



UPPSC AE 2020 PAPER-2

Electrical Engineering

Mega Mock Challenge (May 23- May 24 2020)

Questions & Solutions

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- 1. Which of the following is the correct chronological sequence of struggles led by Gandhiji in India?
 - A. Champaran, Ahmedabad, Kheda
 - B. Kheda, Champaran, Ahmedabad
 - C. Ahmedabad, Kheda, Champaran
 - D. Champaran, Kheda, Ahmedabad

Ans. A

- Sol. Gandhiji arrived in India in **1915** and travelled across the country for two years before actively entering into politics.
 - The correct chronological sequence of Gandhiji's struggles in India is-
 - 1) **Champaran** in **1917** in Bihar on request of Rajkumar Shukla.
 - 2) Ahmedabad Mill Strike in 1918 in Gujrat for plague bonus of factory workers.
 - 3) **Kheda Satyagrah** in **1918** in Gujrat for compensating drought hit farmers in Kheda.
- 2. The Battle of Chausa was fought between Humayun and _____
 - A. Nadir Shah B. Krishnadeva Raya
 - C. Sher Shah Suri D. Hemu

Ans. C

Sol. • The Battle of Chausa took place between Mughal Emperor Humayun and Sher Shah Suri on June 26,1539 at **Chausa**, south west of Buxar in modern-day Bihar.

- In this battle Humayun got defeated .
- 3. Vajji Mahajanpada is located in_____.
 - A. Madhya Pradesh B. Bihar
 - C. Maharashtra D. West Bengal

Ans. B

- Sol. Vajji or Vrajhi was one of the 16 Mahajanapadas of ancient India.
 - It originated by joining several small states.
 - Its capital was **Vaishali**.
 - It was located on the north of River Ganga in Bihar.
- 4. Which Kushana dynasty's ruler was known as Second Ashoka?
 - A. Vasishka B. Huvishka
 - C. Vasudeva I D. Kanishka

Ans. D

- Sol. Kanishka was the most famous ruler of Kushana dynasty.
 - He was also known as **second Ashoka**.
 - He has two capitals-Purushpur and Mathura.

• He started an era in 78 AD, which is now known as Saka era and is used by Government of India.

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- 5. The first charter act of India was passed in which year?
 - A. 1777 B. 1783
 - C. 1793 D. 1803
- Ans. C

Sol. * The first charter act of India was passed in 1793.

- * It continued the company's trade monopoly in India for another 20 years.
- * This Act separated the revenue administration and the judiciary functions of the company.
- * Major charter acts are- Charter Act of 1793, Charter Act of 1813, Charter Act of 1833, Charter Act of 1853 and Charter Act of 1858.
- 6. The concept of union territories was introduced by which constitutional amendment?
 - A. Sixth B. Seventh
 - C. Eighth D. Eleventh

Ans. B

- Sol. The concept of union territories was introduced by the seventh constitutional **amendment.** This amendment was done on 1 Nov 1956.
 - The Andaman and Nicobar Islands was the first union territory of India.
 - Union Territories are special administrative sectors in the republic of India which operate directly under the central government.
- 7. Which article deals with prohibition of the slaughter of cows, calves and draught cattle?
 - A. Article 32 B. Article 48
 - C. Article 53 D. Article 148

Ans. B

- Sol. Article 48 deals with prohibition of the slaughter of cows, calves and draught cattle.
 - **Article 32** of the Indian Constitution gives the right to individuals to move to the Supreme Court to seek justice.
 - Article 53 deals with Executive power of the Union.
 - Article 148 is related to the Comptroller and Auditor General of India.
- 8. The President may resign from his office by writing under his hand addressed to the:
 - A. Vice President B. Prime Minister of India
 - C. Speaker of the Lok Sabha D. Chief Election Commissioner
- Ans. A
- Sol. **Under article 56,** the President shall hold office for a term of five years from the date on which he enters upon his office.

• He may resign from his office by writing under his hand addressed to the Vice-President.

- 9. Khadi and Village Industries Commission was founded in which year?
 - A. 1957 B. 1956
 - C. 1958 D. 1955

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Ans. B

- Sol. The Khadi and Village Industries Commission (KVIC) is a statutory body.
 - It was formed by the Government of India, under the Act of Parliament, 'Khadi and

Village Industries Commission Act of 1956'.

- It is an apex organisation under the Ministry of Micro, Small and Medium Enterprises.
- It is headquartered in Mumbai, Maharashtra.
- 10. Which state is the largest producer of Gypsum in India?
 - A. West Bengal B. Rajasthan
 - C. Bihar D. Jharkhand

Ans. B

- Sol. Rajasthan is considered as the largest producer of gypsum in India.
 - Rajasthan produces 99 percent of India's total production of gypsum.
 - The remaining gypsum is produced by Tamil Nadu, Jammu and Kashmir, Gujarat and Uttar Pradesh in order of production.
- 11. Barren Island, the active volcano, is located in _____
 - A. Andaman Islands B. Nicobar Islands
 - C. Lakshadweep Islands D. None of the above

Ans. A

Sol. Barren Island is located in Andaman Islands archipelago.

- Barren Island is the only active volcano in South Asia. It belongs to North and Middle Andaman administrative district of Andaman and Nicobar Islands.
- Narcondam Volcano is also situated in Andaman and Nicobar Islands but it is a dormant volcano.
- The volcano here was dormant for a long time, but in the year 1991, it experienced an explosion which was quite major and it again erupted in 2017.
- 12. Which of the following in NOT a part of the Meghalaya Plateau?
 - A. Palamu Hills B. Khasi Hills
 - C. Jaintia Hills D. Garo Hills

Ans. A

- Sol. Palamu hills are located in Jharkhand and are not a part of Meghalaya Plateau.
 - Meghalayan Plateau is a extension of Indian peninsular plateau.
 - The western, central and the eastern parts of the plateau are known as the Garo Hills,

the Khasi-Jaintia Hills and the Mikir Hills.

- Meghalayan Plateau is rich in coal and uranium deposits.
- Cherrapunji and Mawsynram, located in the Khasi hills, are the wettest places in India and are a part of the plateau.

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- 13. As per the Census of 2011 which district of India is the most populous?
 - A. Theni, Tamil Nadu B. Thane, Maharashtra
 - C. Churu, Rajasthan
- D. Ghaziabad, Uttar Pradesh

- Ans. B
- Sol. As per the Census of 2011, **Thane district of Maharashtra** is the most populated district of India.
 - Thane with population of **1.1 Crore** is the most populated district of India.
 - **North Twenty Fourth Pargana in West Bengal** is the second most populous district of India with a population of 1.08 Crore.
- 14. In which state has the Jawara Dance, a dance form to celebrate wealth, originated?
 - A. Gujarat B. Madhya Pradesh
 - C. Kerala D. Rajasthan

Ans. B

- Sol. Jawara Dance is a dance form to celebrate wealth in **Bundelkhand region of Madhya** pradesh.
 - It is also known as the Harvest Dance.
 - The women carry a basket full of Jawara crop on their heads while performing the dance.
- 15. Wembley Stadium is located in_____
 - A. London B. Washington DC
 - C. Mexico D. Beijing

Ans. A

- Sol. Wembley Stadium is located in **Wembley, London**.
 - It was opened in **2007**.
 - It is a football stadium. The stadium hosts major football matches including home matches of the England national football team, and the FA Cup Final.
 - It is the most iconic stadium in world football.
 - The stadium has a seating capacity of over 90000 people.
- 16. The National Charkha Museum is located at which place?
 - A. Calcutta B. Ahmedabad
 - C. Gandhinagar . New Delhi
- Ans. D

Sol. • The National Charkha Museum is located in Connaught Place, New Delhi.

• It has been jointly constructed by the New Delhi Municipal Council and the Khadi Development and Village Industries Commission.

• The Museum was inaugurated on May 21, 2017 by the then BJP National President Amit Shah.

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17. Which organization of UNO aims at building space through International Cooperation of Education, Science and Culture?

B. WIPO

- A. FAO
- C. UNESCO D. UNHCR

Ans. C

- Sol. The United Nations Education, Scientific and Cultural Organization is a specialised agency which aims at building space through International Cooperation inf Education, Science and Culture.
 - UNESCO has 193 members and 11 associate members.
 - UNESCO has five major objectives:
 - A) Education
 - B) Natural Sciences
 - C) Social Sciences
 - D) Culture
 - E) Communication

• UNESCO's aim is "to contribute to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information".

