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Prelims Through Questions

for

ESE 2021

Electronics & Telecommunication

Day 7 of 11

Q.271 - Q.320

(Out of 500 Questions)

Signals & Systems + Advanced Communication + Basic Electrical Engineering

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Q.271 The Laplace transform of a signal given below is

$$x(t) = \begin{cases} \cos(\pi t); & 0 < t < 1 \\ 0 \quad ; & \text{otherwise} \end{cases}$$

(a) $\dfrac{1-e^{-s}}{s^2+\pi^2}$

(b) $\dfrac{1-e^{-\pi s}}{s^2+\pi^2}$

(c) $\dfrac{s[1+e^{-s}]}{s^2+\pi^2}$

(d) $\dfrac{s[1-e^{-s}]}{s^2+\pi^2}$

271. (c)

We know that the Laplace transform of

$$\cos(at)\,u(t) = \frac{s}{s^2+a^2}$$

$$\therefore \quad \cos(\pi t)\,u(t) = \frac{s}{s^2+\pi^2}$$

now, the given function $x(t)$ can be written as,

$$= \cos\pi t[u(t) - u(t-1)]$$

$$= \cos(\pi t)u(t) - \cos\pi t\; u(t-1)$$

$$= \cos\pi t\, u(t) - \cos\pi(t-1+1)u(t-1)$$

$$= \cos\pi t\, u(t) - \cos[\pi(t-1)+\pi]\,u(t-1)$$

$$x(t) = \cos(\pi t)\,u(t) + \cos[\pi(t-1)]\,u(t-1)$$

By taking Laplace transform,

$$X(s) = \frac{s}{s^2+\pi^2} + \frac{s\,e^{-s}}{s^2+\pi^2}$$

[$\because x(t-t_0) = X(s)\cdot e^{-st_0}$, by shifting property]

$$X(s) = \frac{s[1+e^{-s}]}{s^2+\pi^2}$$

Q.272 Let $x(t) = \dfrac{\sin(10\pi t)}{\pi t}$ be the continuous time signal, the condition on the sampling interval 'T_s' so that $x(t)$ is uniquely represented by the discrete-time sequence $x[n] = x[nT_s]$ is

(a) $T_s > \dfrac{1}{10}$

(b) $T_s < \dfrac{1}{10}$

(c) $T_s > 10\pi$

(d) $T_s < \dfrac{1}{5\pi}$

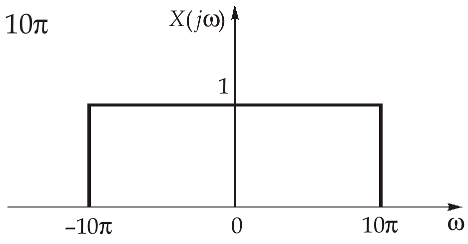
272. (b)

Given, $$x(t) = \frac{\sin(10\pi t)}{\pi t}$$

Taking Fourier transform

$$X(j\omega) = \begin{cases} 1 \; ; & |\omega| \le 10\pi \\ 0 \; ; & |\omega| > 10\pi \end{cases}$$

or



∴ The maximum frequency 'ω_m' present in $x(t)$ is $\omega_m = 10\pi$

Hence we require,

$$\frac{2\pi}{T_s} > 2\omega_m$$

$$\frac{2\pi}{T_s} > 20\pi$$

$$\therefore \quad T_s < \frac{1}{10}$$

Q.273 Laplace transform of double differentiation of unit impulse signal is

(a) 1
(b) s
(c) s^2
(d) $\frac{1}{s^2}$

273. (c)

We know that, unit impulse let $x(t)$,

$$x(t) = \delta(t)$$

for $\quad \delta(t) \xleftrightarrow{LT} 1$

for $\quad \frac{d}{dt}x(t) \xleftrightarrow{LT} sX(s)$

$$\frac{d}{dt}\delta(t) \xleftrightarrow{LT} s$$

$$\frac{d^2}{dt^2}\delta(t) \xleftrightarrow{LT} s^2$$

Q.274 The expression of trigonometric Fourier series coefficient a_n in terms of exponential Fourier series coefficient C_n is

(a) $j(C_n + C_{-n})$
(b) $j(C_n - C_{-n})$
(c) $C_n + C_{-n}$
(d) $C_n - C_{-n}$

274. (c)

We know that,

$$a_n = \frac{2}{T}\int_T x(t)(\cos\omega_0 nt)\,dt = \frac{2}{T}\int_T x(t)\left[\frac{e^{j\omega_0 nt} + e^{-j\omega_0 nt}}{2}\right]dt$$

$$= \frac{1}{T}\left[\int_T x(t)e^{j\omega_0 nt}dt + \int_T x(t)e^{-j\omega_0 nt}dt\right]$$

$$a_n = C_n + C_{-n}$$

[By the definition of exponential Fourier series coefficient].

