Engineering Mathematics

1. Let A, B, C, and D be n × n matrices, each with a non-zero determinant, If ABCD = I, then B^{-1} is

A. $D^{-1} C^{-1} A^{-1}$
B. CDA
C. ADC
D. does not necessarily exist

2. Let A be a 3 × 3 matrix with rank 2. Then AX = 0 has

A. Only the trivial solution X = 0
B. One independent solution
C. Two independent solutions
D. Three independent solutions

3. A rail engine accelerates from its stationary position for 8 seconds and travels a distance of 280 m. According to the Mean Value Theorem, the speedometer at a certain time during acceleration must read exactly.

A. 0
B. 8 kmph
C. 75 kmph
D. 126 kmph

4. Which one of the following functions is strictly bounded?

A. $\frac{1}{x^2}$
B. e^x
C. x^2
D. e^{-x^2}

5. The value of the integral of the function g(x, y) = $4x^3 + 10y^4$ along the straight line segment from the point (0, 0) to the point (1, 2) in the x-y plane is.

A. 33
B. 35
C. 40
D. 56

6. The temperature field in a body varies according to the equation T(x,y) = x^3+4xy. The direction of the fastest variation in temperature at the point (1,0) is given by

A. $3\hat{\imath} + 8\hat{\jmath}$

B. $\hat{\imath}$

C. $0.6\hat{\imath} + 0.8\hat{\jmath}$

D. $0.5\hat{\imath} + 0.866\hat{\jmath}$

7. With K as constant, the possible solution for the first order differential equation $\frac{dy}{dx} = e^{-3x}$ is

A. $-\frac{1}{3}e^{-3x} + K$

B. $-\frac{1}{3}e^{3x} + K$

C. $-3e^{-3x} + K$

D. $-3e^{-x} + K$

8.A function n(x) satisfies the Differential equation $\frac{d^2n(x)}{dx^2} - \frac{n(x)}{L^2}$=0 where L is a constant. The boundary conditions are: n (0) =K and n(∞) $= 0$. The solution to this equation is

A. $n(x) = Kexp(x/L)$

B. $n(x) = Kexp(x/\sqrt{L})$

C. $n(x) = K^2exp(-x/L)$

D. $n(x) = Kexp(-x/L)$

9. The solution of $\frac{dy}{dx} = y^2$ with initial value y (0)=1 bounded in the interval

A. $-\infty \leq x \leq \infty$

B. $-\infty \leq x \leq 1$

C. $x < 1, x > 1$

D. $-2 \leq x \leq 2$

10. **Given that $x'' + 3x = 0$, and $x(0) = 1, x(0) = 0$ what is $x(1)$**

A. - 0.99

B. - 0.16

C. 0.16

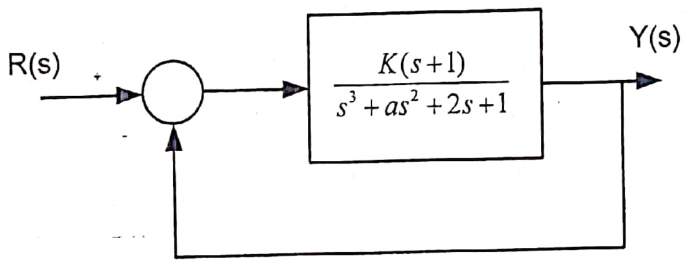
D. 0.99

ELECTRICAL ENGINEERING

11. **An open loop system represented by the transfer function $G(s) = \frac{(s-1)}{(s+2)(s+3)}$ is**

A. stable and of the minimum phase type
B. stable and of the non-minimum phase type
C. unstable and of the minimum phase type
D. unstable and of the non-minimum phase type

12. **The feedback system shown below oscillates at 2 rad/s when**



A. K = 2 and a = 0.75
B. K = 3 and a = 0.75
C. K = 4 and a = 0.5
D. K = 2 and a = 0.5

13. For the transfer function $G(s) = \frac{5(s+4)}{s(s+0.25)(s^2+4s+25)}$ The values of the constant gain term and the highest corner frequency of the Bode plot respectively are

A. 3.2, 5.0
B. 16.0, 4.0
C. 3.2, 4.0
D. 16.0, 5.0

14. For the system $\frac{2}{(s+1)}$ the approximate time taken for a step response to reach 98% of its final value is

A. 1.51 s
B. 2.35 s
C. 3.91 s
D. 4.25 s

15. In the Bode-plot of a unit feedback control system, the value of phase of G (jω) at the gain crossover frequency is – 125°. The phase margin of the system is—