- 18. The book "Mother India" was written by_____
 - A. B.R Ambedkar B. Mahatma Gandhi
 - C. Amrita Pritam D. Katherine Mayo

Ans. D

- Sol. The book 'Mother India' was published in 1927.
 - It was a polemical book by the American author Katherine Mayo.
 - In her book, She attacked society, religion and culture of India.
 - The book pointed to the treatment of India's women, the untouchables, animals, dirt, and the character of its nationalistic politicians.
 - Katherine Mayo was an American researcher and historian.
- 19. The process of absorption of digested food in the bloodstream is known as ______.
 - A. Digestion B. Ingestion
 - C. Assimilation D. Egestion

Ans. C

- Sol. **Egestion** is the process of discharging waste material from body.
 - **Digestion** is the process of breaking larger food particles into smaller one.
 - Ingestion is the process of taking in food.
 - Assimilation is process of absorption of digested food in the bloodstream.

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- 20. The first Kirchhoff's current law states that "current flowing into a node must be _ current flowing out of it.
 - A. Less than B. More than
 - C. Equal to D. Either more or equal to

Ans. C

Sol. • Kirchhoff's first current law states that current flowing into a node must be equal to current flowing out of it.

• It is statement of conservation of charge and energy in a circuit. As, charge cannot be created or destroyed at a junction, So whatever current enters a given junction in a circuit must leave that junction.

- 21. Recently which country launched its first military satellite 'Noor'?
 - A. Pakistan B. Iran
 - C. Iraq D. Afghanistan

Ans. B

- Sol. * Recently Iran launched its first military satellite 'Noor'.
 - * The satellite is launched by **Ghased Launcher**.
 - * The Satellite was launched by Iran's Islamic Revolutionary Guard Corps (IRGC).
 - * IRGC is operates its own military infrastructure in parallel to armed forces and answerable only to Leader **Ayatollah Ali Khamenei**.

* The US administration has warned that the technology used to launch satellites could help Iran develop Inter Continental Ballistic Missiles

- 22. Which is the most commonly used nail polish remover?
 - A. Acetone B. Sodium borate
 - C. Boric Acid D. Methyl alcohol

Ans. A

- Sol. The most commonly used nail polish remover is Acetone.
 - Acetone can also remove artificial nails made of acrylic gel.
 - Acetone is a colorless, volatile, flammable liquid and the simplest ketone.
- 23. Ayushman Bharat Diwas is celebrated on _____.
 - A. 22 March B. 25 April
 - C. 30 April D. 25 September
- Ans. C

Sol. • Ayushman Bharat Diwas is celebrated on 30th April.

• Ayushman Bharat is a centrally sponsored scheme launched in 2018 under Ayushman Bharat Mission. Under this mission, National Health Protection Scheme and Wellness Centres were introduced.

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• National Health Protection Scheme aimed at covering around 10 crore poor and vulnerable families providing coverage up to 5 lakh rupees per family per year for secondary and tertiary care hospitalization.

- 24. In Microsoft Word shortcut key Ctrl+W is used for?
 - A. To underline selected text B. To close the currently open document
 - C. To save the open document D. None of these

Ans. B

- Sol. In Microsoft Word shortcut key Ctrl+W is used for to close the currently open document.
 - By using this shortcut key we can Closes the active window, but does not Exit Word.
 - Ctrl+U is used to underline the selected text.
 - Ctrl+S is used to save the open document.
- 25. The three-day fourth International Diabetes Summit was held from **March 6 to 8**, **2020** in_____.

Α.	Bengaluru	B. N	4umbai

C. New Delhi D. Pune

Ans. D

- Sol. * The three-day Fourth International Diabetes Summit was held from March 6 to 8, 2020, in Pune, Maharashtra.
 - * It was organised by the **Chellaram Diabetes Institute**.

* The Chellaram Diabetes Institute (CDI) is well known for its commitment towards the fight against Diabetes organized International Diabetes Summits for three consecutive years.

- 26. Which of the following technique can preferred to avoid race around condition in JK flip-flop
 - A. Level triggering B. Redundant gate
 - C. Edge triggering D. Any of the above

Ans. C

Sol. By edge triggering (or) Master slave flip-flop the race around condition can be resolved.

27. If $s_{12} = 0.85 \ \angle -45^{\circ}$ and $s_{21} = 0.85 \ \angle 45^{\circ}$ for a two port network then two port network is

- A. Non reciprocal B. lossless
- C. reciprocal D. lossy
- Ans. A
- Sol. As we known,

for reciprocal network $s_{ij} = s_{ji}$

s₁₂ = 0.85 ∠-45°

and,

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s₂₁ = 0.85 ∠45°

As, s_{12} is not equal to s_{21}

Hence, two port network is not reciprocal.

- 28. The motor which can work on both ac and dc supply is
 - A. Induction motor B. Hysteresis motor
 - C. Universal motor D. Reluctance motor

Ans. C

- Sol. Universal motor is the motor which can work on both ac and dc supply.
- 29. The neutral of 10MVA, 11kV alternator is earthed through a resistance of 6Ω . The earth fault relay is set to operate at 2A . The CT's have a ratio of 400/5 . What percentage of the alternate winding is protected?
 - A. 15.11 %B. 84.88 %C. 15 %D. 84 %

Ans. B

Sol. % winding unprotected = $\frac{I_n R_n}{V_{ph}}$

Where, I_n = pick-up current × CT Ratio

 $I_n = 2 \times 400/5 = 160 \text{ A}$

$$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{11000}{\sqrt{3}}$$

% winding unprotected

 $= \frac{160 \times 6 \times \sqrt{3}}{11000} = 15.11\%$

% winding protected = 100 - % winding unprotected

= 100 - 15.11 = 84.88 %

30. The order and degree of following differential equation is:

$$\left(\frac{d^2y}{dx^2}\right)^2 + \left(\frac{dy}{dx}\right)^5 = y + \left(\frac{d^3y}{dx_3}\right)^2$$

A. order = 3, degree = 2	B. Order = 2, degree = 2
C. order = 3, degree = 5	D. order = 2, degree = 5

Ans. A

Sol. Order of differential equation is the highest order of the equation.

Hence, order is 3

Degree of differential equation is the degree of highest ordered term in differential equation.

Hence, degree is 2

Option A is correct.

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- 31. When both the amplitude and the frequency of a sinusoidal message signal are doubled, the modulation index will be doubled in
 - 1) Amplitude Modulation
 - 2) Frequency Modulation
 - 3) Phase Modulation

Select the correct answer using the codes given below:

- A. 2 only B. 1 and 3 only
- C. 2 and 3 only D. 1, 2 and 3

Ans. B

Sol. Let $m(t) = A_m \cos(2\pi f_m t)$

For AM₁ $\mu_{AM} = k_a A_m$

For AM1 B_{FM} = $k_f \frac{A_m}{f_m}$

For $PM_1 B_{PM} = k_p A_m$

So, when both A_m and f_m are doubles μ_{AM} and B_{PM} will be doubled and B_{FM} will remain be unchanged.

32. A 50 Hz, 3-phase synchronous generator has inductance per phase of 4 mH. The capacitance of generator and circuit breaker is 0.001 μ F. What is the natural frequency of oscillation?

