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The following details **MUST** be filled by the candidate:

Application ID	
Reservation category	
Candidate's name	
Post applied for	Executive Engineer (Civil/ Electrical)
Mobile number	
Date of written test	19.02.2021
Signature of candidate	
Signature of invigilator	

Instructions:

1. Candidate is required to return this question booklet to the invigilator before leaving the hall.
2. This question paper contains 50 questions related to Electrical Engineering. Each question carries 1 mark. There is no negative marking.
3. The written test duration is 2 hours.
4. Candidate is required to write his/her choice (e.g., A or B or C or D) in the answer sheet given separately. Inappropriate actions such as writing more than one choice, writing the choice in an ambiguous manner, overwriting, cutting, etc. will be awarded 0 mark corresponding to that question.

1. Nullity of the matrix $A = \begin{bmatrix} -1 & 4 & 2 \\ 1 & 3 & 2 \\ -2 & 1 & 0 \\ 2 & 6 & 4 \end{bmatrix}$ is

- (A) 1 (B) 2 (C) 3 (D) 4

2. The value of $\lim_{\theta \rightarrow \pi/2} \frac{\cot \theta}{\left(\frac{\pi}{2} - \theta\right)}$ is

- (A) 1 (B) 2 (C) 0 (D) $\frac{1}{2}$

3. A fair coin is tossed three times in succession. If the first toss produces a tail, then the probability of getting exactly two tails in three tosses is

- (A) $\frac{1}{8}$ (B) $\frac{1}{2}$ (C) $\frac{3}{8}$ (D) $\frac{3}{4}$

4. Evaluate the following integral using residue theorem $\int_C \frac{1+z}{z(2-z)} dz$ where C is the circle $|z| = 1$

- (A) $\frac{3}{4}$ (B) $\frac{1}{8}$ (C) $\frac{1}{2}$ (D) 0

5. Consider $\vec{A} = 3\hat{a}_x + 4\hat{a}_y$ and $\vec{B} = 7\hat{a}_y - 2\hat{a}_z$. The smaller angle between two vectors $\vec{A}$ and $\vec{B}$ will be

- (A) 39.72° (B) 27.93° (C) 41.9° (D) 19.4°

6. A spherical shell has a radius $r = 0.05m$. What will be the value of current crossing the shell, if $\vec{j} = 10^3 \sin \theta \hat{a}_r A/m^2$?

- (A) $2\pi A$ (B) $1.6\pi A$ (C) $7.2\pi A$ (D) $2.5\pi^2 A$

7. In the circuit of the Fig. 1, bulb A uses 48 W when lit, bulb B uses 22 W when lit and bulb C uses 14.4 W when lit. The additional bulb in parallel to the circuit, that would be required below

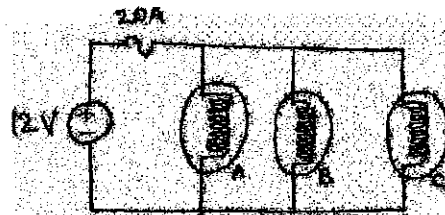


Fig. 1

- (A) 4 (B) 5 (C) 6 (D) 7

8. In the Fig. 2, the value of resistance R in Ω

- (A) 10 (B) 20 (C) 30 (D) 40

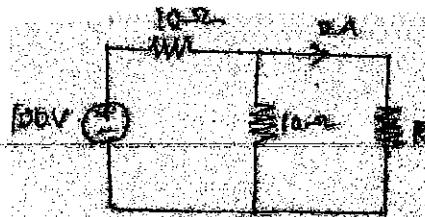


Fig. 2

9. Two AC sources feed a common variable resistive load as shown in the given Fig. 3. Under the maximum power transfer condition, the power absorbed by the load resistance R_L is

- (A) 2200 W (B) 1250 W (C) 1000 W (D) 621 W

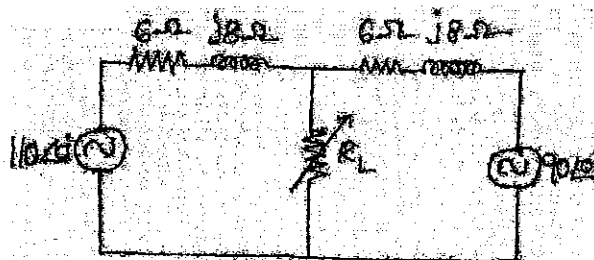


Fig. 3

10. A single phase energy meter is operated on 240 V, 50 Hz supply with a load of 25 A for a 2 h at UPF. The meter makes 1500 revolution in that period the meter constant is

