

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), December 2021

B. Tech (All Branches), Semester III

Roll No.....

COURSE CODE: ES1106

Time: 2 hours

Max. Marks: 30

Course Name: Computational Engineering Analysis-I

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Use of calculator is not allowed.
4. Cheat sheet has given at end of paper.
5. Be neat!! Be clean!! All the best!!!

Q.1	Solve the differential equation $\frac{d^2y}{dx^2} + a^2y = \frac{a^2R}{p}(l-x)$ where a, R, p and l are constants subject to the conditions. $y = 0, \frac{dy}{dx} = 0 \text{ at } x = 0$	1.5
Q.2	Solve the homogenous equation: $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = \sin(\log x^2)$	2

Q.3	Find the Laplace transform of $\sin at \cosh bt$.	1
Q.4	Represent $f(t) = \sin 2t$, $2\pi < t < 4\pi$ and $f(t)=0$ otherwise, in terms of unit step function and find its Laplace transform.	1.5
Q.5	Find inverse Laplace transform of $\frac{s^2}{(s^2 + a^2)(s^2 + b^2)}$	2
Q.6	Using Laplace transform, solve the initial value problem $y'' + 25y = 10 \cos 5t$, $y(0) = 2, y'(0) = 0$.	03

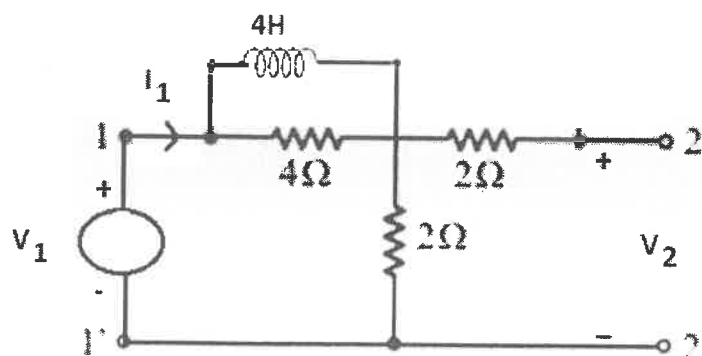
Q.7	Find zeros and poles of the given function $(s) = \frac{s^3 - 7s^2 + 10s}{s^2 + s - 6}$	01
Q.8	Find the Taylor series expansion of $f(z) = \frac{z+1}{(z-3)(z-4)}$ about $z=2$.	03
Q.9	Determine the stability of below function using pole zero diagram.	01

$$Z(S) = \frac{S(S+5)}{(S+9)(S^2+5S+4)}$$

Q.10 For the given network, Determine

02

- Transfer function ($\frac{V_2(S)}{I_1(S)}$)
- Voltage gain function ($\frac{V_2(S)}{V_1(S)}$)



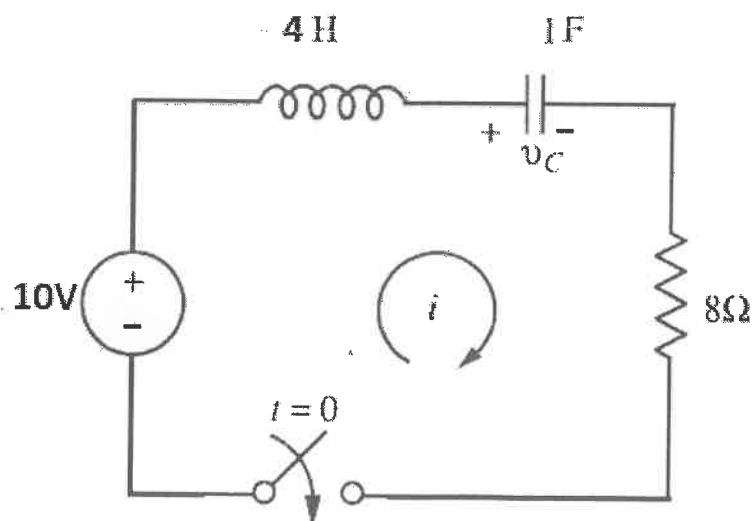
Q.11 Check the stability of the polynomial $F(s)$ using Hurwitz criteria

02

$$F(S) = S^4 + 8S^3 + 18S^2 + 16S + 5$$

Q.12 At $t=0$ switch is closed. Derive an expression for the current $i(t)$ and $v_c(t)$