A. 500 kHz	B. 79.57 kHz
C. 50 kHz	D. 735.7 kHz

Ans. B

Sol. Frequency of oscillation:

$$\omega_n = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{4 \times 10^{-3} \times 0.001 \times 10^{-6}}}$$

= 500krad/sec

$$f_n = \frac{\omega_n}{2\pi} = \frac{500 \times 10^3}{2\pi} = 79.57 \text{ kHz}$$

33. A 6-pole, 3-phase IM is supplied from a 60 Hz supply. Rotor resistance and reactance are 1.2 Ω and 15 Ω per phase respectively. Neglecting stator impedance, the speed at which it will develop maximum torque will be:

A. 1104 RPM	B. 1200 RPM
C. 1000 RPM	D. 920 RPM

Ans. A

Sol. As we known,

Maximum slip, $s_m = \frac{R_2}{X_2}$

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$$s_m = \frac{1.2}{15} = 0.08$$

 $N_s = \frac{(120 \times 60)}{5} = 1200 \text{ RPM}$

Speed of motor, $N_r = N_s(1 - s)$

 $N_r = 1200(1 - 0.08) = 1104 \text{ RPM}$

34. A stepper motor with stator and rotor teeth of 12 and 10 respectively. The value of single step of stepper motor will be:

A. 3°	B. 6°
C. 12°	D. 24°

Ans. B

Sol. Single step of stepper motor can be expressed as:

$$\alpha = \frac{N_s - N_r}{N_s N_r} \times 360^{\circ}$$

where,

 N_s = Number of stator teeth

 N_r = Number of rotor teeth

$$\alpha = \frac{12 - 10}{12 \times 10} \times 360^{\circ}$$
$$\alpha = 6^{\circ}$$

35. The slip of 5th harmonic wave in supply in a 3-phase induction machine is:

A. 0.8	B. 0.6
C. 1.2	D. 1.4

Ans. C

Sol. The 5th harmonic wave moves in opposite direction as that of normal direction. Hence, slip will be:

$$s = \frac{N_s - (-N_s / 5)}{N_s} \Rightarrow s = 6/5 \Rightarrow s = 1.2$$

- 36. The unit cell of certain type of crystal is defined by three vectors a, b and c. the vectors are mutually perpendicular, and a = b = c. The crystal structure is:
 - A. TriclinicB. TetragonalC. CubicD. Monoclinic
- Ans. C
- Sol. Cubic crystal has its three vectors mutually perpendicular to each other and with a relation as a = b = c.

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- 37. Schottky defect is an example of
 - A. Point defect
 - C. Surface defect

- B. Line defect
- ect D. Volume defect
- Ans. A
- Sol. Schottky defect occurs in case of ionic solid whenever "cation and anion pair" vacancy is formed.

Hence, it is example of point defect.

38. A 16 KVA, 800V/400 V, single phase transformer with 20% impedance, draws a steady short-circuit consist of.

A. 150 A	B. 125 A
C. 75 A	D. 100 A

Ans. D

Sol. Impedance on primary side

$$= Z_{pu} \times \frac{V^2}{KVA \times 1000} = 0.2 \times \frac{800^2}{16000} = 8 \Omega$$
$$I_{Sc} = \frac{V}{Z} = \frac{800}{8}$$
$$I_{Sc} = 100 \text{ A}$$

39. When a plane is parallel to an axis. Its miller induces on that axis will be:

A. 1	B. Infinity	
C. 0	D. Cannot be determined	

Ans. C

Sol. As plane is parallel to an axis, its intercept on that axis will be infinite.

Miller indices = $\frac{1}{\text{int ercept}} = \frac{1}{\infty} = 0$

- 40. A 50Hz, 34.64 kV generator is connected to a power system. The system reactance and capacitance per phase are 5 mH and 0.04 pF respectively. What is the maximum voltage across the contacts of circuit breaker at an instant when it passes through zero?
 - A. 69.28 kV B. 40.00 kV
 - C. 56.56 kV D. 97.97 kV

Ans. C

Sol. The maximum voltage across circuit breaker will be:

 $V_{max} = 2V_m$

where V_m is maximum phase voltage,

$$V_{\rm m} = \frac{V_{\rm L}}{\sqrt{3}} \times \sqrt{2} = 28.28 \text{ kV}$$

 $V_{\rm max} = 2 \times 28.28 = 56.56 \, \rm kV$

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- 41. In a voltage commutation chopper circuit, the chopper operates at 400Hz and 50% duty cycle. The load current remains ripple free at 10 A. Assuming input voltage to be 250 V and commutating inductance and capacitance of 1 mH and 5µF. The turn off time of thyristor will be:
 - A. 20 µsec B. 40 µsec
 - C. 100 µsec D. 125 µsec

Ans. D

Sol. Circuit turn off time for voltage commutation circuit will be:

$$t_c = C \frac{V_s}{I_o} = 5 \times 10^{-6} \times \frac{250}{10}$$

 $t_c = 125 \ \mu sec$

- 42. An electric kettle has input power of 500 W and is found to take 15 minutes to bring 1 kg of water at 15 °C to 100°C, If the specific heat of water is 4200 J/kg°C, the heat efficiency of the kettle will be
 - A. 87.3% B. 83.6% D. 75.6%
 - C. 79.3%

Ans. C

Sol. Heat = $mC\Delta t$

m- Mass

C- Specific heat

 Δt = Change in temperature

Output heat = $1 \times 10^3 \times 4.2 \times (100 - 15)$

Output heat = 357000 Joule

Output power,

 $P = \frac{\text{Output heat}}{\text{Time}} = \frac{357000}{15 \times 60} = 396.67 \text{ Watt}$

Input power = 500 Watt

 $=\frac{396.67}{500}\times100=79.3\%$ Heat efficiency

In a step-down chopper with supply voltage of 100 V and duty ratio of 0.4. The load 43. indicator is 0.5 mH and switching frequency of 20 kHz. the value of load resistance at the point of discontinuous operation will be:

Α. 33.34 Ω	Β. 66.67 Ω
C. 20.00 Ω	D. 40.00 Ω

Ans. A

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Sol. At the point of discontinuous operation,

$$I_{0} = \frac{\Delta I_{L}}{2}$$

$$\frac{\alpha V_{s}}{R} = \frac{\alpha (1 - \alpha) V_{s}}{2 f L}$$

$$R_{crt} = \frac{2 f L}{1 - \alpha} = \frac{2 \times 20 \times 10^{3} \times 0.5 \times 10^{-3}}{1 - 0.4}$$

$$R_{crt} = 33.34 \ \Omega$$

44. Which of these is software interrupt?

A. RST 5.5	B. RST 6.5
C. RST 7.5	D. RST 5

Ans. D

- Sol. Except RST 5, all other options are example of hardware interrupts.
- 45. The solution of the differential equation is:

$$\frac{d^2 y}{dx^2} - 5 \frac{dy}{dx} + 6y = 0$$

A. $C_1 e^{-2x} + C_2 e^{-3x}$
B. $C_1 e^{4x} + C_2 e^{2x}$
C. $C_1 e^{2x} + C_2 e^{3x}$
D. $C_1 e^{-4x} + C_2 e^{-2x}$

Ans. C

Sol. The differential equation is

$$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$$

Auxiliary equation is
$$m^2 - 5m + 6 = 0$$
$$(m - 2)(m - 3) = 0$$

m = 2, 3

Hence, the solution will be:

 $Y(x) = C_1 e^{2x} + C_2 e^{3x}$

46. A 4 pole, 3 phase, 50Hz induction motor is running at a speed of 1410 RPM. Neglecting stator impedance, core loss and friction and windage loss. The efficiency of the motor can be expressed as:

A.6%	B. 94 %
C. 95 %	D.85 %

Ans. B

Sol. As we known:

 $P_m = (1-s) P_g$

where, P_m = mechanical power

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P_g = air gap power

 $P_g = P_{in}$ (because of negligible stator copper loss and core loss)

Efficiency =
$$\frac{P_{out}}{P_{in}} = \frac{P_m}{P_g} = 1 - s$$

Where,
$$s = \frac{1500 - 1410}{1500} = 0.06$$

 \Rightarrow Efficiency = 1 - 0.06 \Rightarrow 94 %

47. A 4-bit asynchronous ripple counter is designed by using JK flip-flops with a square wave frequency of 100 KHz. The maximum permissible propagation delay of each flip-flop should be

A. Less than and equal to 5 μ sec

B. Less than and equal to 2.5 msec

- C. Less than and equal to 2.5 µsec
- D. Less than and equal to 10 µsec

Ans. C

Sol.

$$T_{c} = \frac{1}{100 \text{ KHz}} = 10 \text{ } \mu\text{sec}$$
$$T_{c} \ge nt_{pd}$$
$$t_{pd} \le \frac{T_{c}}{n}$$
$$t_{pd} \le \frac{10 \text{ } \mu\text{sec}}{4}$$
$$t_{pd} \le 2.5 \text{ } \mu\text{sec}$$

- 48. A material which has zero resistivity is:
 - A. Conductor
 - C. Semiconductor

B. InsulatorsD. Super conductor

- Ans. D
- Sol. Conductors exhibit some resistance.

But a material with zero resistance is super conductor.

49. A step-down chopper control of a dc separately excited motor has supply voltage of 200V with duty ratio of 0.6. Neglecting armature inductance and assuming continuous conduction of motor current. Calculate the average current when the motor speed is 1200 RPM and has a voltage constant of $K_V = 0.8$ V/rad per sec. The armature resistance is 5 Ω .