Q.275 If $f(t)$ is a real even continuous time signal, then its Fourier transform will be

(a) $\int_0^{\infty} f(t)\cos(2\omega t)\,dt$

(b) $2\int_0^{\infty} f(t)\cos(\omega t)\,dt$

(c) $\int_0^{\infty} f(t)\sin(\omega t)\,dt$

(d) $2\int_0^{\infty} f(t)\sin(\omega t)\,dt$

275. (b)

$$F(\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t}\,dt = \int_{-\infty}^{\infty} [f(t)\cos\omega t - jf(t)\sin\omega t]\,dt$$

$$= \int_{-\infty}^{\infty} f(t)\cos\omega t\,dt - j\int_{-\infty}^{\infty} f(t)\sin\omega t\,dt$$

$f(t) \Rightarrow$ even signal
$f(t)\cos\omega t \Rightarrow$ even signal
$f(t)\sin\omega t \Rightarrow$ odd signal

$$\int_{-\infty}^{\infty} f(t)\sin\omega t\,dt = 0$$

$$\int_{-\infty}^{\infty} f(t)\cos\omega t\,dt = 2\int_0^{\infty} f(t)\cos\omega t\,dt$$

$$\therefore \quad F(\omega) = 2\int_0^{\infty} f(t)\cos\omega t\,dt$$

Q.276 The region of convergence of a signal $x[n]$ whose z-transform is represented as $X(z)$, where

$$x[n] = \begin{cases} 1\,; & -5 \le n \le 5 \\ 0\,; & \text{otherwise} \end{cases}$$

(a) $|z| > 0.2$

(b) $|z| > 5$

(c) $0.2 < |z| < 5$

(d) entire z-plane except $z = 0$ and $z = \infty$

276. (d)

The given sequence of $x[n]$ is finite duration. Hence, the region of convergence is $0 < |z| < \infty$.

Q.277 A discrete time sequence is given by $x[n] = \{-1, \underset{\uparrow}{-2}, 1, 2\}$. If the autocorrelation is defined as $r_{xx}(k)$, then $\sum_{k=-4}^{4} r_{xx}(k)$ is

(a) 0

(b) 4

(c) 8

(d) 16

277. (a)

$$r_{xx}(k) = \sum_{k=-\infty}^{\infty} x[n]\,x[n-k]$$

$$\sum_{k=-4}^{k=4} r_{xx}(k) = x[n]\,x[n+3] + x[n]\,x[n+2] + x[n]\,x[n+1]$$

$$+ x[n]\,x[n] + x[n]\,x[n-1] + x[n]\,x[n-2] + x[n]\,x[n-3]$$

$$= -2 -5 + 2 + 10 + 2 - 5 - 2 = 0$$

Q.278 The signal $x[n] = e^{j\omega n} + e^{j2\omega n}$ is

(a) Eigen function of LTI system
(b) Not an eigen function of LTI system
(c) May or may not be eigen function
(d) Eigen function for positive value of ω

278. (b)

The output of the given LTI system is,

$$y[n] = \sum_{k=-\infty}^{+\infty} h[k]e^{j\omega(n-k)} + \sum_{k=-\infty}^{+\infty} h[k]e^{j2\omega(n-k)}$$

$$= e^{j\omega n}\sum_{k=-\infty}^{+\infty} h[k]e^{-j\omega k} + e^{j2\omega n}\sum_{k=-\infty}^{+\infty} h[k]e^{-j2\omega k}$$

$$= e^{j\omega n}\,H(e^{j\omega}) + e^{j2\omega n}\,H(e^{j2\omega})$$

Since the input cannot be extracted from the above expression, the sum of the complex exponential is not an eigen function.

