EE : ELECTRICAL ENGINEERING

Duration: Three Hours *Maximum Marks*: 100

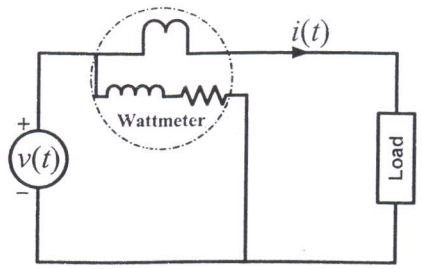
Read the following instructions carefully.

1. Do not open the seal of the Question Booklet until you are asked to do so by the invigilator.
2. Take out the **O**ptical **R**esponse Sheet (**ORS**) from this Question Booklet **without breaking the seal** and read the instructions printed on the **ORS** carefully. If you find that the Question Booklet Code printed at the right hand top corner of this page does not match with the Booklet Code on the **ORS**, exchange the booklet immediately with a new sealed Question Booklet.
3. On the right half of the **ORS,** using ONLY a **black ink ball point pen**, (i) darken the bubble corresponding to your test paper code and the appropriate bubble under each digit of your registration number and (ii) write your registration number, your name and name of the examination centre and put your signature at the specified location.
4. This Question Booklet contains **20** pages including blank pages for rough work. After you are permitted to open the seal, please check all pages and report discrepancies, if any, to the invigilator.
5. There are a total of 65 questions carrying 100 marks. All these questions are of objective type. Each question has only **one** correct answer. Questions must be answered on the left hand side of the **ORS** by darkening the appropriate bubble (marked A, B, C, D) using ONLY a **black ink ball point pen** against the question number. **For each question darken the bubble of the correct answer**. More than one answer bubbled against a question will be treated as an incorrect response.
6. Since bubbles darkened by the black ink ball point pen **cannot** be erased, candidates should darken the bubbles in the **ORS very carefully**.
7. Questions Q.1 – Q.25 carry 1 mark each. Questions Q.26 – Q.55 carry 2 marks each. The 2 marks questions include two pairs of common data questions and two pairs of linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is unattempted, then the answer to the second question in the pair will not be evaluated.
8. Questions Q.56 – Q.65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.56 – Q.60 carry 1 mark each, and questions Q.61 – Q.65 carry 2 marks each.
9. Unattempted questions will result in zero mark and wrong answers will result in **NEGATIVE** marks. For all 1 mark questions, ⅓ mark will be deducted for each wrong answer. For all 2 marks questions, ⅔ mark will be deducted for each wrong answer. However, in the case of the linked answer question pair, there will be negative marks only for wrong answer to the first question and no negative marks for wrong answer to the second question.
10. Calculator is allowed whereas charts, graph sheets or tables are **NOT** allowed in the examination hall.
11. Rough work can be done on the question paper itself. Blank pages are provided at the end of the question paper for rough work.
12. Before the start of the examination, write your name and registration number in the space provided below using a black ink ball point pen.

Name	KRISHNA JAYADEV VEDALA							
Registration Number	EE	1	2	0	8	0	7	6

Q. 1 – Q. 25 carry one mark each.

Q.1 For the circuit shown in the figure, the voltage and current expressions are $v(t) = E_1 \sin(\omega t) + E_3 \sin(3\omega t)$ and $i(t) = I_1 \sin(\omega t - \phi_1) + I_3 \sin(3\omega t - \phi_3) + I_5 \sin(5\omega t)$. The average power measured by the Wattmeter is



(A) $\frac{1}{2}E_1 I_1 \cos\phi_1$

(B) $\frac{1}{2}[E_1 I_1 \cos\phi_1 + E_1 I_3 \cos\phi_3 + E_1 I_5]$

(C) $\frac{1}{2}[E_1 I_1 \cos\phi_1 + E_3 I_3 \cos\phi_3]$

(D) $\frac{1}{2}[E_1 I_1 \cos\phi_1 + E_3 I_1 \cos\phi_1]$

Q.2 The typical ratio of latching current to holding current in a 20 A thyristor is

(A) 5.0
(B) 2.0
(C) 1.0
(D) 0.5

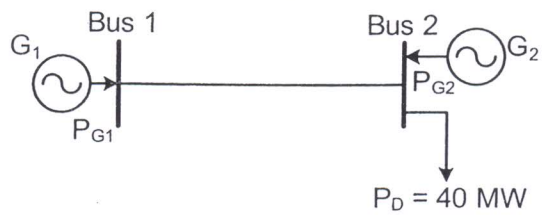
Q.3 A half-controlled single-phase bridge rectifier is supplying an R-L load. It is operated at a firing angle α and the load current is continuous. The fraction of cycle that the freewheeling diode conducts is

(A) $1/2$ (B) $\left(1 - \alpha/\pi\right)$ (C) $\alpha/2\pi$ (D) α/π

Q.4 The sequence components of the fault current are as follows: $I_{positive}$ = j1.5 pu, $I_{negative}$ = –j0.5 pu, I_{zero} = –j1 pu. The type of fault in the system is

(A) LG (B) LL (C) LLG (D) LLLG

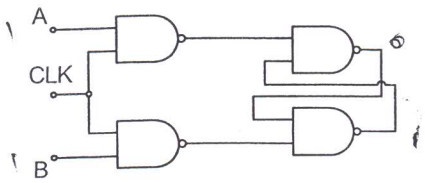
Q.5 The figure shows a two-generator system supplying a load of P_D = 40 MW, connected at bus 2.