A. 4.893 A		B. 3.893 A

Ans. B

Sol. For step down chopper,

 $V_0 = \propto V_{in} = 0.6 \times 200 = 120 V$

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Back emf of motor, $E_b = K_V \times \omega_S$

$$= 0.8 \times \frac{2\pi \times 1200}{60} = 100.53 \text{ V}$$
$$V = E_{b} + i_{a}R_{a}$$
$$120 = 100.53 + i_{a} \times 5$$
$$i_{a} = 3.893 \text{ A}$$

50. In an AM system, for satisfactory operation carrier frequency must be n times the bandwidth of message signal. What is the value of n?

A. > 2	B. > 5

C. > 10 D. > 5	50
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Ans. D
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Sol. Ideally for satisfactory operation, carrier frequency should be 50 times or higher than message bandwidth (B.W)

51. How many relays are used to detect interphase fault of a three line systems?

A. One	B. Two

C. Six	D. three
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Ans. D

- Sol. Number of relays required to protect three lines system are three which are (two over current relay and one earth fault relay).
- 52. Two planes are given by their miller indices as plane 1: [1, 1, $\sqrt{2}$] and plane 2: [1, 2, 2]. The angle between both planes are:

A. 7.83°	B. 13.73°
C. 23.73°	D. 33.73°

Ans. B

Sol. When planes are,

 $P_1 = [h_1 k_1 l_1]$ and

 $P_2 = [h_2 k_2 l_2]$

Then angle between them will be:

$$\cos \theta = \frac{h_1 h_2 + k_1 k_2 + l_1 l_2}{\sqrt{h_1^2 + k_1^2 + l_1^2} \sqrt{h_2^2 + k_2^2 + l_2^2}}$$
$$= \frac{1 \times 1 + 1 \times 2 + 2 \times \sqrt{2}}{\sqrt{1^2 + 1^2} + (\sqrt{2})^2 \sqrt{1^2 + 2^2 + 2^2}}$$
$$\cos \theta = \frac{5.828}{2 \times 3} = 0.971$$
$$\theta = 13.73^{\circ}$$

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53. A three phase AC to DC diode bridge rectifier is supplied from a three phase, 300 V supply. The rectifier supplies a purely resistive load. The average DC current across load when the resistance is 4 Ω .

A. 405.14 A	B. 101.28 A
C. 202.46 A	D. 300.50 A

Ans. B

Sol. The DC output voltage of 3-phase bridge rectifier will be,

$$V_{0} = \frac{3V_{m}}{\pi} = \frac{3 \times 300\sqrt{2}}{\pi} = 405.14 \text{ V}$$
$$I_{0_{arg}} = \frac{V_{0}}{R} = \frac{405.14}{4}$$
$$I_{0_{arg}} = 101.28 \text{ A}$$

54. A digital locker has been created by an individual which is protected by dual password security. First password has been shared to individual and the second password with his family member.

Find the digital operation which expresses the process to unlock the digital locker.

- A. EX-OR operation B. AND operation
- C. OR operation D. NOT operation

Ans. B

Sol. Let the digital locker be defined as function (F) and the password are termed as A and B. To unlock the locker, both A and B passwords has to be entered otherwise it remains locked ie. A=1 B = 1. So, it's truth table is as follows:

А	В	F
0	0	0
0	1	0
1	0	0
1	1	1

 $F = A.B \Rightarrow AND$ gate operation.

55. Which of the following statement is true for both transformer and Induction machine.

- A. Requires less magnetising current (2 6% of rated current)
- B. Primary & secondary frequencies are same
- C. Converts electrical to mechanical energy.
- D. With increase in load, power factor improves.

Ans. D

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- Sol. 1. Induction motor requires more magnetising current (30 50%) of rated current.
 - 2. Stator & rotor frequencies are not same in induction motor.
 - 3. There is no electromechanical conversion in transformer.
- 56. Thermal rays are used for protection of motors against over current swing to.
 - A. Short circuits B. Heavy loads
 - C. Earth fault D. All of these.

Ans. B

Sol. Thermal relay is used to protect motor from increase in temperature in its winding due to heavy loads.

57. Which of the following statement is correct regarding induction motor construction.

- (i) Space harmonics in greater in open slots as compared to closed slots
- (ii) Maintenance is easier in closed slots as compared to open slots
- A. (i) and (ii) B. (i) only

C. (ii) only D. neither (i) nor (ii)

Ans. B

Sol. Space harmonies is greater in open slots because of larger air gap.Maintenance is easier in open slots as compared to closed slots.Hence, statement (i) is correct only.

58. The solution of differential equation $\frac{d^2y}{dx^2} = y$ is

A. $C_1 e^x + C_2 x e^x$	B. $C_1 e^x + C_2 x e^{-x}$
C. $C_1 e^x + C_2 e^{-x}$	D. $C_1 e^x + C_2 e^x$

Ans. C

Sol. Differential equation is,

 $\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} - y = 0$

Auxiliary equation is:

 $m^2 - 1 = 0$

m = ± 1

The solution of differential equation is,

 $Y(x) = C_1 e^x + C_2 e^{-x}$

59. How many nibbles are there in 10-byte data?

- A. 320 nibbles B. 20 nibbles
- C. 40 nibbles D. 80 nibbles

Ans. B

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Sol. As we known,

1 Nibbles = 4 bits

Number of bits in 10-byte data.

 $= 10 \times 8 = 80$ bits

Number of nibbles = $\frac{80}{4}$ = 20 nibbles

60. A chip is made using 12 address lines and 8 data lines. Total number of chips required to make 16kB memory are:

A. 4	B. 8

C. 16 D. 2

Ans. A

Sol. Capacity of chip will be

 $= 2^n \times m$

Where, n is number address lines

m is number of data lines

Capacity of one chip

$$= 2^{12} \times 8$$

= 4 kB

Number of chips required = $\frac{16kB}{4kB} = 4$

61. Main purpose of OCB (oil circuit breaker) is to:

A. Quenching arc B. Providing insulation

C. Provide cooling of contacts D. None of the above

Ans. A

Sol. The main purpose of circuit breaker is to open circuit the line when fault exist. At the time of breaking arc exists between contacts.

Hence, it is used to quench arc at the time of breaking of contacts.

62. $F = \overline{Wxz} + \overline{Wyz} + \overline{xyz} + w\overline{xyz}$ and d = wyz. The minimum no of NAND and NOR gates

required to implement the above function 'F' respectively are _____ and _____.

- A. 4 and 4 B. 4 and 5
- C. 5 and 4 D. 5 and 5

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Ans. A



Sol.



Implementing using NAND gates :

Consider minterms : $F = xz + \overline{x}y$



Minimum number of NAND gates required to implement F is 4.

Implementing using NOR gates :

Consider maxterms : $F = (\overline{x} + z)(x + y)$



Minimum number of NOR gates required to implement F is 4.

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- 63. Which of the following distance relay is used for long transmission line?
 - A. Mho relay

- B. Reactance relay
- C. Impedance relay D. None of the above

Ans. A

Sol. The relay can be expressed as:

Mho relay \rightarrow long transmission line

Reactance relay \rightarrow short transmission line

Impedance relay \rightarrow medium transmission line

64. If in a microprocessor, there are 14 address lines and 8 data lines. The capacity of microprocessor will be:

A. 64kB	B. 128kB
C. 32kB	D. 16kB

Ans. D

- Sol. Addressing capacity of the microprocessor can be calculate as:
 - $= 2^n \times m$ bits

Where, n is number of addressing lines

m is number of data lines

 $= 2^{14} \times 8$ bits

```
= 2^{10} \times 2^4 bytes
```

Capacity = 16kB

- 65. Which one of the following blocks can not be used in an AM super heterodyne receiver?
 - A. RF amplifier B. IF amplifier
 - C. AF amplifier D. Amplitude limiter

Ans. D

- Sol. Amplitude limiter can be used in FM receiver which converts the incoming modulated signal directed into baseband spectrum but not used in AM receiver.
- 66. Which of the following expression is correct corresponding to low slip region in an induction machine?