Q.279 The energy of the signal $x[n] = \dfrac{\sin(2n)}{\pi n}$ is

(a) 0.64 J
(b) 0.75 J
(c) 0.84 J
(d) 1.24 J

279. (a)

By Parseval's theorem,

Energy of a signal $x[n]$ is, $E = \dfrac{1}{2\pi}\displaystyle\int_{-\pi}^{\pi}\left|X(e^{j\omega})^2\right|d\omega$

where $X(e^{j\omega})$ is discrete time Fourier transform of $x[n]$,

So, $$\frac{\sin(2n)}{\pi n} \xleftrightarrow{\text{DTFT}} X(e^{j\omega}) = \begin{cases} 1; & |\omega| \le 2 \\ 0; & \text{otherwise} \end{cases}$$

∴ $$\text{Energy, } E = \frac{1}{2\pi}\int_{-2}^{2} 1\cdot d\omega = \frac{1}{2\pi}[4]$$

∴ $$E = \frac{2}{\pi} = 0.64 \text{ J}$$

Q.280 The value of $x(t) = \delta(t) * 2\delta(t-1) * 3\delta(t-2)$ is equal to

(a) $2\delta(t-2)$
(b) $6\delta(t-2)$
(c) $3\delta(t-3)$
(d) $6\delta(t-3)$

280. (d)

Given, $x(t) = \delta(t) * 2\delta(t-1) * 3\delta(t-2)$

From the convolution property of impulse,

$$x(t) * \delta(t - t_0) = x(t - t_0)$$

$$\therefore \quad x(t) = \delta(t) * 6\delta(t-3)$$

$$x(t) = 6\delta(t-3)$$

Q.281 For a periodic square wave, which of the following statements is TRUE?
(a) The Fourier series coefficient exist but the reconstruction converges atmost point.
(b) The Fourier series coefficient exist and the reconstruction converges at no points.
(c) The Fourier series coefficient exist and the reconstruction converges at every point.
(d) None of these

281. (a)

Q.282 Two sequences $X_1[n]$ and $X_2[n]$ are related by $X_2[n] = X_1[-n]$. In the z-domain their ROC values are
(a) the same
(b) reciprocal of each other
(c) negative of each other
(d) complements of each other

282. (b)

For sequence $X_1[n] \xleftrightarrow{Z} X_1[z]$; ROC = R

For sequence $X_2[n] = X_1[-n] \xleftrightarrow{Z} X_1[1/z]$; ROC = $1/R$

$\therefore$ ROC's are reciprocal of each other.

Q.283 Consider the following system $y(t) = x^2(t)$, the above system is
(a) linear and invertible
(b) linear and non invertible
(c) non linear and invertible
(d) non linear and non invertible

283. (d)

Let us consider two signals,

$$x_1(t) = 1, \quad \forall\, t$$

$$x_2(t) = -1, \quad \forall\, t$$

Clearly $x_1(t) \neq x_2(t)$ but $(x_1(t))^2 = (x_2(t))^2$

Therefore different inputs gives the same output hence the system is non invertible.
And also it is non linear system.

Q.284 If the Fourier transform of the signal $x(t)$ is $X(\omega)$, then the Fourier transform of the signal $-\dfrac{d^2x(t+2)}{dt^2}$ is
(a) $\omega^2 e^{-j2\omega} X(\omega)$
(b) $\omega^2 e^{j2\omega} X(\omega)$
(c) $-\omega^2 e^{-j2\omega} X(\omega)$
(d) $-\omega^2 e^{j2\omega} X(\omega)$

284. (b)

By the differentiation property of Fourier transform,

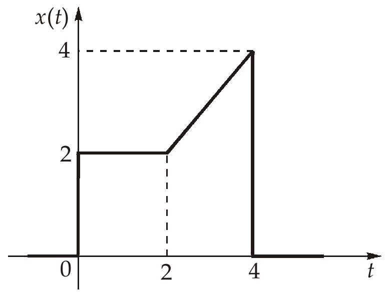
$$\frac{dx(t)}{dt} \xleftrightarrow{\text{F.T}} j\omega X(\omega)$$

$$\frac{d^2x(t)}{dt^2} \xleftrightarrow{\text{F.T}} -\omega^2 X(\omega)$$

By the time shifting property,

$$-\frac{d^2x(t+2)}{dt^2} \xleftrightarrow{\text{F.T}} \omega^2 e^{j2\omega} X(\omega)$$

Q.285 Consider the following signal:



The signal $x(t)$ is expressed as,

$x(t) = 2u(t) + (t-2)\,u(t-2) - (t-t_0)\,u(t-4)$

If $u(t)$ is a unit step function, then the value of t_0 will be

(a) zero
(b) –4
(c) 4
(d) 3

285. (a)

The given signal $x(t)$ can be expressed as,

$$x(t) = 2u(t) + r(t-2) - r(t-4) - 4u(t-4)$$

$$r(t) = tu(t)$$

So,
$$\begin{aligned} x(t) &= 2u(t) + (t-2)\,u(t-2) - (t-4)\,u(t-4) - 4u(t-4) \\ &= 2u(t) + (t-2)\,u(t-2) - tu(t-4) + 4u(t-4) - 4u(t-4) \\ &= 2u(t) + (t-2)\,u(t-2) - tu(t-4) \end{aligned}$$

Given that, $x(t) = 2u(t) + (t-2)\,u(t-2) - (t-t_0)\,u(t-4)$

So, $t_0 = 0$

Q.286 If the Fourier transform of $x(t)$ is $X(f)$, then the Fourier transform of $x(2t+4)$ will be

(a) $\frac{1}{2}X\left(\frac{f}{2}\right)e^{-j8\pi f}$
(b) $\frac{1}{4}X\left(\frac{f}{4}\right)e^{+j4\pi f}$
(c) $\frac{1}{2}X\left(\frac{f}{2}\right)e^{+j8\pi f}$
(d) $\frac{1}{2}X\left(\frac{f}{2}\right)e^{+j4\pi f}$

286. (d)

$$x(t) \xleftrightarrow{\text{CTFT}} X(f)$$
$$x(t+4) \xleftrightarrow{\text{CTFT}} X(f)\, e^{+j8\pi f}$$
$$x(2t+4) \xleftrightarrow{\text{CTFT}} \frac{1}{2} X\left(\frac{f}{2}\right) e^{+j4\pi f}$$

Q.287 Consider the following statements:

S_1 : Hilbert transform does not change the domain of the signal.

S_2 : Hilbert transform does not change the magnitude spectrum of the signal.

S_3 : A signal $x(t)$ and its Hilbert transform $\hat{x}(t)$ are orthogonal to each other.

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

287. (d)

Q.288 The discrete time Fourier transform (DTFT) of the following sequence $x(n)$ is

$$x(n) = \begin{cases} n\,; & -4 \le n \le 4 \\ 0\,; & \text{otherwise} \end{cases}$$

(a) $j2\sum_{k=1}^{4} k\sin(k\omega)$
(b) $-j2\sum_{k=1}^{4} k\sin(k\omega)$
(c) $j4\sum_{k=1}^{4} k\sin(k\omega)$
(d) $-j4\sum_{k=1}^{4} k\sin(k\omega)$

288. (b)

$$X(\omega) = \sum_{n=-\infty}^{\infty} x(n)e^{-j\omega n} = \sum_{n=-4}^{4} n\,e^{-j\omega n}$$
$$= \sum_{k=1}^{4}\left[ke^{-j\omega k} - k^{+j\omega k}\right] = \sum_{k=1}^{4} k[-j2\sin(k\omega)]$$
$$= -j2\sum_{k=1}^{4} k\sin(k\omega)$$

Q.289 Consider the following statements about transport layer:

1. It is responsible for flow and error control.
2. It is responsible for reassembly of segments at the destination.
3. It is responsible for dividing the message into manageable segments:

Which of the above statements are true?

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

289. (d)

Q.290 A step index glass fiber has higher core index and lower cladding index of 1.50 and 1.45 respectively. Then the percentage of light collected by the fiber is

(a) 52.35% (b) 38.30%
(c) 14.75% (d) 86.20%

290. (c)

$$\%\text{Light collected} = (NA)^2 \times 100$$

$$NA = \sqrt{n_1^2 - n_2^2}$$

$$(NA)^2 = n_1^2 - n_2^2 = (1.50)^2 - (1.45)^2 = 2.25 - 2.1025 = 0.1475$$

$$\%\text{ Light collected} = (NA)^2 \times 100 = 14.75\%$$

Q.291 The soft hand-off occurs in

(a) Intra MTS (b) CDMA based system
(c) Intra BTS (d) GSM based system

291. (b)

Soft handoff generally takes place in CDMA based system.