A. – 125°
B. – 55°
C. 55°
D. 125°

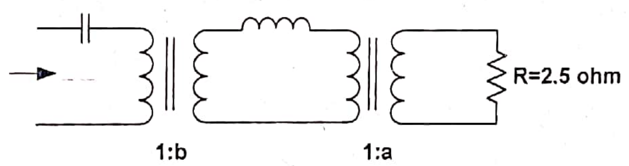
16. Consider the following properties attributed to state model of a system: (1) State model is unique. (2) State model can be derived from the system transfer function. (3) State model can be derived from time variant systems. Of these statements—

A. 1, 2 and 3 are correct
B. 1 and 2 are correct
C. 2 and 3 are correct
D. 1 and 3 are correct

17. A three –phase 440V, 6 pole, 50Hz, squirrel cage induction motor is running at a slip of 5%. The speed of stator magnetic field to rotor magnetic field and speed of rotor with respect to stator magnetic field are

A. Zero, -50rpm
B. Zero, 955 rpm
C. 1000rpm, -50rpm
D. 1000rpm, 955rpm

18. **Find the transformer ratios a and b that the impedance (Z_{in}) is resistive and equal 2.5Ω when the network is excited with a sine wave voltage of angular frequency of 5000 rad/s.**



A. a=0.5, b=2
B. a=2, b= 0.5
C. a=1, b=1
D. a=4, b=0.5

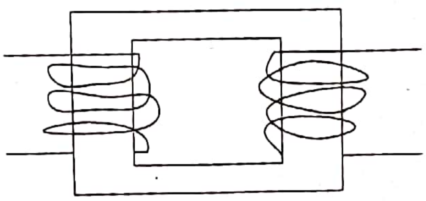
19. **Consider a system consisting of a synchronous generator working at a lagging power factor, a synchronous motor working at an overexcited condition and a directly grid-connected induction generator. Consider capacitive VAr to be a source and inductive VAr to be a sink of reactive power. Which one of the following statements is TRUE?**

A. Synchronous motor and synchronous generator are sources and induction generator is a sink of reactive power.
B. Synchronous motor and induction generator are sources and synchronous generator is a sink of reactive power.
C. Synchronous motor is a source and induction generator and synchronous generator are sinks of reactive power
D. All are sources of reactive power.

10.A field excitation of 20 A in a certain alternator result in an armature current of 400A in short circuit and a terminal voltage of 2000V on open circuit. The magnitude of the internal voltage drop within the machine at a load current of 200A is

A. 1V
B. 10V
C. 100V
D. 1000V

11.The single phase, 50Hz, iron core transformer in the circuit has both the vertical arms of cross-sectional area 20 cm^2 and both the horizontal arms of cross-sectional area 10 cm^2. If the two windings shown were wound instead on opposite horizontal arms, the mutual inductance will



A. double
B. remain same
C. be halved
D. become one quarter

12.In cylindrical coordinate system, the potential produced by a uniform ring charge is given by $\phi = f(r, z)$, where f is a continuous function of r and z. Let $\vec{E}$ be the resulting electric field. Then the magnitude of $\nabla \times \vec{E}$

A. increases with r.
B. is 0
C. is 3
D. decreases with z.

13.Consider the following statements regarding the complex Poynting vector $(\vec{P})$for the power radiated by a point source in an infinite homogeneous and lossless medium. Re$(\vec{P})$denotes the real part of $\vec{P}$. S denotes a spherical surface whose centre is at the point source, and $\hat{n}$ denotes the unit surface normal on S. Which of the following statements is TRUE?

A. Re$(\vec{P})$remains constant at any radial distance from the source.
B. Re$(\vec{P})$increases with increasing radial distance from the source
C. $\oiint_s Re(\vec{P}).\ \hat{n}\, ds$ remains constant at any radial distance from the source.
D. $\oiint_s Re(\vec{P}).\ \hat{n}\, ds$ decreases with increasing radial distance from the source

14.If a vector field $\vec{V}$ is related to another vector field $\vec{A}$ through $\vec{V} = \nabla \times \vec{A}$ which of the following is true? (Note: C and SC refer to any closed contour and any surface whose boundary is C.)

A. $\oint_c \vec{V}.\vec{dl} = \int_s \int_c \vec{A}.\vec{ds}$

B. $\oint_c \vec{A}.\vec{dl} = \int_s \int_c \vec{V}.\vec{ds}$

C. $\oint_c \Delta \times \vec{V}.\vec{dl} = \int_s \int_c \Delta \times \vec{A}.\vec{ds}$

D. $\oint_c \Delta \times \vec{V}.\vec{dl} = \int_s \int_c \vec{V}.\vec{ds}$

15.For static electric and magnetic fields in an inhomogeneous source-free medium, which of the following represents the correct form of Maxwell's equations?