A. ⁻	Гe	×	R_2
-----------------	----	---	-------

C. $T_e \times R_2^2$

B. $T_e \times \frac{1}{R_2}$ D. T_e is independent of R_2

Ans. B

Sol. The equation of torque can be expressed as:

$$T_{e} = \frac{3}{\omega_{s}} \frac{sV^{2}R_{2}}{R_{2}^{2} + (sX_{2})^{2}}$$

for law slip: $(sX_2)^2 \ll R_2^2$

$$T_e \times \frac{sV^2}{R_2} \Rightarrow T_e \times \frac{1}{R_2}$$

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67.	Which of the following microwave component dielectric, ohmic and radiation losses?	nents has got the combined characteristics of
	A. Wavequide	B. Microstrip line
	C. Co-axial line	D. Parallel twin line
Ans.	В	
Sol.	Microstrip line has all the three losses	
	1). Directric	
	2). Ohmic	
	3). Radiation	
68.	Which of the following is a circularly pola	rized antenna?
	A. Horn	B. Dipole
	C. Helical	D. Pyramidal
Ans.	C	
Sol.	The wide bandwidth, simplicity, highest	directivity and circular polarization of the helical
	beam antenna have made it indispensabl	e for space communication applications.
69.	What is the RST for the TRAP and what is	address of it?
	A. RST 6.5; 0034 H	B. RST 7.5; 004CH
	C. RST 5.5; 002 CH	D. RST 4.5 ; 0024H
Ans.	D	
Sol.	TRAP is a non-maskable, vectored interru - $(4.5 \times 8) = 0.024$ H	pt. It is also called as RST 4.5; and the address
70	A broadcast AM radio transmitter radiate	s 125 kW when the modulation percentage is 70
70.	% How much of this is carrier power?	125 kw when the modulation percentage is 70
	A. ≈ 25.4 kW	B. ≈ 50.4 kW
	C. ≈ 75.4 kW	D. ≈ 100.4 kW
Ans.	D	
Sol.	Given values:	
	$P_t = 125 \text{ kW}$	
	modulation percentage, $m_a = 0.7$	
	Carrier power, P_c can be expressed as:	
	$P_c = \frac{P_t}{1}$	
	$\left(1+\frac{{\mathbf{m}_a}^2}{2}\right)$	

$$P_{c} = \frac{125000}{\left(1 + \frac{(0.7)^{2}}{2}\right)}$$

 $P_c = 100.4 \text{ kW}$

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71. The rotor power output of a 3-phase IM is 12 kW and the corresponding slip is 4%. the rotor ohmic loss will be:

A. 12.5 kW	B. 500 W
C. 1000 W	D. 12 kW

- Ans. B
- Sol. As we known,

 $P_{cu} = s P_g$ (where, P_g is air gap power)

W

$$P_{cu} = \frac{sP_{out}}{(1-s)}$$
$$P_{cu} = \frac{0.04}{0.96} \times 12 = 500$$

72. The RMS current rating of SCR in single phase diode full converter is 333 A. Then average current rating will be:

A. 333 A	B. 369.63 A
C. 300 A	D. 100 A

Ans. C

Sol. As we known

$$(I_{avg})_{rating} = \frac{(I_{RMS})_{rating}}{FF}$$

 $V_{0_{arg}}$

for full converter

$$V_{RMS} = \frac{V_m}{\sqrt{2}}$$
$$V_{Avg} = \frac{2V_m}{\pi}.$$
$$FF = \frac{\frac{V_m}{\sqrt{2}}}{\frac{V_m}{\pi}} = 1.11$$
$$333$$

 $(I_{avg})_{rating} = \overline{1.11} = 300 \text{ A}.$

1

73. The Combinational logic circuit shown is the given figure has an output Q which is



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A. ABC

 $\mathsf{C}. \ \mathsf{A} \oplus \ \mathsf{B} \oplus \ \mathsf{C}$

Ans. B

Sol.



B. A + B + C

D.AB + C

- $Q = \overline{A}\overline{B}C + \overline{A}B.1 + A\overline{B}.1 + AB.1$ $= \overline{A}\overline{B}C + \overline{A}B + A.(\overline{B} + B)$
 - $= \overline{A}\overline{B}C + \overline{A}B + A.1$ = $\overline{A}\overline{B}C + (A + \overline{A}B)$ = $\overline{A}\overline{B}C + (A + B)$ (: $A + \overline{A}B = A + B$)
 - $= \overline{A}\overline{B}C + A + B$
 - $= A + \overline{A}\overline{B}C + B$
 - $= A + B + \overline{B}C$
 - = A + B + C

74. In a memory map of RAM, the lowest and highest address of memory is 1000H and 2FFFH, respectively. The capacity of memory chip be:

- A. 1kB B. 2kB
- C. 4kB D. 8kB

Ans. A

Sol. Highest address of chip can be calculated as:

```
Highest address = Lowest address + Memory + memory of chip - 1

2FFFH = 1000H + Memory of chip - 1

Memory of chip

= [3000 H - 1000 H]

Memory = 2000 H

Converting into decimal:

2000 H \rightarrow 2 × 16<sup>3</sup> + 0 × 16<sup>2</sup> + 0 × 16<sup>1</sup> + 0 × 16<sup>0</sup>

= 2 × 16<sup>3</sup>

= 2 × (2<sup>4</sup>)<sup>3</sup>

= 2<sup>13</sup>

= 2<sup>3</sup> × 2<sup>10</sup> bits

Memory = 1kB
```

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75. The content of accumulator after the execution of following instructions will be

MVI A, B7 H ORA A RAL A. 6E H B. 6F H C. EE H D. EF H Ans. A Sol. A = B7 HORA A: CY = 0, AC = 0RAL: Rotate left with carry A = 6EH76. Consider a 3-phase full wave rectifier. The source is a symmetrical 3-phase four-wire system. The supply frequency is 200 Hz. The ripple frequency of output will be: A. 200 Hz B. 600 Hz C. 1200 Hz D. 33.34 Hz Ans. C Sol. For 3-phase full wave rectifier, there are 6-pulses of output waveform. Ripple frequency, $f_0 = nf_i$ where, n = Number of pulse $f_0 = 6 \times 200 = 1200 \text{ Hz}$ 77. Machine instructions are written using which of the following? A. Bits 0 and 1 only B. Digits 0 to 9 only C. Digits 0 to 9 and capital alphabets A to Z only D. Digits 0 to 9, a capital alphabets A to Z only and certain special characters. Ans. A Sol. Machine instructions are written using 0 and 1 only. 78. The equation $x^3 - x^2 + 4x - 4 = 0$ is to be solved using the Newton-Raphson method. If x = 3 is taken as the initial approximation of the solution, then the next approximation using this method will be. A. 2.46 B. 2.96 C. 4.96 D. 1.96

- Ans. D
- Sol. Formula to solve by newton Raphson method is:

$$X_{n+1} = X_n - \frac{f(X_n)}{f'(X_n)}$$

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$$X_{1} = X_{0} - \frac{f(X_{0})}{f'(X_{0})}$$

$$f(x) = x^{3} - x^{2} + 4x - 4$$

$$f'(x) = 3x^{2} - 2x + 4$$

$$X_{1} = 3 - \frac{(x^{3} - x^{2} + 4x - 4)_{x=3}}{(3x^{2} - 2x + 4)_{x=3}}$$

$$X_{1} = 3 - \frac{26}{25}$$

$$X_{1} = 1.96$$

79. Which of the following conversion of (2F9A)₁₆ is correct?

A. (00101111011010)2
C. (01011111011010)2

B. (0001111110011010)₂
D. (0010111110011010)₂

Ans. D

Sol. Conversion of hexadecimal to binary

2	F	9	Α
\downarrow	\downarrow	\downarrow	\downarrow
0010	1111	1001	1010

```
(2F9A)_{10} = (0010111110011010)_2
```

80. Which of the following method is used to decrease ratio and phase angle error in current transformer?

A. Use of high permeable material

- C. Decreasing primary turns
- B. Use of toroidal core

D. All of the above

Ans. D

Sol. Ratio and phase angle error can be reduced by reducing the magnetic current (I_{\circ}) .

It can be reduced by using

- * High permeable material
- * Use of toroidal core
- * Decreasing primary turn
- 81. In a single-phase DC to AC inverter, using single phase modulation for control of output voltage, harmonics of order n can be eliminated by making the pulse width β .

C. π / n D. π / 2n

Ans. B

Sol. For single pulse modulation, output voltage of single DC to AC inverter will be:

$$V_0 = \sum_{n=1,3,5...}^{\infty} \frac{4Vs}{n\pi} \quad \sin \frac{n\pi}{2} \quad \sin nd \sin(n\omega t)$$

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To eliminate nth harmonic

nd = π

 $d = \pi / n$

But pulse width is 2d,

Hence, pulse width to eliminate n^{th} harmonic = $2\pi\,/\,n$

82. As compared to power factor at starting in 3-phase induction motor, the power factor in running condition will be:

A. Lower than at starting

C. Unity

B. Higher than at startingD. Cannot be determined.

Ans. B

Sol. Power factor of motor;

$$\cos \phi_2 = \frac{R_2}{\sqrt{R_2^2 + (sx_2)^2}}$$

At lower slip, power factor will be better.

