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Prelims Through Questions

for

ESE 2021

Electronics & Telecommunication

Day 11 of 11

Q.451 - Q.500

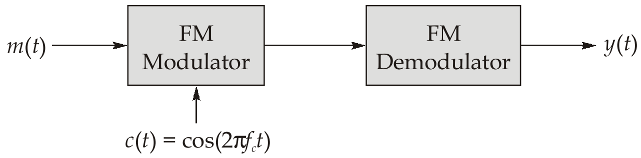
(Out of 500 Questions)

Analog & Digital Communication Systems +

Computer Org. & Architecture + Advanced Electronics

A&D Communication Systems + Computer Org. & Architecture + Advanced Electronics

Q.451 A message signal $m(t)$ is applied to an ideal FM modulator and the resultant FM signal is applied to an ideal demodulator (based on PLL) as shown in the figure below.



The frequency sensitivity of the FM modulator (k_f) is 5 Hz/V and the frequency sensitivity of the VCO (k_v) used in the PLL is 10 Hz/V. If the average power of the message signal $m(t)$ is 20 W, then the average power of the signal $y(t)$ will be equal to

(a) 5 W (b) 10 W
(c) 20 W (d) 40 W

451. (a)

For properly designed PLL based demodulator,

$$y(t) = \frac{k_f}{k_v}m(t) = \frac{5}{10}m(t) = \frac{1}{2}m(t)$$

$$P_y = \left(\frac{1}{2}\right)^2 P_m = \frac{1}{4}(20)\text{ W} = 5\text{ W}$$

Q.452 A frequency modulated signal with a carrier frequency of "f_c" is given by,

$$s(t) = 10\cos[2\pi f_c t + 4\sin(1500\pi t) + 3\cos(1500\pi t)]$$

The maximum phase deviation of the signal $s(t)$ is

(a) 3 radians (b) 4 radians
(c) 5 radians (d) 7 radians

452. (c)

The phase of the given modulated signal is,

$$\phi(t) = 4\sin(1500\pi t) + 3\cos(1500\pi t)\text{ rad}$$

$$= \sqrt{(4)^2 + (3)^2}\,[\cos(1500\pi t - \alpha)]\text{ rad}$$

$$= 5\cos(1500\pi t - \alpha)\text{ rad}$$

where, $\alpha = \tan^{-1}\left(\frac{4}{3}\right)$

Maximum phase deviation of the signal $s(t)$ is,

$$\Delta\phi_{max} = |\phi(t)|_{max} = 5\text{ radians}$$

Q.453 A random variable X is uniformly distributed in range [–4, 6]. Another random variable Y is defined as,

$$Y = \begin{cases} +1 \ ; & \text{for } X > 0 \\ -1 \ ; & \text{for } X \le 0 \end{cases}$$

The probability density function of Y is

(a) $0.4u(y + 1) + 0.6u(y - 1)$
(b) $0.6u(y + 1) + 0.4u(y - 1)$
(c) $0.4\delta(y + 1) + 0.6\delta(y - 1)$
(d) $0.6\delta(y + 1) + 0.4\delta(y - 1)$

453. (c)

$$P(Y = +1) = P(X > 0) = \frac{6}{6-(-4)} = 0.6$$

$$P(Y = -1) = P(X \le 0) = \frac{4}{6-(-4)} = 0.4$$

So, $$f_Y(y) = 0.4\delta(y + 1) + 0.6\delta(y - 1)$$

Q.454 The entropy of a discrete random variable X is $H(X)$. If another discrete random variable Y is defined as $Y = 4X$, then the entropy of Y, i.e. $H(Y)$ will be equal to

(a) $4H(X)$
(b) $2H(X)$
(c) $H(X) + 2$
(d) $H(X)$

454. (d)

$$H(X) = -\sum_{i=1}^{N} P(x_i)\log_2 P(x_i)$$

$$Y = 4X$$

$$P(y_i) = P(x_i)$$

$$H(Y) = H(X)$$

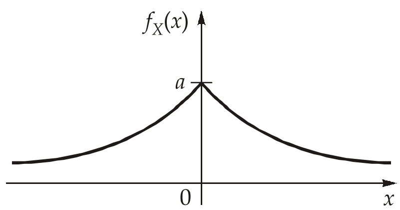
Q.455 The probability density function of a random variable X is given by, $f_X(x) = ae^{-b|x|}$. If "a" and "b" are two positive real constants, then the correct relation between the constants a and b will be

(a) $a = b$
(b) $a = 2b$
(c) $b = 2a$
(d) $ab = 1$

455. (c)

From the basic properties of probability density function,

$$\int_{-\infty}^{\infty} f_X(x)\,dx = 1$$



$f_X(x)$ is an even function.