- (A) 0.125 rev/kW-h (B) 750 rev/kW-h (C) 125 rev/kW-h (D) 1/25 rev/kW-h

11. A CRO probe has an impedance of 500 kΩ in parallel with a capacitance of 10 pF. The probe is used to measure the voltage between P and Q as shown in Fig.4. The measured voltage will be

- (A) 3.53 V (B) 4.37 V (C) 4.54 V (D) 5.00 V

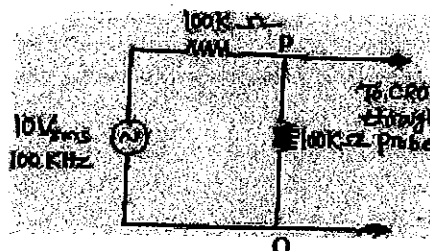


Fig.4

12. In a dual slope integrating type digital voltmeter, the first integrating is carried out for 10 periods of the supply frequency of 50 Hz. If the reference voltage used is 2 V, the total conversion time for an input of 1 V is

- (A) 0.01 s (B) 0.05 s (C) 0.1 s (D) 1 s

13. The minimum number of wattmeter(s) required to measure 3-phase, 3-wire balanced or unbalanced power, if the common point is located one of the line is

- (A) 1 (B) 4 (C) 3 (D) 2

14. The MOSFET switch in its on state may be considered equivalent to

- (A) Inductor (B) Battery (C) Capacitor (D) Resistor

15. Which oscillator is characterized by a split capacitor in its tank circuits

- (A) RC phase shift oscillator (B) Colpitts oscillator
(C) Wien bridge oscillator (D) None of the above

16. In the voltage regulator circuit shown in Fig.5, the power rating of Zener diode is 400 mW. The value of R_L that will establish maximum power in Zener diode is

- (A) 5 kΩ (B) 8 kΩ (C) 10 kΩ (D) 2 kΩ

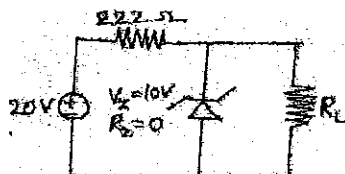


Fig.5

17. For the op-amp circuit shown in the Fig.6., V_0 is

- (A) -2 V (B) -1 V (C) -0.5 V (D) 0.5 V

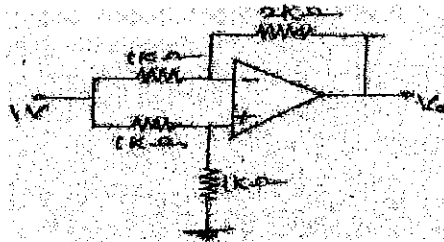


Fig.6

18. A memory system of size 16k bytes is required to be designed using memory chips which have 12 address lines and 4 data lines each. Then, the number of such chips required to design the memory system is

- (A) 16 (B) 8 (C) 4 (D) 2

19. Number of comparator required to build a 5-bit analog to digital type converter

- (A) 5 (B) 11 (C) 31 (D) 21

20. To implement full adder using 8:1 MUX the number of 8:1 MUX required is/are

- (A) 4 (B) 2 (C) 1 (D) 3

21. How many classes of insulating materials are there

- (A) 6 (B) 5 (C) 8 (D) 7

22. The magnetization and applied field in ferromagnetic materials are related

- (A) Sinusoidal (B) Non linearly (C) Linearly (D) Parabolically

23. DNS internet technology stands for

- (A) Distributed Name System (B) Data Name System
(C) Dynamic Name System (D) Domain Name System

24. Where is computer's BIOS stored

- (A) DRAM (B) Flash (C) SRAM (D) EEPROM

25. For given equation find Z transform $y(k) + 2y(k-1) + y(k-2) = u(k)$

- (A) $\frac{z}{1+2z^{-1}+z^{-2}}$ (B) $\frac{z}{(1+z)^2}$ (C) $\frac{z^2}{(1+z)^2}$ (D) $\frac{z^2}{1+z}$

26. A band-limited signal with a maximum frequency of 5 kHz is to be sampled. According to the sampling theorem, the sampling frequency in kHz which is not valid is

- (A) 5 (B) 12 (C) 15 (D) 20

27. Find the signal power of $x(t)$ with the help of following Fig.7:

- (A) 0.25 W (B) 0.75 W
(C) 0.5 W (D) None of these



Fig.7

28. For the system shown in Fig.8, the transfer function $\frac{C(s)}{K(s)}$ is equal to

- (A) $\frac{10}{s^2+s+10}$ (B) $\frac{10}{s^2+11s+10}$ (C) $\frac{10}{s^2+9s+10}$ (D) $\frac{10}{s^2+2s+10}$