At starting, slip will be 1

$$\cos\phi_2 = \frac{R_2}{\sqrt{R_2^2 + x_2^2}}$$

Hence, option B is correct.

83. Fruit salads are served in a restaurant only in certain combination. One choice is either grapes or apples or both. Another choice is either mango and apples or neither. A third choice is grapes, but if you choose grapes, then you must also take bananas. If the fruits are represented by their first alphabet of the name, then the logical expression that specifies the fruit available for desert in the simplified form is,

В

A. A + B			B. M + G
----------	--	--	----------

C. A + G D. M -

```
Ans. C
```

```
Sol. A = apples; B = bananas; M = mango; G = grapes
```

 $1^{\mbox{\scriptsize st}}$ choice- A OR G or both

2nd choice- M and A or neither

3rd choice- G and B

So, the function becomes f(A, B, M, G) = (A + G) + MA + GB

$$= A (1 + M) + G (1 + B)$$

84. The number of input lines in 8085 microprocessor are:

A. 40 B. 27 C. 21 D. 19

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Ans. C

- Sol. In 8085, there are 40 pins out of which 27 pins are output pins, 21 pins are input pins and 8 pins are shared between input and output signals
- 85. In a 220 KV system, the inductance and capacitance up to the circuit breaker locations are 27 mH and 0.3 μ F respectively. The value of resistor required to be connected across breaker contacts which will give no transient oscillation is

C. 600 Ω D. 900 Ω

Ans. A

Sol. Value of resistance required can be expressed as:

$$R_{cb} = \frac{1}{2} \sqrt{\frac{L}{C}}$$

$$R_{cb} = \frac{1}{2} \sqrt{\frac{27 \times 10^{-3}}{0.3 \times 10^{-6}}}$$

$$R_{cb} = 150 \ \Omega$$

86. The solution of differential equation

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{2x} \text{ is}$$

A. $C_1e^{2x} + C_2e^{2x} + \frac{1}{16}e^{2x}$

B. $C_1e^{2x} + C_2xe^{2x} + \frac{1}{16}e^{2x}$

C. $C_1e^{2x} + C_2e^{2x} + 4e^{2x}$

D. $C_1e^{2x} + C_2xe^{2x} + 4e^{2x}$

Ans. B

Sol. For calculating complimentary function,

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$$

Auxiliary equation is:

 $m^{2} - 4m + 4 = 0$ (m - 2)² = 0 m = 2, 2 Hence, C.f will be = C₁e^{2x} + C₂xe^{2x} For calculating particular integral,

$$= \left| \frac{1}{(D-2)^2} e^{2x} \right|_{D \to -2}$$
$$= \frac{1}{16} e^{2x}$$

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Total solution is

$$y(x) = C.f + P.I$$

 $y(x) = C_1 e^{2x} + C_2 x e^{2x} + \frac{1}{16} e^{2x}$

87. A paramagnetic material has a magnetic field intensity of 10⁵Am⁻¹. If the susceptibility of the material at room temperature is 4.2×10^{-4} . The value of magnetisation is:

A. 4.2 × 10 ⁻⁹ Am ⁻¹	B. 42Am ^{−1}
C. 4.2 ×10 ⁻⁴ Am ⁻¹	D. 4.2Am ⁻¹

Ans. B

Sol. As we known,

Susceptibility, $\chi = \frac{M}{H}$ Magnetization, $M = \gamma H$ $M = 4.2 \times 10^{-4} \times 10^{5}$ $M = 42Am^{-1}$

88. Which of the following distance relay have inherently directional characteristic?

A. Mho relay	B. Impedance relay

C. Reactance relay	D. None of the above

Ans. A

- Sol. Mho relay has inherently directional characteristic.
- 89. What will be the value of critical current for a wire of lead having a diameter of 2mm at 5K. The critical temperature for lead is 10K and $H_0 = 5 \times 10^4 Am^{-1}$

A. 3.75 × 10 ⁴ A	B. 235.6A
C. 130A	D. 240.5A

C. 130A

Ans. B

Sol. As we known,

Critical magnetic field, H_c

$$H_{c} = H_{0} \left[1 - \left(\frac{T}{T_{c}} \right)^{2} \right]$$
$$H_{c} = 5 \times 10^{4} \left[1 - \left(\frac{5}{10} \right)^{2} \right]$$

 $H_C = 3.75 \times 10^4 \text{ Am}^{-1}$

Critical current,
$$I_C = 2\pi r H_C$$

$$= 2 \times 3.14 \times \frac{2}{2} \times 10^{-3} \times 3.75 \times 10^{4}$$

 $I_{C} = 235.6A$

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- 90. In a 3-phase induction machine, the speed of rotor magnetic field with respect to stator magnetic field is. (where N_s is synchronous speed and N_r is rotor speed)
 - A. Ns B. sNs
 - C. Nr D. 0
- Ans. D
- Sol. The rotor magnetic field is stationary with respect to stator magnetic field. Hence, option D is correct.
- 91. The switching circuit given below can be expressed in binary logic notation as,



$$C. L = E + (A + B) (C + D)$$

D. L = (AB + CD) E

Ans. A

Sol. The series and parallel connection of switches can be represented in digital operation forms as follow,



Thus, for the given switching circuit the binary logic notation is (A + B). (C + D). E i.e. L = (A + B) (C + D) E

92. Which of the following option is correct where I_f represents sub-transient current, I_f represents transient current and I_f represent steady state current.

A.
$$I_f'' = I_f = I_f$$
B. $I_f'' > I_f > I_f$ C. $I_f'' < I_f < I_f$ D. None of the above

Ans. B

Sol. Sub-transient current is the current which flows at the instant of fault and is maximum. Steady state current is current when all the transients of fault are damped out and it is minimum.

Hence option B is correct.

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93. The particular integral of

 $(D^2 - 4D + 4)y = e^{2x} \cos x \text{ is}$ A. $e^{2x} \sin x$ B. $e^{2x} \cos x$ C. $-e^{2x} \sin x$ D. $-e^{2x} \cos x$

Ans. D

Sol. P.I will be:

$$= \frac{1}{(D-2)^2} e^{2x} \cos x$$
$$= \left[e^{2x} \cdot \frac{1}{(D-2)^2} \cos x \right]_{D \to D+2}$$
$$= e^{2x} \cdot \frac{1}{((D+2)-2)^2} \cos x$$
$$= e^{2x} \cdot \frac{1}{D^2} \cos x$$

 $P.I = -e^{2x} \cos x$ (as $1 / D^2 \cos x$ is double integration of $\cos x$)

94. A half wave diode converter supplies a purely inductive load as shown in figure. The diode will conduct for:



D. 270°

A. 180°

C. 360°

Ans. C

Sol. Diode will start conducting at $\omega t = 0^{\circ}$



$$i = \frac{1}{L} \int v dt = \frac{1}{L} \int V_m \sin \omega t dt$$
$$i = \frac{-1}{\omega L} V_m \cos \omega t + A$$
At, $\omega t = 0^\circ$, $i = 0$

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$$0 = \frac{-V_{m}}{\omega L} + A$$
$$i = \frac{V_{m}}{\omega L}$$

$$i = \frac{V_m}{\omega L} (1 - \cos \omega t)$$

Hence, current will again be zero at

ωt = 360°

Hence, diode conducts for 360°

95. Which of the following load will have better power factor when connected to single pulse rectifier?

A. RL load

C. Both will have same power factor

B. RL with free-wheeling diode

D. Cannot be determined

- Ans. B
- Sol. With RL load

There will exist a negative output pulse by some angle that will cause negative power. With RL load and freewheeling diode,

Negative pulse of output voltage will get clipped and there will be no negative power. Hence, average power in RL with free-wheeling diode will be comparatively higher than RL load.

Hence, p.f will be better in RL with freewheeling diode load.

96. If an FM wave is represented by the equation $e = 10 \sin(9 \times 10^8 t + 4 \sin 1500 t)$, then what is the carrier frequency?