So, $$2\int_0^{\infty} a e^{-bx}\,dx = 1$$

$$2a\left[\frac{e^{-bx}}{-b}\right]_0^{\infty} = 1$$

$$\frac{2a}{b} = 1$$

$$b = 2a$$

Q.456 A discrete memoryless source emits 4 symbols with probabilities $\frac{1}{8}, \frac{1}{8}, \frac{1}{4}, \frac{1}{2}$. The entropy of the 2nd order extension of this source will be

(a) 0.875 bits/block
(b) 1.75 bits/block
(c) 3.50 bits/block
(d) 3.0625 bits/block

456. (c)

Entropy of the source,

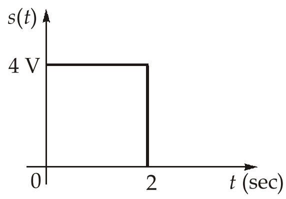
$$H(X) = \frac{2}{8}\log_2(8) + \frac{1}{4}\log_2 4 + \frac{1}{2}\log_2 2 \text{ bits/symbol}$$

$$= \frac{6}{8} + \frac{2}{4} + \frac{1}{2} = \frac{14}{8} = 1.75 \text{ bits/symbol}$$

The entropy of the 2nd order extension of the source will be,

$$H(X^2) = 2H(X) = 2(1.75) = 3.50 \text{ bits/block}$$

Q.457 Consider the signal shown below:



This signal is passed through an AWGN channel with two-sided noise power spectral density of $\frac{N_0}{2}$ and received by a filter matched to $s(t)$. The maximum signal-to-noise ratio possible at the output of the filter is

(a) $\frac{8}{N_0}$
(b) $\frac{16}{N_0}$
(c) $\frac{32}{N_0}$
(d) $\frac{64}{N_0}$

457. (d)

For matched filter,

$$(\text{SNR})_{\max} = \frac{2E_s}{N_0}$$

$$E_s = \text{Energy of the signal } s(t)$$

$$= \int_{-\infty}^{\infty} |s(t)|^2 dt = \int_0^2 (4)^2 dt = 32$$

So, $$(\text{SNR})_{\max} = \frac{2(32)}{N_0} = \frac{64}{N_0}$$

Q.458 The differential entropy of a Gaussian random variable with zero mean and variance of 2 will be

(a) $\log_2(\pi e)$
(b) $\frac{1}{2}\log_2(\pi e)$
(c) $1+\frac{1}{2}\log_2(\pi e)$
(d) $\frac{1}{2}+\frac{1}{2}\log_2(\pi e)$

458. (c)

For zero mean Gaussian random variable, the differential entropy can be given by,

$$H(X) = \frac{1}{2}\log_2(2\pi e\sigma^2)$$

Given that, $\sigma^2 = 2$

So, $$H(X) = \frac{1}{2}\log_2(4\pi e) = \frac{1}{2}\log_2(4) + \frac{1}{2}\log_2(\pi e)$$
$$= 1+\frac{1}{2}\log_2(\pi e)$$

Q.459 Consider the following statements with reference to PCM and DPCM systems having same sampling frequency:

S_1 : For same BW requirement, DPCM provides better SQNR than that of PCM.
S_2 : For same SQNR, DPCM requires less BW than that of PCM.

Select the correct statement(s) using the codes given below:

(a) S_1 only
(b) S_2 only
(c) Both S_1 and S_2
(d) Neither S_1 nor S_2

459. (c)

Both the given statements are correct.

Q.460 A BPSK signal, with equiprobable bits, is transmitted through an AWGN channel and received by a correlator receiver. The two-sided power spectral density of the channel noise is 1 nW/Hz and the average bit energy transmitted is 10 μJ. If there is no phase mismatch between the carrier signals used in the transmitter and receiver, then the probability of error of the system will be

(a) $Q(10)$
(b) $Q(10\sqrt{2})$
(c) $Q(100)$
(d) $Q(100\sqrt{2})$

460. (c)

For coherent BPSK,

$$P_e = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) = Q\left(\sqrt{\frac{E_b}{(N_0/2)}}\right)$$
$$= Q\left(\sqrt{\frac{10\times10^{-6}}{1\times10^{-9}}}\right) = Q\left(\sqrt{10^4}\right) = Q(100)$$