Q.292 Consider the following statements about data link layer:

1. Data link control deals with the designs and procedures for node-to-node communication.
2. Media access control deals with procedures for sharing the link.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

292. (c)

The two main functions of the data link layer are data link control and media access control. The data link control deals with the design and procedures for communication between two adjacent nodes and media access control deals with procedures for sharing the link.

Q.293 Which one of the following methods is used to increase the efficiency of bidirectional communication by sending data in one direction along with acknowledgment in the other direction?

(a) Stop and wait protocol (b) Go back-*N* protocol
(c) Piggybacking (d) None of the above

293. (c)

The efficiency of bidirectional communication can be increased by piggyback data in one direction along with acknowledgment in the other direction.

Q.294 Consider the following statements regarding IPv4:

1. A multicast address identifies all stations on a network.
2. A unicast address identifies one of the addresses in the group.

Which of the following is/are true?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

294. (b)

A broadcast address identifies all stations on a network.

Q.295 A satellite communication link has uplink C/N_0 = 80 dB-Hz, downlink C/N_0 = 80 dB-Hz. Then the overall link C/N_0 will be approximately equal to

(a) 83 dB-Hz
(b) 77 dB-Hz
(c) 62 dB-Hz
(d) 81 dB-Hz

295. (b)

$$10\log_{10}(10^8) = 80 \text{ dB}$$

$$\frac{1}{CNR_{\text{overall}}} = \frac{1}{CNR_{\text{up}}} + \frac{1}{CNR_{\text{down}}}$$

$$= \frac{1}{10^8} + \frac{1}{10^8} = \frac{2}{10^8}$$

$$CNR_{\text{overall}} = \frac{10^8}{2}$$

In decilogs,
$$[CNR]_{\text{overall}} = 10\log_{10}\left(\frac{10^8}{2}\right) \text{dB-Hz}$$

$$= 10\log_{10}10^8 - 10\log_{10}2$$

$$\approx 80 - 3 = 77 \text{ dB-Hz}$$

Q.296 The cluster size of a cellular system is 12. The values of i and j will be respectively

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

296. (a)

$$N = i^2 + j^2 + ij$$

By trial and error if we put $i = 2$ and $j = 2$, we have

$$N = 4 + 4 + 4 = 12$$

Q.297 If the cluster size in a cellular mobile communication system is reduced, then the co-channel reuse ratio will be

(a) increased
(b) decreased
(c) unaffected
(d) none of the above

297. (b)

Co-channel reuse ratio $(Q) = \sqrt{3N}$

N = Cluster size

So, as cluster size reduces, the co-channel reuse ratio will be decreased.

Q.298 An optical fiber has input power P_{in} = 1 mW and an attenuation α = 0.5 dB/km. If the minimum output power required is equal to 50 μW, then the maximum distance of the fiber link will be (Assume that, all other losses are negligible)

(a) 18 km
(b) 15 km
(c) 35 km
(d) 26 km

298. (d)

$$L = \frac{10}{\alpha}\log_{10}\left(\frac{P_{in}}{P_{out}}\right)\text{km}$$

$$L_{max} = \frac{10}{0.5}\log_{10}\left(\frac{10^{-3}}{50\times10^{-6}}\right)\text{km}$$

$$= \frac{10}{0.5}\log_{10} 20\text{ km} \approx \frac{10}{0.5}\times 1.30 = 26\text{ km}$$

Q.299 A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.5 and a cladding refractive index of 1.47. Then the numerical aperture (NA) for the fiber is approximately equal to

(a) 0.5
(b) 0.8
(c) 0.3
(d) 0.6

299. (c)

$$\text{N.A} = \sqrt{1.5^2 - 1.47^2} \approx \sqrt{2.25-2.16} = \sqrt{0.09} = 0.3$$

Q.300 A microwave communication link employs two antennas for transmission and reception elevated at 81 m and 64 m respectively. Considering obliqueness of the earth, the maximum possible link distance is

(a) 60 km
(b) 70 km
(c) 75 km
(d) 80 km

300. (b)

$$h_t = 81\text{ m}$$

$$h_r = 64\text{ m}$$

$$\therefore \quad d = 4.12\left[\sqrt{81}+\sqrt{64}\right]\text{km}$$

$$= 4.12[9+8]\text{ km} = 4.12\times 17\text{ km} = 70.04\text{ km} \approx 70\text{ km}$$