A. 127.32 MHz	B. 150.00 MHz
C. 143.31 MHz	D. 208.00 MHz

Ans. C

Sol. Given that

 $e = 10 \sin(9 \times 10^8 t + 4 \sin 1500 t)$

Compare this that standard FM equation

 $c(t) = A_c \sin\left[2\pi f_c t + \beta \sin 2\pi f_m t\right]$

 $f_c \rightarrow$ carrier frequency

fm message signal

frequency comparing we have

 $2\pi f_c = 9 \times 10^8$

 $f_c = \frac{9 \times 10^8}{2\pi} = 143.3 \, 1 MHz$

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97. By Simpson's one third rule, the value of

$$\int_{0}^{4} \frac{1}{1+x} dx$$
 is (When, n = 4)
A. 2.623
C. 3.623
D. 1.745

Ans. B

Sol. When number of subintervals between (0 to 4) is 4.

h = 1

Simpson, 1/3 rule:

$$\int_{0}^{n} f(x)dx = \frac{h}{3} \Big[(y_{(0)} + y_{(n)}) + 4(y_{1} + y_{3} + ...) + 2(y_{2} + y_{4} + ...) \Big]$$

$$\int_{0}^{4} \frac{1}{1 + x} dx = \frac{h}{3} \Big[(y_{(0)} + y_{(4)}) + 4(y_{(1)} + y_{(3)}) + 2y_{(2)} \Big]$$

$$\int_{0}^{4} \frac{1}{1 + x} dx = \frac{1}{3} \Big[\Big(\frac{1}{1 + 0} + \frac{1}{1 + 4} \Big) + 4 \Big(\frac{1}{1 + 1} + \frac{1}{1 + 3} \Big) + 2 \Big(\frac{1}{1 + 2} \Big) \Big]$$

$$= \frac{1}{3} \Big[1.2 + 3 + 0.67 \Big]$$

$$\int_{0}^{4} \frac{1}{1 + x} dx = 1.623$$

- 98. A 4-bit ripple counter and a 4-bit synchronous (parallel) counter are made using flipflops each with propagation delay of 20ns. If one more flipflop is added and converted them as 5-bit counters, determine the f_{max} for the mod-32 ripple and parallel counters respectively.
 - A. 5GHz, 5GHz B. 10GHz, 10GHz
 - C. 5GHz, 50GHz D. 10GHz, 50GHz

Ans. D

Sol. The f_{max} of the mod-32 ripple counter = $\frac{1}{5 \times 20 \text{ns}} = 10 \text{GHz}$.

The f_{max} of the mod-32 parallel counter = $\frac{1}{20ns}$ = 50GHz. Since in the parallel counters, clock signal is given simultaneously to all the flipflops at a time.

99. Surge current rating of single cycle for SCR is 100 A, then half (1/2) cycle surge current rating will be:

A. 70.71 A	B. 50 A
C. 100 A	D. 141.42 A

Ans. D

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Sol. As we known:

(Surge Current rating)_{1/n} = $\sqrt{n} \times ($ Surge Current rating)₁

$$(I)_{1/2} = \sqrt{2} \times (I)_1 = \sqrt{2} \times 100$$

=141.42 A

100. A fault current 1000 A is passing on the primary side of 400/5 C.T. On the secondary side of C.T, current relay is connected whose plug sitting is 75%. The plug setting multiplier will be:

A. 5	B. 3.34
C. 7.5	D. 6.67

- Ans. B
- Sol. Plug setting multiplier (PSM)

$$\mathsf{PSM} = \frac{\mathbf{1}_{\mathsf{f}}}{\mathsf{pick up current} \times \mathsf{CT Ratio}}$$

Pick up current

= (Secondary side current × plug setting)

$$\mathsf{PSM} = \frac{1000}{3.75 \times \frac{400}{5}}$$

PSM = 3.34

101. The figure shows a black box which is comprised of AND, OR and NOT gates.

The output f(a, b, c) = 1, only when a and c are different otherwise it remains 0.

A necessary condition is given that all the three inputs a, b, c can never have all similar value.

Which one of the following equations to correct design for minimum complexity circuit?



Ans. D

Sol. Truth table when output is to be 1.

а	b	С	f(a, b, c)
			Output
0	Г О	1	1
1	0	0	1
0	آ ا	1	1
1	1	0	1

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Given condition: abc = 000 & abc = 111 are not possible cases.

So, $f(a, b, c) \Rightarrow \overline{a}\overline{b}\overline{c} + a\overline{b}\overline{c} + \overline{a}bc + ab\overline{c}$

 $f(a, b, c) \Rightarrow \overline{a}c \left[b + \overline{b}\right] + a\overline{c}\left[b + \overline{b}\right] \Rightarrow \overline{a}c + a\overline{c} \Rightarrow a \oplus c$

102. Consider a differential equation $\frac{dy(x)}{dx} - 2y(x) = x$ with initial condition y(0) = 0. Using

Euler method with step size of 0.05, the value of y(1) is:

A. 0.5 B. 0

C. 1 D. 0.25

Ans. D

Sol. Differential equation is,

$$\frac{dy(x)}{dx} - 2y(x) = x$$
$$f(x) = \frac{dy(x)}{dx} = 2y + x$$

Euler's method,

Y(0 + h) = y(0) + hf (x(0)), y(0) Y(0.5) = y(0) + hf (0, 0) Y(0.5) = 0 + (0.5)(0 + 2(0)) Y(0.5) = 0 Y(0.5 + h) = y(0.5) + h f(0.5, y(0.5)) $Y(1) = 0 + 0.5 (0.5 + 2 \times 0) = 0.25$

103. The critical field of a material is 10^4 A/m at 10K and 2 × 10^5 A/m at absolute zero temperature. Find the transition temperature of the element.

A. 10K		B. 15K

C. 4.26K			D. 10.26K
----------	--	--	-----------

Ans. D

Sol. Critical field at T = 10K is $H_c = 10^4$ A/m Critical magnetic field at 0K, $H_0 = 2 \times 10^5$ A/m By formula,

$$H_{c} = H_{0} \left[1 - \left(\frac{T}{T_{c}} \right)^{2} \right]$$
$$\frac{10^{4}}{2 \times 10^{5}} = 1 - \left(\frac{T}{T_{e}} \right)^{2}$$
$$0.95 = \left(\frac{T}{T_{c}} \right)^{2}$$

 $T_{c} = 10.26K$

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104. The solution of equation $x \frac{dy}{dx} + y = x^3$ with y(1) = 0 is.

A.
$$\frac{x^3}{4} - 4x$$

B. $\frac{x^2}{4} - \frac{1}{4x}$
C. $\frac{x^3}{4} - \frac{1}{4x}$
D. $\frac{x^2}{4} - \frac{4}{x}$

Ans. C

Sol. The differential equation is

$$x \frac{dy}{dx} + y = x^{3}$$

$$\frac{dy}{dx} + \frac{y}{x} = x^{2}$$
I.F = $e^{\int \frac{1}{x}dx} = e^{\ln x} = x$
Solution will be:
 $y \times I.f = \int I.F \times x^{2}dx$
 $y \times x = \int x \times x^{2}dx$
 $yx = \frac{x^{4}}{4} + C$
 $y = \frac{x^{3}}{4} + \frac{C}{x}$
At x = 1, y = 0

 $\mathsf{C}=-\frac{1}{4}$

Hence the solution will be,

$$\rightarrow$$
 y(x) = $\frac{x^3}{4} - \frac{1}{4x}$

105. A certain 8-bit successive-approximation converter has 2.65 V full scale. The conversion time for $V_A = 1.5$ V is 75 µs. Find the conversion time for $V_A = 2V$.

A. 75 μs	B. 100 μs

Ans. A

Sol. The total conversion time for an N-bit successive approximation type ADC will be N-clock cycles. The conversion time will be same regardless of the value of V_A. This is because the control logic has to process each bit to see whether a 1 is needed or not. Hence, the conversion time for V_A = 2V and for V_A = 1.5 V will be same and is 75 μ sec.

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- 106. The most common type of fault is:
 - A. Single phase to ground
 - C. Two phase to ground

- B. Phase to phase
- D. Three phase to ground

Ans. A

Sol. The list of fault with occurrence of fault decreasing from left to right is:

 $SLG \rightarrow L-L \rightarrow L-L-G \rightarrow L-L-L-G$

Hence, option A is correct.

107. If the value of latching current of SCR is 100 A. Then which of the following could be the value of holding current.

A. 120 A	B. 150 A
C. 200 A	D. 80 A

Ans. D

Sol. The value of holding current of SCR is always lesser than the latching current. From the given options, only option D has the lower value than 100 A. Hence, option D is correct.