Q.461 A 100 kbps data is transmitted using a DS-CDMA system with a chip rate of 7.2 Mcps. The processing gain achieved by the CDMA system is

(a) 3.6
(b) 36
(c) 7.2
(d) 72

461. (d)

Bit rate, $R_b = 100$ kbps

Chip rate, $R_c = 7.2$ Mcps

$$\text{Processing gain} = \frac{R_c}{R_b} = \frac{7.2 \times 1000}{100} = 72$$

Q.462 The samples of a sinusoidal message signal $m(t) = \cos(2\pi f_m t)$ V are applied to a delta modulator, whose step size is 2 V. The minimum sampling rate required to eliminate the slope-overload distortion is approximately

(a) f_m
(b) $2f_m$
(c) $3.14f_m$
(d) f_m

462. (c)

The condition required to eliminate the slope-overload distortion is,

$$\frac{\Delta}{T_s} \geq \left|\frac{dm(t)}{dt}\right|_{\max} = \left|2\pi f_m \sin(2\pi f_m t)\right|_{\max}$$

$$2f_s \geq 2\pi f_m$$

$$f_s \geq \pi f_m \approx 3.14 f_m$$

$$f_{s(\min)} = 3.14 f_m$$

Q.463 An amplitude modulated signal is given by,

$$s(t) = [10 + 5\cos(5000t) + 4\cos(2500t)] \cos(2\pi f_c t)$$

The modulation efficiency of this AM signal is equal to

(a) 7.40%
(b) 11.11%
(c) 17%
(d) 33.33%

463. (c)

The modulation efficiency of an AM signal can be given as,

$$\%\eta = \frac{P_{SB}}{P_{total}} \times 100 = \frac{\mu^2}{2+\mu^2} \times 100$$

Where, μ = modulation index

For a multi-tone modulation, $\mu = \sqrt{\mu_1^2 + \mu_2^2}$

For the given AM signal, $\mu_1 = 0.5$ and $\mu_2 = 0.4$

So, $\mu^2 = \mu_1^2 + \mu_2^2 = (0.5)^2 + (0.4)^2 = 0.41$

$$\%\eta = \frac{0.41}{2+0.41} \times 100 \approx 17\%$$

Q.464 A message signal, $m(t) = A_m\cos(2\pi f_m t)$ is applied to a frequency modulator and a phase modulator separately. If β_{FM} is the modulation index of the FM signal and β_{PM} is the modulation index of the PM signal, then select the correct one of the following statements.

(a) β_{FM} is independent of A_m
(b) β_{PM} is independent of A_m
(c) β_{FM} is independent of f_m
(d) β_{PM} is independent of f_m

464. (d)

The modulation index of an FM signal can be given as,

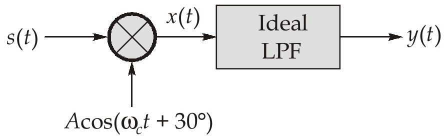
$$\beta_{FM} = \frac{(\Delta f)_{max}}{f_m} = \frac{A_m k_f}{f_m} \quad \text{...(i)}$$

The modulation index of a PM signal can be given as,

$$\beta_{PM} = (\Delta\phi)_{max} = A_m k_p \quad \text{...(ii)}$$

From equations (i) and (ii), option (d) can be selected as the correct one.

Q.465 A DSB-SC signal $s(t) = A\cos(\omega_c t)m(t)$ is passed through the receiver circuit shown below.



If the bandwidth of the LPF is equal to the bandwidth of the message signal $m(t)$ and P_m is the average power of the message signal $m(t)$, then the average power of the signal $y(t)$ will be

(a) $\frac{A^2}{4}P_m$ (b) $\frac{A^4}{16}P_m$

(c) $\frac{3A^4}{16}P_m$ (d) $\frac{\sqrt{3}A^2}{4}P_m$

465. (c)

$$x(t) = s(t)A\cos(\omega_c t + 30°)$$

$$= A^2[\cos(\omega_c t + 30°)\cos(\omega_c t)]m(t)$$

$$= \frac{A^2}{2}[\cos(2\omega_c t + 30°) + \cos 30°]m(t)$$

After passing through LPF, we get,

$$y(t) = \frac{A^2}{2}\cos(30°)\, m(t) = \frac{\sqrt{3}A^2}{4}m(t)$$

Average power of $y(t)$,

$$P_y = \left(\frac{\sqrt{3}}{4}A^2\right)^2 P_m = \frac{3A^4}{16}P_m$$

Q.466 When the frequency of a sinusoidal message signal is increased by keeping all other parameters of modulator constant,

(a) BW of PM signal increases more than that of FM.
(b) BW of FM signal increases more than that of PM.
(c) BW of both PM and FM signals increase by same factor.
(d) No such conclusion can be deduced.