Q.301 A satellite downlink at 12 GHz operate with a transmit power of 8 W and an antenna gain of 45.3 dB. Then EIRP is equal to

(a) 35.3 dBW
(b) 38.3 dBW
(c) 81.3 dBW
(d) 54.3 dBW

301. (d)

$$[\text{EIRP}] = 10\log_{10}\left[\frac{8\text{ W}}{1\text{ W}}\right] + 45.3$$

$$= 10\log_{10} 2^3 + 45.3 \approx 3\times 3 + 45.3$$

$$= 9 + 45.3 = 54.3\text{ dBW}$$

Q.302 A satellite TV signal occupies a full transponder bandwidth of 20 MHz, and it must provide a C/N ratio at the destination earth station of 22 dB. Given that the total transmission losses are 200 dB and the destination earth-station (G/T) ratio is 31 dB/K. The satellite EIRP required is

(a) 18.3 dBW
(b) 26.3 dBW
(c) 35.4 dBW
(d) 41.6 dBW

302. (c)

$$\left[\frac{C}{N}\right]_D = [\text{EIRP}] + \left[\frac{G}{T}\right]_D - [\text{Losses}]_D - [B] - [k]$$

$$[\text{EIRP}]_D = \left[\frac{C}{N}\right]_D - \left[\frac{G}{T}\right]_D + [\text{losses}]_D + [B] + [k]$$

$$[B] = 10\log_{10}(20 \times 10^6) = 10\log_{10}2 + 70 = 73 \text{ dB-Hz}$$

$$[k] = -228.6 \text{ dBW/K-Hz}$$

$$\therefore \quad [\text{EIRP}]_D = 22 - 31 + 200 + 73 - 228.6 = 35.4 \text{ dBW}$$

Q.303 In which switching technique the resources are allocated on demand?
(a) Circuit switching
(b) Datagram switching
(c) Frame switching
(d) None of the above

303. (b)

Q.304 Which layer in the TCP/IP stack is equivalent to the network layer in the OSI model?
(a) Application layer
(b) Host-to-Host layer
(c) Internet layer
(d) Network Access layer

304. (c)

Q.305 Which of the following is not a function of network layer?
(a) Routing
(b) Inter-networking
(c) Congestion control
(d) Media access control

305. (d)
Media access control is the function of a data link layer.

Q.306 A photodiode, whose quantum efficiency of 70%, is exposed to photons each having energy of 1.4×10^{-19} J. The responsivity of the photodiode is
(a) $0.5\ \text{AW}^{-1}$
(b) $0.3\ \text{AW}^{-1}$
(c) $0.8\ \text{AW}^{-1}$
(d) $0.9\ \text{AW}^{-1}$

306. (c)

$$\text{Responsivity} = \frac{\text{Output photocurrent}}{\text{Incident optical power}}$$

$$R = \eta\frac{q}{h\nu} = \frac{0.7 \times 1.6 \times 10^{-19}}{1.4 \times 10^{-19}} = 0.8\ \text{AW}^{-1}$$

Q.307 A coil has a self inductance of 40 mH. If the current in the coil raises from 0 to 10 A in 0.05 sec, then the emf developed in the coil is
(a) 4 V
(b) 5 V
(c) 6 V
(d) 8 V

307. (d)

Emf, $$e = L\frac{di}{dt}$$

$$e = 40 \times 10^{-3} \times \frac{10-0}{0.05} \text{ V}$$

$$e = 8 \text{ V}$$

Q.308 A solenoid of 400 turns is wound on a continuous ring of iron, the mean diameter of the ring being 10 cm. The relative permeability of iron is 1250. The current required to maintain a flux density of 1.2 Wb/m^2 in the iron core is

(a) 0.4 A (b) 0.5 A
(c) 0.7 A (d) 0.6 A

308. (d)

$$l = \text{circumference of the ring} = \pi d = \pi 10 \times 10^{-2} \text{ m}$$

For a solenoid,
$$B = \mu_0 \mu_r \frac{NI}{l}$$

$$I = \frac{B \times l}{\mu_0 \mu_r N} = \frac{1.2 \times \pi \times 10 \times 10^{-2}}{1250 \times 4\pi \times 10^{-7} \times 400} = 0.6 \text{ A}$$

Q.309 A transformer has 2% resistance and 5% reactance. Its voltage regulation at full load with 0.8 p.f. leading is

