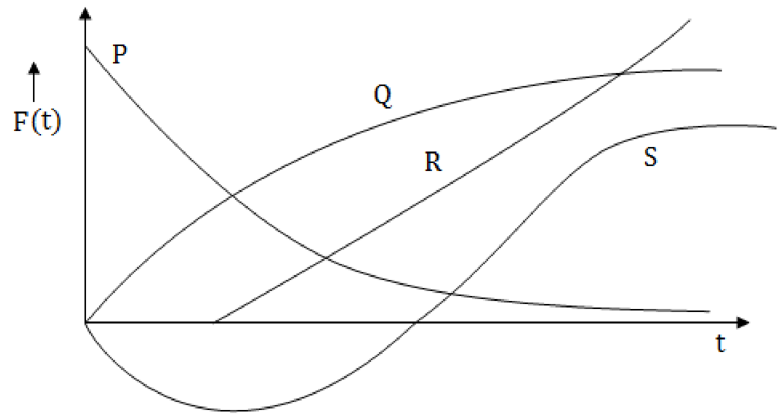
(d) h(t) = H 4. Defined as the height of the Liquid level in the tank at time ‘t’.

16) The Laplace Transform of the input function X(t), given in the figure below is given by



17) A process is disturbed by a sinusoidal input, x(t) = 5 Sint. The resulting process output is y(s) = $\dfrac{5K_p}{(\tau s+1)(s^2+1)}$. If y(o) = 0, the differential equation representing the process is ____________.

18)



Identify the above Response.

19) A tank of volume 0.50 m^3 and height of 0.5 m has water flowing in at 0.08 m^3/hr. The outlet flow rate is governed by the relation $F_o = 0.2h$, where 'h' is the height of the water in the tank in 'm' and F_o is the outlet flow rate in m^3/hr. A step change of magnitude 0.10 m^3/hr is given to the inlet flow rate. Calculate the value of height of the Liquid level after 1 hr?

20) The inverse Laplace transform of $\frac{1}{5s^2+15s+30}$ is

21) For a tank of cross-sectional area 200 m^2 and inlet flow rate of F_i in m^3/s. The outlet flow rate is related to the Liquid level height as $F_O = (h)^{1/4}$

If the initial flow rate at steady – State is 16 m^3/s and Liquid level height is 16 m, then determine

(a) Transfer function

(b) Time Domain Response

(c) Liquid level height after 5 sec.

22) If the span/ Range of a flow measuring instrument is 200 m^3/hr, then determine

(a) zero of the device, if the maximum point of measurement is 400 m^3/hr.

(b) upper point of measurement, If the zero of the measuring device is 50 m^3/hr.

(c) If the zero is 100 m^3/hr then Will this instrument be able to measure the values between (150 m^3/hr to 250 m^3/hr) or not?

23) A thermometer initially at 150°C is dipped at t = 0 in to an oil bath maintained at 225°C. If the temperature recorded is 200°C after 5 minutes then calculate

(a) steady state gain of thermometer

(b) Time constant of thermometer

(c) Time domain Response Equation

(d) temperature recording after 10 min.

(e) Time taken to reach 225°C.

24) $\bar{f}(s) = \frac{3(s+4)}{(s+2)(s+1)(s+5)}$ Determine f(0) and f(∞)

25) Define Seeback effect?

26) Match

Column 1	Column 2	Column 3
(a) $\frac{A}{s^2}$	P. Step change	1. A
(b) $\frac{AK_p}{(\tau_p s+1)(s)}$	Q. Ramp Change	2. A sin ωt
(c) $\frac{A\omega}{s^2+\omega^2}$	R. Impulse Response	3. A K_p $(1- e^{-t/\tau_p})$
(d) $\frac{1-e^{-As}}{As}$	S. Sinusoid Response	4. $\frac{K_p}{1+\tau_p s}$
(e) $\frac{K_p}{\tau_p}e^{-t/\tau_p}$	T. Step Response	5. r sin (ωt + ϕ)
(f) A $K_p t$ – A $K_p \tau_p$	U. Impulse change	6. $\frac{AK_p}{s^2(\tau_p s+1)}$
(g) $\frac{AK_p\omega}{(s^2+\omega^2)(\tau_p s+1)}$	V. Ramp Response	7. $\begin{Bmatrix} A, & o<t\le A \\ o, & t>A \end{Bmatrix}$
	W. Sinusoid Change	8. At