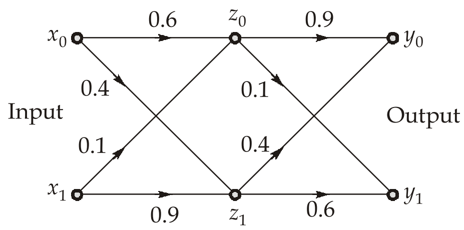
466. (a)

$$(BW)_{FM} = \left(1 + \frac{\Delta f}{f_m}\right)(2f_m) = \left(1 + \frac{A_m k_f}{f_m}\right)(2f_m)$$

$$(BW)_{PM} = (1 + A_m k_p)\,(2f_m)$$

When only f_m is increased, $(BW)_{PM}$ will be increased by higher factor than that of $(BW)_{FM}$.

Q.467 Consider the discrete memoryless channel shown below:



If the probability of sending the symbol x_0 is 0.60, then the probability of receiving a symbol at output as y_0, i.e. $P(y_0)$ will be

(a) 0.40
(b) 0.50
(c) 0.60
(d) 0.70

467. (c)

$$P(y_0|x_0) = (0.6 \times 0.9) + (0.4 \times 0.4) = 0.54 + 0.16 = 0.70$$
$$P(y_0|x_1) = (0.1 \times 0.9) + (0.9 \times 0.4) = 0.09 + 0.36 = 0.45$$
$$P(y_0) = P(y_0|x_0)P(x_0) + P(y_0|x_1)P(x_1)$$
$$= (0.70)(0.60) + (0.45)(0.40) = 0.42 + 0.18 = 0.60$$

Q.468 Consider the following statements:

S_1: The lock range of a PLL depends on the overall DC gain of the loop.
S_2: The capture range of a PLL primarily depends on the loop filter characteristics.
S_3: Capture range of PLL is always greater than the lock range.

Which of the above statements are correct?

(a) S_1 and S_2 only
(b) S_1 and S_3 only
(c) S_2 and S_3 only
(d) S_1, S_2 and S_3

468. (a)

Capture range of a PLL is much narrower than the lock range.

Q.469 The intermediate frequency (IF) of an AM superheterodyne receiver is 455 kHz and the local oscillator frequency (f_{LO}) of the mixer is selected, such that $f_{LO} > f_c$ always. If the carrier frequency (f_c) of the received signal is 640 kHz, then the carrier frequency of the corresponding image signal will be

(a) 1095 kHz
(b) 1250 kHz
(c) 1550 kHz
(d) 1735 kHz

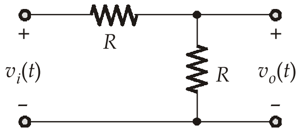
469. (c)

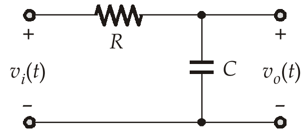
Given that,
$$f_c = 640 \text{ kHz}$$
$$\text{IF} = 455 \text{ kHz}$$
$$f_{LO} > f_c$$

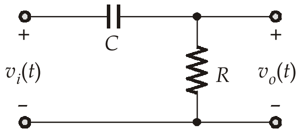
So, the carrier frequency of the corresponding image signal can be given as,

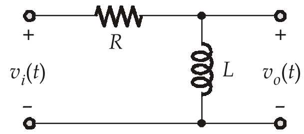
$$f_i = f_c + 2(\text{IF})$$
$$= 640 + 2(455) = 1550 \text{ kHz}$$

Q.470 Which one of the following circuits can be used for the purpose of de-emphasis?

(a) 

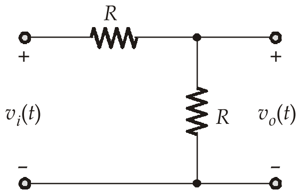
(b) 

(c) 

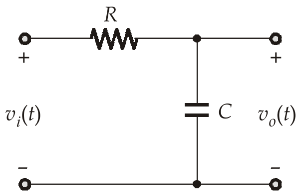
(d) 

470. (b)

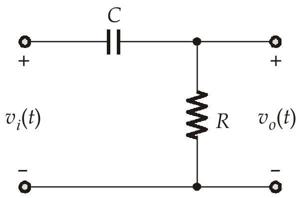
A practical low-pass filter circuit can be used for the purpose of de-emphasis.