A. $\nabla . E = 0\ ,\ \ \nabla \times B = 0$
B. $\nabla . E = 0\ ,\ \ \nabla . B = 0$
C. $\nabla \times E = 0\ ,\ \ \nabla \times B = 0$
D. $\nabla \times E = 0\ ,\ \ \nabla . B = 0$

16.A sinusoidal waveform, when observed on an oscilloscope, has a peak-to-peak amplitude of 6 cm. If the vertical sensitivity setting is 5V/ cm, then rms value of the voltage will be ____________V

A. 10
B. 12.4
C. 10.6
D. 11.6

27.A Lissajous pattern on an oscilloscope has 5 horizontal tangencies and 2 vertical tangencies. The frequency of the horizontal input is 100 Hz. The frequency of the vertical input will be ________Hz

A. 2300
B. 2100
C. 2400
D. 2500

28.In a digital voltmeter, the oscillator frequency is 400 kHz, and the ramp voltage falls from 8V to 0V is 20 msec. The number of pulses counted by the counter is __________

A. 8000
B. 8100
C. 8500
D. 8012

29.The number of comparators needed in a parallel conversion type 8-bit A to D converter is __________

A. 255
B. 244
C. 355
D. 425

30.A resistance strain gauge with a gauge factor of 3 is fastened to a steel member subjected to a stress of 100 N/mm². The modulus of elasticity of steel is approximately 2×10^5 N/mm². The percentage change in resistance is ________

A. 0.15
B. 15
C. 2
D. 55

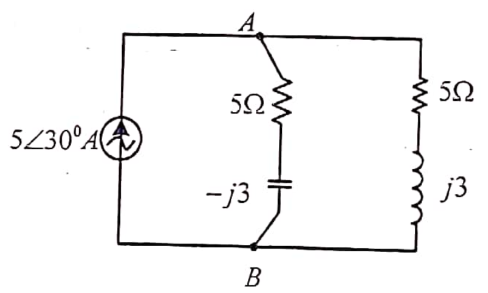
31. A 0-10 mA PMMC ammeter reads 4 mA in a circuit. It's the bottom control spring that snaps suddenly. The meter will now read nearly ___________mA

A. 0
B. 1
C. 2
D. 3

32. One single-phase wattmeter operating on 230 V and 5 A for 5 hours makes 1940 revolutions. Meter constant in revolutions is 400. The power factor of the load will be ________

A. 0.8
B. 0.5
C. 0.4
D. 0.9

33. In the ac network shown in the figure, the phasor voltage V_A (in Volts) is



A. 0
B. $5\angle 30^0$
C. $12.5\angle 30^0$
D. $17\angle 30^0$

34. The damping ratio of a series RLC circuit can be expressed as

A. $\frac{R^2C}{2L}$

B. $\frac{2L}{R^2C}$

C. $\frac{R}{2}\sqrt{\frac{C}{L}}$

D. $\frac{2}{R}\sqrt{\frac{L}{C}}$

35. For maximum power transfer between two cascaded sections of an electrical network, the relationship between the output impedance Z_1 of the first section to the input impedance Z_2 of the second section is

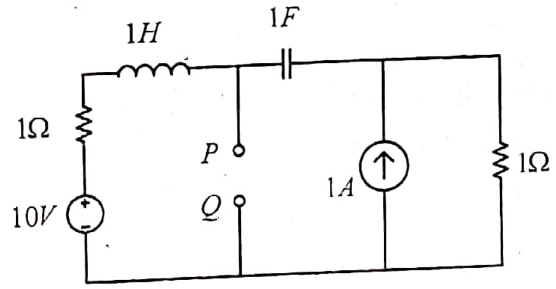
A. $Z_2 = Z_1$

B. $Z_2 = -Z_1$

C. $Z_2 = Z_1^*$

D. $Z_2 = -Z_1^*$

36. The Thevenin equivalent impedance Z_{th} between the nodes P and Q in the following circuit is



A. 1

B. $1 + S + \frac{1}{S}$

C. $2 + S + \frac{1}{S}$

D. $\frac{S^2+S+1}{S^2+2S+1}$

37. For enhancing the power transmission in along EHV transmission line, the most preferred method is to connect a

A. Series inductive compensator in the line

B. Shunt inductive compensator at the receiving end

C. Series capacitive compensator in the line

D. Shunt capacitive compensator at the sending end

38. The sequence components of the fault current are as follows: $I_{positive}$ = j1.5 pu, $I_{negative}$ = −j0.5 pu, I_{zero} = −j1 pu. The type of fault in the system is