108. If a device is passive and contains no isotropic elements, then the device is _____ network.

A. Reciprocal	B. Non – Reciprocal
---------------	---------------------

C. Lossless D. Lossy

Ans. A

Sol. When device is passive and having no isotropic elements, and when input and output ports are interchanged the power delivered remains the same.

- 109. Si, Ge, diamond are examples of
 - A. Paramagnetic material B. Ferromagnetic material
 - C. Diamagnetic material
- D. Antiferromagnetic material
- Ans. C
- Sol. Silicon, Germanium, diamond are examples of diamagnetic material.
- 110. Induction generator works on:
 - A. Lagging power factor B. Leading power factor
 - C. Unity power factor D. Cannot be determined
- Ans. B
- Sol. As induction generator supplies active to bus but draws reactive power from bus for magnetization. Hence, it works on leading power factor.
- 111. In microwave communication systems, sometimes, the same frequency is used by separation of signals through vertical and horizontal polarizations. This technique is generally called

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B. variable frequency modulation technique

D. frequency re-uses technique

- A. steady frequency multiplexing
- C. frequency reconditioning technique

Ans. D

- Sol. By definition the technique used is frequency reuse-technique.
- 112. The magnetic field require to reduce the residual magnetization to zero is called
 - A. Retentivity B. Coercivity
 - C. Hysteresis D. Saturation magnetization

Ans. B

Sol. Magnetic field required (applied) in reverse direction to reduce residual magnetization (spontaneous magnetization) is called coercive magnetic field and this phenomenon is called coercivity.

113. A step-up chopper has input voltage of 300 V and output voltage of 900 V. If the conducting time of chopper is 50 µsec. then pulse width of output voltage is

- A. 50 μsec B. 25 μsec
- С. 100 µsec D. 150 µsec

Sol. For step up chopper,

$$V_0 = \frac{V_{in}}{1 - \alpha}$$

$$1 - \alpha = \frac{V_{in}}{V_0} = \frac{300}{900} = \frac{1}{3}$$

$$\alpha = \frac{2}{3}$$
As, Ton = \propto T

 $T_{OFF} = (1 - \alpha)T$

Pulse width = TOFF

$$\frac{T_{OFF}}{T_{ON}} = \frac{1-\alpha}{\alpha} = \frac{1/3}{2/3}$$

⇒ Toff = 25 µsec

- 114. Which of the following is not a benefit of speech-processing circuits in an AM transmitter?
 - A. Improved frequency stability
 - B. Increase average output power
 - C. Prevention of excessive signal band width
 - D. Prevention of over modulation

Ans. A

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Sol. Speech Processing circuits in AM transmit are used for,

- Prevention of over modulation
- Prevention of excessive signal band width
- Increasing the average transmitted power.

115. Newton Raphson method is used to compute roots of equation $x^3 - 5 = 0$ with 1.5 as initial value. The approximate after one interaction is:

- A. 2.7407 B. 1.7407
- C. 1.3403 D. 2.3403

Ans. B

Sol. Newton Raphson formula,

$$X_{1} = X_{0} - \frac{f(X_{0})}{f'(X_{1})}$$

$$f(1.5) = (1.5)^{3} - 5 = -1.625$$

$$f'(1.5) = 3(1.5)^{2} = 6.75$$

$$X_{1} = 1.5 - \frac{(-1.625)}{(6.75)}$$

$$x_{1} = 1.7407$$

116. What will be the conversion of $(6327)_8$ into its equivalent decimal number.

A. (3280)10	B. (3287) ₁₀
C. (4280)10	D. (4287) ₁₀

```
Ans. B
```

Sol. Conversion of octal number into decimal number will be:

$$(6327)_8 = 6 \times 8^3 + 3 \times 8^2 + 2 \times 8^1 + 7 \times 8^0$$

= 3072 + 192 + 16 + 7

 $(6327)_8 = (3287)_{10}$

- 117. Which relay is used to detect and protect internal faults in a transformer?
 - A. Directional relay B. Distance relay
 - C. Thermal relay D. Buchholz relay
- Ans. D
- Sol. Buchholz relay is used to protect transformer from its internal faults.

```
118. Consider X = (78)<sub>a</sub> where 'a' is the base of the number system. If \sqrt{X} = 8, then base 'b'
```

A. 7	B. 8
C. 9	D. 6

Ans. B

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Sol. Decimal value of X will be:

$$\sqrt{x} = 8$$

(X)₁₀ = 64
Hence, (78)_a = 64
Converting (78)_a into decimal value:
7 x a¹ + 8 x a⁰ = 64
7a + 8 = 64
a = 8

119. What is the atomic packing factor of face-centred cubic (FCC) structure.

A. 0.6801	B. 0.57
C. 0.7404	D. 0.7101

Ans. C

Sol. Single face of FCC structure will look like:



 $a^{2} + a^{2} = (4R)^{2}$ $2a^{2} = 16R^{2}$

Total number of atoms per unit cell of FCC are 4.

$$APF = \frac{4 \times \frac{4}{3} \times \pi \times R^3}{a^3} = \frac{16}{3} \frac{\left(\pi \times R^3\right)}{\left(2\sqrt{2}R\right)^3}$$

APF = 0.7404

120. In a power circuit of 5KV, 6 thyristors each of rating 900 V are connected in series. What is the percentage series dreading factor?

A. 92.59 %	B. 7.4 %
C. 50 %	D.6%

Ans. B

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Total Voltage

Sol. Efficiency= Number of thyristors × Rating of each thyristor

$$=\frac{5000}{6 \times 900} = 0.9259$$

% Derating Factor = (1.n) × 100
= (1 - 0.9259) × 100
= 7.4 %

121. To eliminate the 5th harmonic contact in distributed winding of a 3-phase induction. The phase spread must be:

A. 36°	B. 18°
C. 72°	D. 134º

Ans. C

Sol. Distributed factor is;

$$K_{d} = \frac{\sin \frac{n \text{ phase spread}}{2}}{\frac{n \text{ phase spread}}{2}}$$

For K_d = 0, for n = 5
 $\frac{5 \text{ phase spread}}{2} = 180^{\circ}$

Phase spread = $\frac{360}{5}$ = 72°

122. In a single pulse width modulation technique, when the conduction angle of output voltage in DC to AC converter is 120°, then RMS value of 3rd harmonic component of output voltage will be.

A. 0.78 V		B. 1.10 V
C. 0 V		D. 1.27 V

Ans. C

Sol. Output voltage will be:

$$V_0 = \sum_{n=1,3,5...}^{\infty} \frac{4V_s}{n\pi} \quad \sin \frac{n\pi}{2} \quad \sin nd \sin(n\omega t)$$



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$$\begin{split} d &= \frac{120^{\circ}}{2} = 60^{\circ} \\ \text{For } 3^{\text{rd}} \text{ harmonic, } n &= 3. \\ V_{0_3} &= \sum_{n=1,3,5...}^{\infty} \frac{4V_s}{3\pi} \quad \sin \frac{3\pi}{2} \quad \sin 3 \times 60^{\circ} \\ V_{0_3} &= 0 \text{ V} \end{split}$$

123. A 3-phase IM connected in star takes 60 A as starting current (short circuit current). When connected in data, the motor will take from supply mains a current of

C.
$$60\sqrt{3}$$
 A D. 180 A

Ans. B

Sol. As we known,

Current from main supply at the time of star-delta starter is

$$=\frac{\text{Short circuit current}}{3}$$

124. In a single-phase inverter with RLC load, self-commutation of thyristor will be possible only if:

A.
$$\frac{1}{LC} = \left(\frac{R}{2L}\right)^2$$

B. $\frac{1}{LC} < \left(\frac{R}{2L}\right)^2$
C. $\frac{1}{LC} > \left(\frac{R}{2L}\right)^2$
D. Irrespective of the values of R, L and C

Ans. C

Sol. For self-commutation of thyristor in RLC load, the current response must be under damped Condition for under damped:

$$\left(\frac{R}{2L}\right)^2 < \frac{1}{LC}.$$

125. The reflection coefficient of 2 port network is 0.5, the return loss in the network is

A. 6.5 dB	B. 0.15 dB
C. 6.02 dB	D. 10 dB

Ans. C

Sol. reflection coefficient, $\Gamma = 0.5$

Return loss = $-20 \log (\Gamma)$

= 6.02 dB

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