(a) 

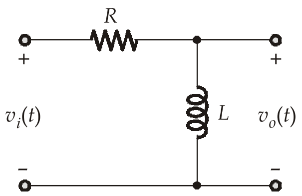
$\Rightarrow$ Attenuator

(b) 

$\Rightarrow$ Low-pass filter

(c) 

$\Rightarrow$ High-pass filter

(d) 

$\Rightarrow$ High-pass filter

Hence, option (b) is correct.

Q.471 Two independent random variables X and Y are uniformly distributed in the range [0, 8] and [0, 4] respectively. Another random variable Z is defined as, $Z = X + Y$.
The variance of Z, that is σ_Z^2 is equal to

(a) $\frac{32}{3}$
(b) $\frac{26}{3}$
(c) $\frac{20}{3}$
(d) $\frac{5}{3}$

471. (c)

It is given that, X and Y are statistically independent.

So,
$$\sigma_Z^2 = \sigma_X^2 + \sigma_Y^2$$
$$\sigma_X^2 = \frac{(8-0)^2}{12} = \frac{64}{12} = \frac{16}{3}$$
$$\sigma_Y^2 = \frac{(4-0)^2}{12} = \frac{16}{12} = \frac{4}{3}$$
$$\sigma_Z^2 = \frac{16}{3} + \frac{4}{3} = \frac{20}{3}$$

Q.472 For a discrete memoryless channel, input and output random variables are represented as X and Y respectively. Which of the following **does not** give the correct relation for the mutual information $I(X ; Y)$ between the two random variable X and Y?

(a) $H(X) - H(X|Y)$
(b) $H(Y) - H(Y|X)$
(c) $H(X|Y) + H(Y|X) - H(X ; Y)$
(d) $H(X) + H(Y) - H(X ; Y)$

472. (c)

The mutual information between two random variables X and Y can be expressed in the following ways:

$$\begin{aligned} I(X ; Y) &= H(X) - H(X|Y) \\ &= H(Y) - H(Y|X) \\ &= H(X) + H(Y) - H(X ; Y) \\ &= H(X ; Y) - H(X|Y) - H(Y|X) \end{aligned}$$

Q.473 The Nyquist sampling rate of the signal, $x(t) = \text{sinc}^2(1000t) * \text{sinc}^3(2000t)$ is
[Assume that, $\text{sinc}(t) = \sin(\pi t)/\pi t$]

(a) 2 kHz
(b) 4 kHz
(c) 6 kHz
(d) 8 kHz

473. (a)

$$\text{sinc}(1000t) \xleftrightarrow{\text{CTFT}} \frac{1}{1000}\text{rect}\left(\frac{f}{1000}\right) \Rightarrow f_{max} = 500 \text{ Hz}$$

$$x_1(t) = \text{sinc}^2(1000t) \xleftrightarrow{\text{CTFT}} \frac{1}{10^6}\left[\text{rect}\left(\frac{f}{1000}\right) * \text{rect}\left(\frac{f}{1000}\right)\right] \Rightarrow f_{max} = 1000 \text{ Hz}$$

$$x_2(t) = \text{sinc}^3(2000t) \xleftrightarrow{\text{CTFT}} \frac{1}{(2000)^3}\left[\text{rect}\left(\frac{f}{2000}\right) * \text{rect}\left(\frac{f}{2000}\right) * \text{rect}\left(\frac{f}{2000}\right)\right] \Rightarrow f_{max} = 3000 \text{ Hz}$$

$$x(t) = x_1(t) * x_2(t) \xleftrightarrow{\text{CTFT}} X_1(f)X_2(f) \Rightarrow f_{max} = \min\{1000 \text{ Hz}, 3000 \text{ Hz}\} = 1000 \text{ Hz}$$

So,
$$f_{s\,(min)} = 2f_{max} = 2000 \text{ Hz} = 2 \text{ kHz}$$

Q.474 Increasing the RAM of a computer typically improves performance because

(a) Virtual memory increases
(b) Larger RAMs are faster
(c) Fewer page faults occur
(d) Fewer segmentation faults occur

474. (c)

Increasing the RAM means increasing the primary memory which reduces the swapping. So, fewer page faults occur.