A. LG
B. LL
C. LLG
D. LLLG

39. Incremental fuel costs (in some appropriate unit) for a power plant consisting of three generating units are $IC_1 = 20 + 0.3P1$, $IC_2 = 30 + 0.4P2$, $IC_3 = 30$. Where P1 is the power in MW generated by unit i for i = 1, 2, and 3. Assume that all the three units are operating all the time. The minimum and maximum loads on each unit are 50 MW and 300 MW respectively. If the plant is operating on economic load dispatch to supply the total power demand of 700 MW, the power generated by each unit is

A. P1= 242.86 MW, P2= 157.14MW, and P3= 300MW
B. P1= 157.14 MW, P2= 242.86MW, and P3= 300MW
C. P1= 300 MW, P2= 300MW, and P3 = 100MW
D. P1 = 233.3 MW, P2 = 233.3 MW, and P3 = 233.4MW

40. For a fixed value of complex power flow in a transmission having a sending end voltage V, the real power loss will be proportional to

A. V
B. V^2
C. $1/V^2$
D. 1/V

41. The concept of an electrically short, medium, and long line is primarily based on the

A. nominal voltage of the line
B. physical length of the line
C. wavelength of the line
D. power transmitted over the line

42. A 400 kV transmission line has a maximum power transfer capacity of P. If the same transmission line is used for 100 kV transmission with series reactance unchanged, the new maximum power transfer capacity will be

A. $\frac{P}{32}$
B. $\frac{P}{16}$

C. $\frac{p}{4}$

D. $\frac{p}{8}$

43. A zero mean random signal is uniformly distributed between limits $-a$ and $+a$ and its mean square value is equal to its variance. Then the r.m.s value of the signal is

A. $\frac{a}{\sqrt{3}}$

B. $\frac{a}{\sqrt{2}}$

C. $a\sqrt{2}$

D. $a\sqrt{3}$

44. The response h(t) of a linear time-invariant system to an impulse $\delta(t)$, under initially relaxed condition is $h(t) = e^{-t} + e^{-2t}$ The response of this system for a unit step input u(t) is

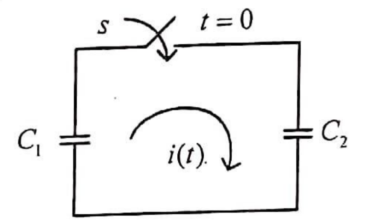
A. $u(t) + e^{-t} + e^{-2t}$

B. $u(t)\,(e^{-t} + e^{-2t})$

C. $(1.5 - e^{-t} - 0.5e^{-2t})u(t)$

D. $e^{-t}\delta(t) + e^{-2t}u(t)$

45. In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charged to 12 V before the ideal switch S is closed at t = 0. The current i(t) for all t is



A. zero

B. a step zero

C. an exponentially decaying function

D. an impulse function

46. Two systems with impulse responses $h_1(t)$ and $h_2(t)$ are connected in cascade. Then the overall impulse response of the cascaded system is given by

A. Product of h_1 (t) and h_2 (t)

B. Sum of h_1 (t) and h_2 (t)

C. Convolution of h_1 (t) and h_2 (t)

D. Subtraction of h_2 (t) from h_1 (t)

47.In an NPN transistor, if the base current is 100 μA and the collector current is 2 mA, the common-emitter current gain (β) is:

A. 2

B. 20

C. 50

D. 200

48.The characteristic equation of a JK flip-flop is given by:

A. $J\bar{K} + \bar{Q}K = Q$

B. $\bar{J}K + \overline{QK} = Q$

C. $JK + \overline{JK} = Q$

D. $\overline{JK} + \bar{Q}K = Q$

49. For a step-up chopper, if the duty ratio is 0.6, the output voltage is:

A. 40% of the input voltage

B. 60% of the input voltage

C. 100% of the input voltage

D. 150% of the input voltage

50.The purpose of a snubber circuit in power electronics is to:

A. Improve power factor

B. Protect the load

C. Reduce switching losses

D. Increase output voltage

Answer Key (Electrical)

Q No.	Answer	Q. No.	Answer
1	B	26	C
2	B	27	D
3	D	28	A
4	D	29	A
5	A	30	A
6	C	31	A
7	A	32	A
8	D	33	D
9	C	34	C
10	D	35	C
11	B	36	A
12	A	37	C
13	A	38	C
14	C	39	A
15	C	40	C
16	C	41	B
17	A	42	B
18	B	43	A
19	A	44	C
20	D	45	D
21	C	46	C
22	B	47	D
23	C	48	C
24	B	49	D
25	D	50	C