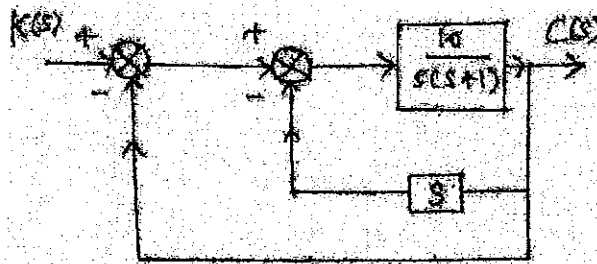


Fig.8

29. For type 1 system with parabolic input, the steady state error is

- (A) Zero (B) Finite constant (C) Infinite (D) Indeterminate

30. The system shown in the Fig.9 is

- (A) Stable (B) Unstable
(C) Conditionally stable (D) Stable for input u_1 , but unstable for input u_2

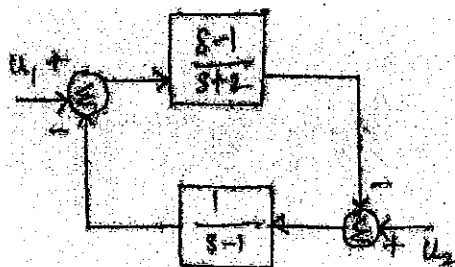


Fig.9

31. The system model described by the state equation

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; Y = [1 \quad 1]x \text{ is}$$

- (A) Controllable and Observable (B) Controllable and not observable
(C) Observable but not Controllable (D) Neither controllable nor Observable

32. Match List I with List II and select the correct answer

List-I
(Controllers)

List-II
(Characteristics)

- | | |
|------------------|---------------------------------------|
| P. PD | 1. Increases order and type of system |
| Q. PI | 2. Improves time response |
| R. PID | 3. Increases damping ratio |
| S. Rate Feedback | 4. Minor loop compensation |

Codes

- | | P | Q | R | S |
|-----|---|---|---|---|
| (A) | 2 | 1 | 3 | 4 |
| (B) | 4 | 2 | 3 | 1 |
| (C) | 4 | 3 | 1 | 2 |
| (D) | 3 | 1 | 2 | 4 |

33. In a constant voltage transformer (CVT), the output voltage remains constant due to

- (A) Capacitor (B) Input Inductor (C) Saturation (D) Tapped winding

34. Neglecting all losses, the developed torque (T) of a DC separately excited motor, operating under constant terminal voltage, is related to its output power (P) as under

- (A) $T \propto \sqrt{P}$ (B) $T \propto P$ (C) $T^2 \propto P^2$ (D) T is independent of P

35. If 400 V, 50 Hz, star connected, 3-phase squirrel cage induction motor is operated from a 400 V, 75 Hz supply, the torque that the motor can now provide while drawing rated current from the supply

- (A) Reduces (B) Increases
(C) Remains the same (D) Increase or reduces, depending upon the rotor resistance

36. A 350 MW 3-phase Y-connected synchronous generator has a rated voltage of 18.2 kV at 0.85 pf. The line current when operating at full load rated conditions will be

- (A) 13.99 kA (B) 13.06 kA (C) 23.25 kA (D) 23.99 kA

37. A 3-phase, 3-stack, variable reluctance step motor has 20 poles on each rotor and stator stack. The step angle of this step motor is

- (A) 3° (B) 18° (C) 9° (D) 6°

38. A 100 kVA, 420 V (line) star -connected synchronous machine generates rated open circuit voltage of 420 V at a field current of 12 A. The short-circuit armature current at a field current of 9 A is equal to the rated armature current. The per unit saturated synchronous reactance is.

- (A) 1.764 (B) 1.701 (C) 1.923 (D) 1.976

39. An industrial consumer has a daily load pattern of 2000 kW, 0.8 lag for 12 h and 1000kW at UPF for 12 h. The load factor is

- (A) 0.65 (B) 0.5 (C) 0.69 (D) 2.0

40. A sample power system network is shown in Fig.10 the reactance marked are in per unit. The per unit value of Y_{22} of the Bus Admittance Matrix Y_{bus} is