Q.475 Register renaming is done in pipelined processors

(a) as an alternative to register allocation at compile time

(b) for efficient access to function parameters and local variables

(c) to handle certain kinds of hazards

(d) as part of address translation

475. (c)

Register renaming is done in pipelining to handle certain hazards.

Operand forwarding (Bypassing), predictive buffer is also used to handle hazards.

∴ Option '(c)' is true.

Q.476 The performance of a pipelined processor suffers if

(a) the pipeline stages have different delays

(b) consecutive instructions are dependent on each other

(c) the pipeline stages share hardware resources

(d) All of the above

476. (d)

Hazards are caused due to dependencies. Different Hazards in pipelined processor are:

1. **Structural Hazard:** arises when two different instructions in the pipeline wants to use same hardware.
2. **Control Hazard:** arises due to branch instructions.
3. **Data Hazard:** arises due to instruction dependency.

Q.477 A processor takes 12 cycles to complete an instruction. The corresponding pipelined processor uses 6 stages with the execution times of 3, 2, 5, 4, 6 and 2 cycles respectively. What is the asymptotic speedup assuming that a very large number of instructions are to be executed?

(a) 1.50 (b) 2

(c) 3 (d) 6

477. (b)

Non pipeline processor time (NP) = 12 cycle × Number of instructions = 12n cycles

Pipeline processor time (P) = $(K + n - 1) \times T_P = (6 - 1 + n) \times T_P$

$$T_P = \text{max (all stages times)} = \text{max } (3, 2, 5, 4, 6, 2) \text{ cycles} = 6 \text{ cycles}$$

$$(P) = (6 - 1 + n) \times T_P = (5 + n) \times 6 \text{ cycles} = 30 + 6n \text{ cycles}$$

So, $$\text{Speed up} = \lim_{n \to \infty} \frac{12n}{30 + 6n} = 2$$

Q.478 Horizontal microprogramming

(a) does not require use of signal decoders

(b) results in larger sized microinstructions than vertical microprogramming

(c) uses one bit for each control signal

(d) All of the above

478. **(d)**

Features of horizontal micro-programming are:

(a) It doesn't require use of signal decoders.

(b) It results in larger sized micro-instructions than vertical micro-programming.

(c) It uses one bit for each control signal.

Q.479 In which one of the following cases, it is possible to obtain different results for call-by-reference and call-by-name parameter passing?

(a) Passing a constant value as a parameter

(b) Passing an array as a parameter

(c) Passing a pointer as a parameter

(d) Passing an array element as a parameter

479. **(d)**

Passing an array element by call-by-name behaves like call-by-value. Therefore, there may be different results for call-by-reference and call-by-name parameter passing for passing an array elements.

Q.480 Consider the following schedules involving two transactions:

S_1: $r_1(X); r_1(Y); r_2(X); r_2(Y); w_2(Y); w_1(X)$

S_2: $r_1(X); r_2(X); r_2(Y); w_2(Y); r_1(Y); w_1(X)$

Which one of the following statements is TRUE?

(a) Both S_1 and S_2 are conflict serializable.

(b) S_1 is conflict serializable and S_2 is not conflict serializable.

(c) S_1 is not conflict serializable and S_2 is conflict serializable.

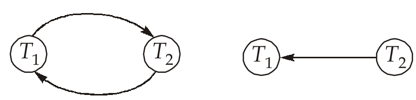
(d) Both S_1 and S_2 are not conflict serializable.

480. **(c)**

Consider the table for transaction

	S_1	S_2
time ↓	$r_1(X)$;	$r_1(X)$;
	$r_1(Y)$;	$r_2(X)$;
	$r_2(X)$;	$r_2(Y)$;
	$r_2(Y)$;	$w_2(Y)$;
	$w_2(Y)$;	$r_1(Y)$;
	$w_1(X)$;	$w_1(X)$;

Precedence graphs:



For S_1 For S_2

So, S_1 is not conflict serializable and S_2 is conflict serializable.

Q.481 The best data structure to check whether an arithmetic expression has balanced parentheses is a

(a) queue (b) stack
(c) tree (d) list

481. (b)

Q.482 Which of the following statements are true?

1. Shortest remaining time first scheduling may cause starvation.
2. Preemptive scheduling may cause starvation.
3. Round robin is better than FCFS in terms of response time.

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

482. **(d)**

In the shortest remaining time first scheduling, process will not get a chance if that one has the highest remaining time, due to this starvation takes place.

In preemptive scheduling, always one process preempt due to low priority, due to this starvation takes place.