03



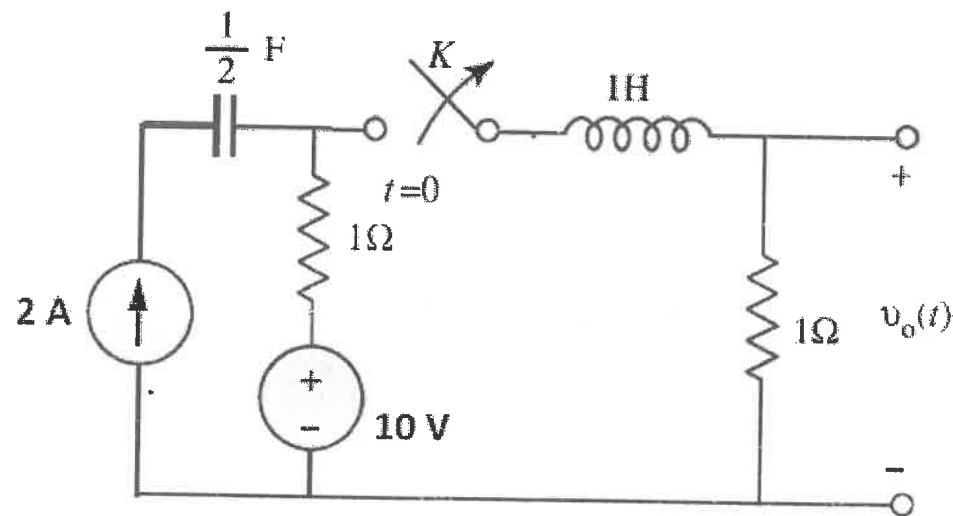
Q.13	At $t=0$ switch is opened. Determine initial value (at $t=0^-$) of capacitor voltage and inductor current. 	02
Q.14	An impedance function is given by $Z(s) = \frac{(s+2)(s+4)}{s(s+3)}$ Identify type of network that can be realized in Foster-I and Cauer II forms.	05
	OR An impedance function is given by $Z(s) = \frac{(s+6)(s+4)}{(s+5)(s+3)}$ Identify type of network that can be realized in Foster-II and Cauer I forms.	05

Table of Laplace Transforms

$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$	$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$
1. 1	$\frac{1}{s}$	2. e^{at}	$\frac{1}{s-a}$
3. $t^n, n=1,2,3,\dots$	$\frac{n!}{s^{n+1}}$	4. $t^p, p > -1$	$\frac{\Gamma(p+1)}{s^{p+1}}$
5. $\sqrt{t}$	$\frac{\sqrt{\pi}}{2s^{3/2}}$	6. $t^{n-1/2}, n=1,2,3,\dots$	$\frac{1 \cdot 3 \cdot 5 \cdots (2n-1) \sqrt{\pi}}{2^n s^{n+1/2}}$
7. $\sin(at)$	$\frac{a}{s^2+a^2}$	8. $\cos(at)$	$\frac{s}{s^2+a^2}$
9. $t \sin(at)$	$\frac{2as}{(s^2+a^2)^2}$	10. $t \cos(at)$	$\frac{s^2-a^2}{(s^2+a^2)^2}$
11. $\sin(at) - at \cos(at)$	$\frac{2a^3}{(s^2+a^2)^3}$	12. $\sin(at) + at \cos(at)$	$\frac{2as^3}{(s^2+a^2)^3}$
13. $\cos(at) - at \sin(at)$	$\frac{s(s^2-a^2)}{(s^2+a^2)^3}$	14. $\cos(at) + at \sin(at)$	$\frac{s(s^2+3a^2)}{(s^2+a^2)^3}$
15. $\sin(at+b)$	$\frac{s \sin(b) + a \cos(b)}{s^2+a^2}$	16. $\cos(at+b)$	$\frac{s \cos(b) - a \sin(b)}{s^2+a^2}$
17. $\sinh(at)$	$\frac{a}{s^2-a^2}$	18. $\cosh(at)$	$\frac{s}{s^2-a^2}$
19. $e^{at} \sin(bt)$	$\frac{b}{(s-a)^2+b^2}$	20. $e^{at} \cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
21. $e^{at} \sinh(bt)$	$\frac{b}{(s-a)^2-b^2}$	22. $e^{at} \cosh(bt)$	$\frac{s-a}{(s-a)^2-b^2}$
23. $t^n e^{at}, n=1,2,3,\dots$	$\frac{n!}{(s-a)^{n+1}}$	24. $f(ct)$	$\frac{1}{c} F\left(\frac{s}{c}\right)$
25. $u_c(t) = u(t-c)$ Heaviside Function	$\frac{e^{-cs}}{s}$	26. $\delta(t-c)$ Dirac Delta Function	e^{-cs}
27. $u_c(t)f(t-c)$	$e^{-cs}F(s)$	28. $u_c(t)g(t)$	$e^{-cs}\mathcal{L}\{g(t+c)\}$
29. $e^{ct}f(t)$	$F(s-c)$	30. $t^n f(t), n=1,2,3,\dots$	$(-1)^n F^{(n)}(s)$
31. $\frac{1}{t} f(t)$	$\int_s^\infty F(u) du$	32. $\int_0^t f(\tau) d\tau$	$\frac{F(s)}{s}$
33. $\int_0^t f(t-\tau)g(\tau) d\tau$	$F(s)G(s)$	34. $f(t-T) = f(t)$	$\frac{\int_0^\infty e^{-st} f(t) dt}{1-e^{-sT}}$
35. $f'(t)$	$sF(s) - f(0)$	36. $f^{(n)}(t)$	$s^n F(s) - sf^{(n-1)}(0) - f^{(n-2)}(0)$
37. $f^{(n)}(t)$	$s^n F(s) - sf^{(n-1)}(0) - s^{n-2}f^{(n-2)}(0) - \cdots - sf^{(n-1)}(0) - f^{(n-1)}(0)$		