(a) –1% (b) 2.6%
(c) –1.4% (d) 4.6%

309. (c)

Percentage voltage regulation for leading load is,

$$\% VR = \% R \cos\phi - \% X \sin\phi$$
$$= (2 \times 0.8) - (5 \times 0.6) = -1.4\%$$

Q.310 When a two winding transformer is connected as an autotransformer, its full load efficiency

(a) remains the same (b) increases
(c) decreases (d) rises to 100%

310. (b)

Q.311 A 100 kVA, 500 V/200 V, 1-ϕ transformer when excited at rated voltage on HV side, draws a no load current of 3 A at 0.8 lagging p.f. If it is excited from the LV side at rated voltage, then the no load current and p.f. will be respectively

(a) 7.5 A and 0.8 lagging (b) 3 A and 0.6 lagging
(c) 7.5 A and 0.6 lagging (d) 9.5 A and 0.8 lagging

311. (a)

No load current, $I_{01} = 3$ A at 0.8 p.f. lagging

$$\frac{V_2}{V_1} = \frac{I_{01}}{I_{02}}$$

$$I_{02} = \frac{V_1 I_{01}}{V_2} = \frac{3 \times 500}{200} = 7.5 \text{ A}$$

At no load p.f. remains same on both sides.

Q.312 A 50 kVA transformer has a core loss of 600 W and a full load copper loss of 900 W. The proportion of full load at maximum efficiency is

(a) 91.62% (b) 72.16%
(c) 81.65% (d) 68.45%

312. (c)

Proportion of full load at maximum efficiency is

$$x = \sqrt{\frac{P_i}{P_{cu\,(FL)}}} = \sqrt{\frac{600}{900}} = \sqrt{0.667} = 0.8165 = 81.65\%$$

Q.313 A 8 kVA, 440/2000 V, 50 Hz single phase transformer gave the following test results:

No load test: 440 V, 0.8 A, 80 W

The core loss component current is

(a) 0.02 A
(b) 2 A
(c) 2.41 A
(d) 0.18 A

313. (d)

No load p.f., $\cos\theta = \frac{80}{440 \times 0.8} = 0.227$

Core loss component current is = $I_0 \cos\theta$ = 0.8 × 0.227 = 0.18 A

Q.314 Two transformers with leakage impedance Z_1 = (0.1 + j0.4) p.u. and Z_2 = (0.05 + j0.2) p.u. are connected in parallel. The ratio of loads share will be

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

314. (b)

$$\frac{I_1}{I_2} = \frac{Z_2}{Z_1} = \frac{0.05 + j0.2}{0.1 + j0.4} = \frac{0.05 + j0.2}{2(0.05 + j0.2)} = \frac{1}{2}$$

Q.315 An ideal transformer has N_1 = 100 turns and N_2 = 200 turns with a mutual flux of $\phi_m(t) = -0.05(t^2 - 2t)$. The induced emf of secondary is

(a) $5(t - 1)$ V
(b) $10(t - 1)$ V
(c) $5(t^2 - 1)$ V
(d) $20(t - 1)$ V

315. (d)

$$\text{Induced emf} = -N\frac{d\phi}{dt} = -200\frac{d}{dt}[-0.05(t^2 - 2t)]$$

$$= 10\frac{d}{dt}(t^2 - 2t) = 10(2t - 2) = 20(t - 1)$$

Direction (Q.316 to Q.320): 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.316 Statement (I): Compared to all other window techniques, rectangular window method provides less smoothing effect.

Statement (II): Compared to all other window techniques, rectangular window method creates more number of side lobes and narrow main lobe.

316. **(a)**

Q.317 Statement (I): Every causal system is static.

Statement (II): Static systems do not require any memory.

317. **(d)**

Every static system is causal but the converse may not be true.

Q.318 Statement (I): In a cellular communication, generally large cells are used in rural area and small cells are used in urban area.

Statement (II): A cell area is established based on the density of subscribers.

318. **(a)**

Q.319 Statement (I): A passive satellite only reflects back the transmitted signals.

Statement (II): Communication satellite is a repeater between many transmitting stations and many receiving stations.

319. **(b)**

Q.320 Statement (I): A dc motor draws high current at the time of starting.

Statement (II): While starting a dc motor, it takes some time to develop a non-zero back emf.

320. **(a)**

■■■■