Response time = first response – process submission time

In the round robin scheduling, every process gets first response after certain time quantum. Whereas in FCFS, when a process is executing, it is executed upto its complete burst time. Due to this, RR is better than FCFS in term of response time.

Q.483 A prime attribute of a relation scheme *R* is an attribute that appears

(a) in all candidate keys of *R*. (b) in some candidate key of *R*.
(c) in a foreign key of *R*. (d) only in the primary key of *R*.

483. **(b)**

A prime attribute is an attribute that appears in some candidate key of given relation *R*.

Q.484 Consider the 3 processes, P1, P2 and P3 shown in the following table:

Process Name	Arrival Time	Time Unit Required
P1	0	5
P2	1	7
P3	3	4

The completion order of these three processes under the policies FCFS and RR2 (round robin scheduling with CPU quantum of 2 time units) are:

(a) **FCFS:** P1, P2, P3 and **RR2:** P1, P2, P3
(b) **FCFS:** P1, P3, P2 and **RR2:** P1, P3, P2
(c) **FCFS:** P1, P2, P3 and **RR2:** P1, P3, P2
(d) **FCFS:** P1, P3, P2 and **RR2:** P1, P2, P3

484. **(c)**

RR Queue:

P1	P2	P1	P3	P2	P1	P3	P2
0	1	2	3	4	6	8	10

P1	P2	P1	P3	P2	P1	P3	P2

0 2 4 6 8 10 11 13 16

Completion order ⇒ P1, P3, P2

FCFS: P1, P2, P3

Therefore option (c) is correct.

FCFS : P1, P2, P3

RR2 : P1, P3, P2

Q.485 The total number of metallisation layers required for the fabrication of an *n*-Well CMOS inverter is

(a) 1
(b) 2
(c) 3
(d) 4

485. (b)

Q.486 A processor needs software interrupt to

(a) test the interrupt system of the processor.
(b) implement co-routines.
(c) obtain system services which need execution of privileged instructions.
(d) return from subroutine.

486. (c)

A processor needs software interrupt to obtain system services which need execution of privileged instructions.

Q.487 Which of the following pairs is not correctly matched?

(a) Oxidation : Masking
(b) Diffusion : Doping
(c) Metallisation : Interconnection
(d) Photolithography : Isolation

487. (d)

Q.488 In fabrication of a *PN* junction on *N*-type substrate, the processes involved are

1. Ion implantation
2. Oxidation
3. Photolithography
4. Metallisation

The correct sequence of these processes is

(a) 2 - 3 - 4 - 1
(b) 4 - 2 - 1 - 3
(c) 2 - 3 - 1 - 4
(d) 2 - 4 - 3 - 1

488. (c)

Q.489 The page fault service time is 10 ms in a computer with average memory access time of 20 ns. If one page fault is generated for every 10^6 memory accesses, then the effective access time of the memory is

(a) 21 ns
(b) 30 ns
(c) 23 ns
(d) 35 ns

489. (b)

Effective access time = [(1 – p) × access time when no page fault + p × page fault service time]

$$= \left[1 - \left(\frac{1}{10^6}\right)\right] \times 20\,\text{ns} + \left(\frac{1}{10^6}\right) \times 10\,\text{ms}$$

$$= \left(\frac{10^6 - 1}{10^6}\right) \times 20\,\text{ns} + \left(\frac{1}{10^6}\right) \times 10 \times 10^6\,\text{ns}$$

≈ 30 ns

Q.490 Oxide is grown on an unoxidised silicon wafer using wet oxidation process. If the process constants are $A = \sqrt{2}\ \mu\text{m}$ and $B = 0.5\ \mu\text{m}^2/\text{hr}$ and the oxidation is performed for 1 hr, then the thickness of oxide grown will be approximately

(a) 0.293 μm (b) 0.414 μm
(c) 0.393 μm (d) 0.517 μm

490. (a)

$$d_{ox}^2 + Ad_{ox} = B(t + \tau)$$

$\tau = 0$, for initial oxide thickness

So, $$d_{ox}^2 + \sqrt{2}\, d_{ox} = 0.5(1) = 0.50$$

$$d_{ox}^2 + \sqrt{2}\, d_{ox} - 0.50 = 0$$

$$d_{ox} = \frac{-\sqrt{2} \pm \sqrt{2+2}}{2}\ \mu\text{m}$$

Since d_{ox} is a positive quantity,

$$d_{ox} = \frac{\sqrt{4} - \sqrt{2}}{2} = 1 - \frac{1}{\sqrt{2}} = 1 - 0.707 = 0.293\ \mu\text{m}$$