- (A) $j10.0$ (B) $j0.4$ (C) $-j0.1$ (D) $-j20.0$

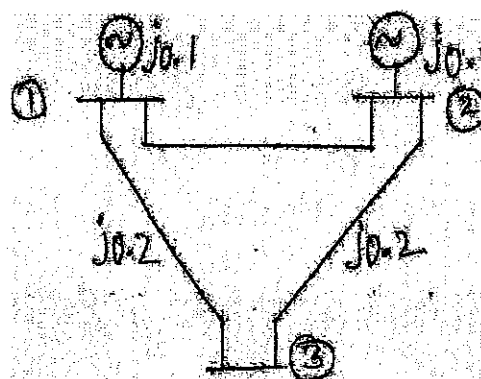


Fig.10

41. In the protection of transformers, harmonic restraint is used to guard against

- (A) Magnetising inrush current (B) Unbalanced operation
(C) Lightning (D) Switching over-voltage

42. A round rotor generator with internal voltage $E_1 = 1.7$ pu and $X = 1.0$ pu is connected to a round rotor synchronous motor with internal voltage $E_2 = 1.2$ pu and $X = 1.1$ pu. The reactance of the line connecting generator to the motor is 0.5 pu. When the generator supplies 0.3 pu power, the rotor angle difference between the machine will be

- (A) 57.42° (B) 51.68° (C) 32.58° (D) 33.25°

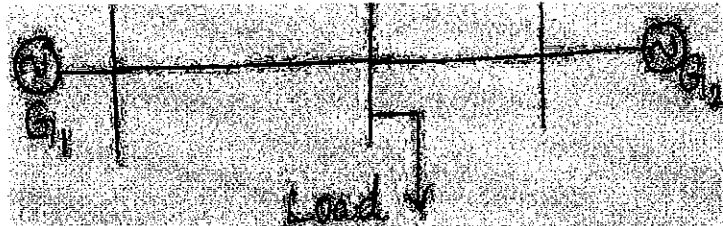
43. Bulk power transmission over long HVDC lines are preferred, on account of

- (A) Low cost HVDC terminals (B) No harmonic problems
(C) Minimum line power loss (D) Simple protection

44. The main objective of series compensation is

- (A) It improves the power factor (B) It reduces the fault current
(C) Reduces the voltage drop over long distance (D) None

45. A load center is at an equidistant from the two thermal generating stations G_1 and G_2 as shown in Figure 11. The fuel cost characteristics of the generating stations are given by



$$F_1 = a + bP_1 + cP_1^2 \text{ Rs/h} : F_2 = a + bP_2 + 2cP_2^2 \text{ Rs/h}$$

Fig.11

Where P_1 and P_2 are the generation in MW of G_1 and G_2 respectively. For most economic generation to meet 300 MW of load P_1 and P_2 , respectively are

- (A) 150, 150 (B) 200, 100 (C) 175, 125 (D) 100, 200

46. The conduction losses versus device current characteristics of a power MOSFET is best approximated by a/an

- (A) Parabola (B) Straight line (C) Rectangular hyperbola (D) Exponentially decaying function

47. A 3-phase fully controlled thyristor bridge converter is used as line commutated inverter to feed 25 kW power 415 V DC to a 3-phase, 410 V (line), 50 Hz AC mains. Consider DC line current to be constant. The rms current of the thyristor is.

- (A) 36.29 A (B) 39.25 A (C) 34.78 A (D) 40.25 A

48. A step down chopper is operated in the continuous conduction mode in steady state with a constant duty ratio D . If V_o is the magnitude of the DC output voltage and if V_s is the magnitude of the DC input voltage, the ratio $\frac{V_o}{V_s}$ is given by

- (A) $\frac{D}{1-D}$ (B) $1-D$ (C) $\frac{1}{1-D}$ (D) D

49. An AC induction motor is used for a speed control application. It is driven from an inverter with a constant V/f control. The motor name plate details are as follows:

$V = 415 \text{ V}$, $P_h = 3$, $f = 50 \text{ Hz}$, $N = 2850 \text{ rpm}$

The motor is run with the inverter output frequency set at 40 Hz and with half the rated slip. The running speed of the motor is.

- (A) 2400 rpm (B) 2280 rpm (C) 2340 rpm (D) 2790 rpm

50. Which semiconductor power device out of the following is not a current triggered device

- (A) Thyristor (B) GTO (C) TRIAC (D) MOSFET

Executive Engineer (Electrical)

KEY

1.A	11.B	21.D	31.A	41.A
2.A	12.C	22.B	32.D	42.B
3.B	13.D	23.D	33.A	43.C
4.C	14.C	24.B	34.B	44.C
5.A	15.B	25.C	35.A	45.B
6.D	16.D	26.A	36.B	46.A
7.A	17.C	27.C	37.D	47.C
8.B	18.B	28.B	38.A	48.D
9.D	19.C	29.C	39.A	49.C
10.C	20.B	30.D	40.D	50.D

