GATE 2011 EE 27-39

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27) The function $f(x) = 2x - x^3 + 3$ has
    a) a maxima at $x = 1$ and a minima at $x = 5$
    b) a maxima at $x = 1$ and a minima at $x = -5$
    c) only a maxima at $x = 1$
    d) only a minima at $x = 1$
28) A lossy capacitor C_x, rated for operation at $5kV, 50Hz$ is represented by an equivalent circuit with an ideal capacitor C_P in parallel with a resistor R_P. The value of C_P is found to be $0.102\mu F$ and the value of $R_P = 1.25M\Omega$. Then the power loss and $\tan\delta$ of the lossy capacitor operating at the rated voltage, respectively, are

    a) $10W$ and 0.0002
    b) $10W$ and 0.0025
    c) $20W$ and 0.025
    d) $20W$ and 0.04

29) Let the Laplace transform of a function $f(t)$ which exists for $t > 0$ be $F_1(s)$ and the Laplace transform of its delayed version $f(t-\tau)$ be $F_2(s)$. Let $F_1^*(s)$ be the complex conjugate of $F_1(s)$ with the Laplace variable set as $s = \sigma + j\omega$. If

$$G(s) = \frac{F_2(s) F_1^*(s)}{\left|F_1(s)\right|^2},$$

    then the inverse Laplace transform of $G(s)$ is

    a) an ideal impulse $\delta(t)$
    b) an ideal delayed impulse $\delta(t-\tau)$
    c) an ideal step function $u(t)$
    d) an ideal delayed step function $u(t-\tau)$

30) 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) $a\sqrt{3}$

31) A $220V$, DC shunt motor is operating at a speed of $1440rpm$. The armature resistance is 1.0Ω and armature current is $10A$. If the excitation of the machine is reduced by 10%, the extra resistance to be put in the armature circuit to maintain the same speed and torque will be

    a) 1.79Ω
    b) 2.1Ω
    c) 3.1Ω
    d) 18.9Ω

32) A load center of $120MW$ derives power from two power stations connected by $220kV$ transmission lines of $25km$ and $75km$ as shown in the figure below. The

three generators $G1, G2$ and $G3$ are of $100MW$ capacity each and have identical fuel cost characteristics. The minimum loss generation schedule for supplying the $120MW$ load is

a) $P1 = 80MW +$ losses
$P2 = 20MW$
$P3 = 20MW$

b) $P1 = 60MW$
$P2 = 30MW +$ losses
$P3 = 30MW$

c) $P1 = 40MW$
$P2 = 40MW$
$P3 = 40MW +$ losses

d) $P1 = 30MW +$ losses
$P2 = 45MW$
$P3 = 45MW$

33) The open loop transfer function $G(s)$ of a unity feedback control system is given as,

$$G(s) = \frac{k\left(s + \frac{2}{3}\right)}{s^2(s+2)}$$

From the root locus, it can be inferred that when k tends to positive infinity,

a) three roots with nearly equal real parts exist on the left half of the s-plane
b) one real root is found on the right half of the s-plane
c) the root loci cross the $j\omega$ axis for a finite value of $k; k \neq 0$
d) three real roots are found on the right half of the s-plane

34) A portion of the main program to call a subroutine SUB in an 8085 environment is given below.

```
        :
LP:     LXI   D, DISP
        CALL  SUB
        :
```

It is desired that control be returned to LP + DISP + 3 when the RET instruction is executed in the subroutine. The set of instructions that precede the RET instruction in the subroutine are

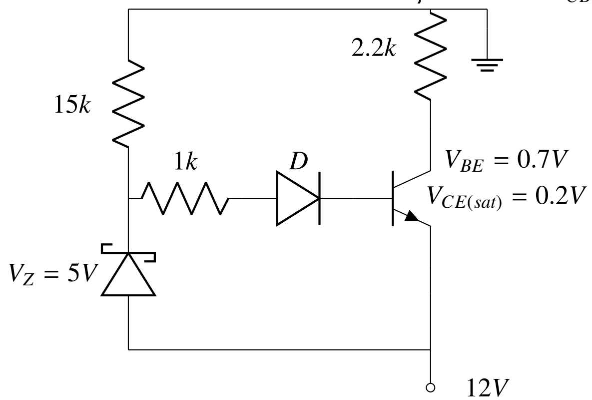
a) POP D
DAD H
PUSH D

b) POP H
DAD D
INX H
INX H
INX H
PUSH H

c) POP H
DAD D
PUSH H

d) XTHL
INX D
INX D
INX D
XTHL

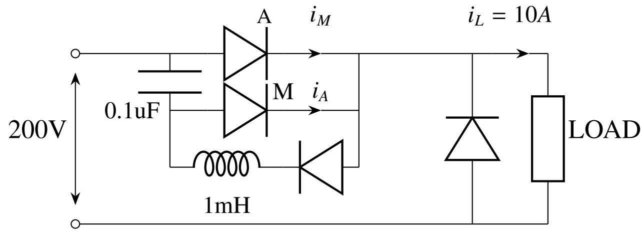
35) The transistor used in the circuit shown below has a β of 30 and I_{CBO} is negligible.



If the forward voltage drop of the diode is $0.7V$, then the current through the collector will be:

a) $168mA$ b) $108mA$ c) $20.54mA$ d) $5.36mA$

36) A voltage commutated chopper circuit, operated at $500Hz$, is shown below.



If the maximum value of load current is $10A$, then the maximum current through the main (M) and auxiliary (A) thyristors will be:

a) $i_{M\max} = 12\,A$ and $i_{A\max} = 10\,A$
b) $i_{M\max} = 12\,A$ and $i_{A\max} = 2\,A$
c) $i_{M\max} = 10\,A$ and $i_{A\max} = 12\,A$
d) $i_{M\max} = 10\,A$ and $i_{A\max} = 8\,A$

37) The matrix $[A] = \begin{pmatrix} 2 & 1 \\ 4 & -1 \end{pmatrix}$ is decomposed into a product of a lower triangular matrix $[L]$ and an upper triangular matrix $[U]$. The properly decomposed $[L]$ and $[U]$ matrices respectively are

a) $\begin{pmatrix} 1 & 0 \\ 4 & -1 \end{pmatrix}$ and $\begin{pmatrix} 1 & 1 \\ 0 & -2 \end{pmatrix}$
b) $\begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix}$ and $\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$
c) $\begin{pmatrix} 1 & 0 \\ 4 & 1 \end{pmatrix}$ and $\begin{pmatrix} 2 & 1 \\ 0 & -1 \end{pmatrix}$
d) $\begin{pmatrix} 2 & 0 \\ 4 & -3 \end{pmatrix}$ and $\begin{pmatrix} 1 & 0.5 \\ 0 & 1 \end{pmatrix}$

38) The two vectors $\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ and $\begin{bmatrix} 1 \\ a \\ a^2 \end{bmatrix}$, where $a = \left(\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)$, are

a) orthonormal b) orthonormal c) parallel d) collinear

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

a) $0, -5rpm$
b) $0, 955rpm$
c) $1000rpm, -5rpm$
d) $1000rpm, 955rpm$