Q.491 Consider the following process steps used in photolithography:

1. Development
2. Oxide etching
3. Photoresist stripping
4. Spinning

The correct sequence of these process steps is

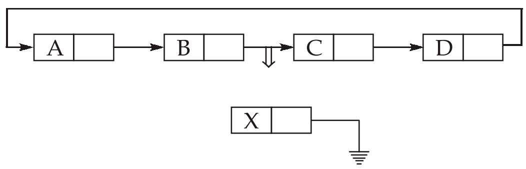
(a) 1 - 2 - 3 - 4 (b) 4 - 3 - 2 - 1
(c) 4 - 1 - 2 - 3 (d) 2 - 3 - 4 - 1

491. (c)

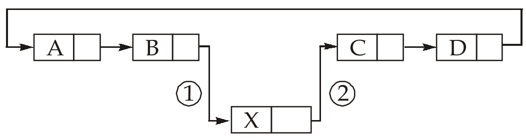
Q.492 In a circular linked list organization, insertion of a record involves modification of

(a) One pointer (b) Two pointers
(c) No pointer (d) Multiple pointers

492. (b)



In above linked list a new record X will be inserted in between B and C



Two pointers are modified to insert X record

Q.493 Why MOSFET with polysilicon gate preferred to a MOSFET with aluminium gate?

(a) The device becomes more resistant to radiation.
(b) The gate can be self-aligned to source and drain.
(c) The isolation between adjacent devices is better.
(d) The gate leakage current is smaller.

493. (b)

Q.494 In ion-implantation, the average penetration depth at which the ions come to rest is called

(a) Process depth (b) Projected depth
(c) Projected range (d) Resolution

494. (c)

Q.495 A computer handles several interrupt sources of which the following are relevant for this question:

- Interrupt from CPU temperature sensor (raises interrupt if CPU temperature is too high)
- Interrupt from Mouse (raises interrupt if the mouse is moved or a button is pressed)
- Interrupt from Keyboard (raises interrupt when a key is pressed or released)
- Interrupt from Hard Disk (raises interrupt when a disk read is completed)

Which one of these will be handled at the **HIGHEST** priority?

(a) Interrupt from Hard Disk (b) Interrupt from Mouse
(c) Interrupt from Keyboard (d) Interrupt from CPU temperature sensor

495. (d)

Interrupt from CPU temperature sensor is given top priority to protect system resources. When CPU temperature is too high, the BIOS initiate an interrupt and informs the Operating System. OS gives top priority to this interrupt and immediately shuts down the system.

Q.496 The most widely used method to form thin gate oxide in the fabrication of a MOSFET is

(a) Wet oxidation (b) Dry oxidation
(c) Vapour phase oxidation (d) Anodic oxidation

496. (b)

The quality of gate oxide should be very high. Dry oxidation produces better quality oxide than other methods. Hence dry oxidation is used most widely to form gate oxide.

Direction (Q.497 to Q.500): The following items consists of two statements, one labelled as **Statement (I)** and the other labelled as **Statement (II)**. You have to examine these two statements carefully and select your answers to these items using the codes given below:

Codes:

(a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.497 Statement (I): Compared to analog systems, PCM is much better for noise immunity.
Statement (II): Generally PCM requires large bandwidth compared to analog systems.

497. (b)

Q.498 Statement (I): Huffman coding applied for a discrete memoryless source, producing equiprobable symbols, gives the 100% coding efficiency.
Statement (II): The entropy of a discrete memoryless source is maximum when the symbols are equiprobable.

498. (d)

The coding efficiency with Huffman coding will not be 100% all the time, even though the source is producing the equiprobable symbols.

Q.499 Statement (I): Associative memory is fast memory.
Statement (II): Associative memory searches by content and not by accessing of address.

499. (a)

Associative memory is any device that associates a set of predefined output patterns with specific input patterns. Associative memory can also be called as content addressable memory (CAM) and is accessed simultaneously and in parallel on the basis of data content rather than by specific address or location.

Q.500 Statement (I): In discrete as well as IC device fabrication, wet oxidation of silicon into it's natural oxide is preferred over deposited oxide.
Statement (II): The rate of growth of wet oxidation is lower than that of dry oxidation. Hence, a better quality oxide can be grown.

500. (c)

The rate of growth of wet oxidation is higher than that of dry oxidation and a better quality oxide can be grown with dry oxidation.

■■■■