The fuel cost of generators G_1 and G_2 are :
$C_1(P_{G1}) = 10{,}000$ Rs/MWh and $C_2(P_{G2}) = 12{,}500$ Rs/MWh
and the loss in the line is $P_{loss(pu)} = 0.5\, P^2_{G1(pu)}$, where the loss coefficient is specified in pu on a 100 MVA base. The most economic power generation schedule in MW is

(A) $P_{G1} = 20,\ P_{G2} = 22$
(B) $P_{G1} = 22,\ P_{G2} = 20$
(C) $P_{G1} = 20,\ P_{G2} = 20$
(D) $P_{G1} = 0,\ P_{G2} = 40$

Q.6 Consider the given circuit.



In this circuit, the race around

(A) does not occur
(B) occurs when CLK = 0
(C) occurs when CLK = 1 and A = B = 1
(D) occurs when CLK = 1 and A = B = 0

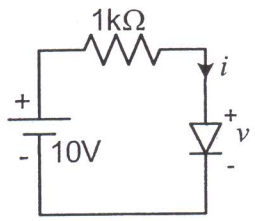
Q.7 The output Y of a 2-bit comparator is logic 1 whenever the 2-bit input A is greater than the 2-bit input B. The number of combinations for which the output is logic 1, is

(A) 4 (B) 6 (C) 8 (D) 10

Q.8 The i-v characteristics of the diode in the circuit given below are

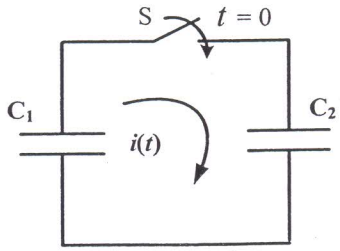
$$i = \begin{cases} \dfrac{v-0.7}{500}\text{A}, & v \geq 0.7\text{ V} \\ 0\text{ A}, & v < 0.7\text{ V} \end{cases}$$

The current in the circuit is



(A) 10 mA (B) 9.3 mA (C) 6.67 mA (D) 6.2 mA

Q.9 In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charged to 12 V before the ideal switch S is closed at $t = 0$. The current $i(t)$ for all t is



(A) zero
(B) a step function
(C) an exponentially decaying function
(D) an impulse function

Q.10 The average power delivered to an impedance $(4 - j3)\ \Omega$ by a current $5\cos(100\pi t + 100)$ A is

(A) 44.2 W (B) 50 W (C) 62.5 W (D) 125 W

Q.11 The unilateral Laplace transform of $f(t)$ is $\dfrac{1}{s^2+s+1}$. The unilateral Laplace transform of $t\,f(t)$ is

(A) $-\dfrac{s}{(s^2+s+1)^2}$
(B) $-\dfrac{2s+1}{(s^2+s+1)^2}$
(C) $\dfrac{s}{(s^2+s+1)^2}$
(D) $\dfrac{2s+1}{(s^2+s+1)^2}$

Q.12 With initial condition $x(1) = 0.5$, the solution of the differential equation

$t\frac{dx}{dt} + x = t$ is

(A) $x = t - \frac{1}{2}$ (B) $x = t^2 - \frac{1}{2}$ (C) $x = \frac{t^2}{2}$ (D) $x = \frac{t}{2}$

Q.13 A two-phase load draws the following phase currents: $i_1(t) = I_m \sin(\omega t - \phi_1)$, $i_2(t) = I_m \cos(\omega t - \phi_2)$. These currents are balanced if ϕ_1 is equal to

(A) $-\phi_2$ (B) ϕ_2 (C) $(\pi/2 - \phi_2)$ (D) $(\pi/2 + \phi_2)$

Q.14 The slip of an induction motor normally does not depend on

(A) rotor speed
(B) synchronous speed
(C) shaft torque
(D) core-loss component

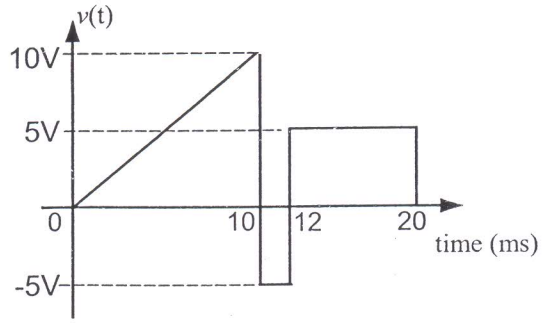
Q.15 The bus admittance matrix of a three-bus three-line system is

$$Y = j\begin{bmatrix} -13 & 10 & 5 \\ 10 & -18 & 10 \\ 5 & 10 & -13 \end{bmatrix}$$

If each transmission line between the two buses is represented by an equivalent π–network, the magnitude of the shunt susceptance of the line connecting bus 1 and 2 is

(A) 4 (B) 2 (C) 1 (D) 0

Q.16 A periodic voltage waveform observed on an oscilloscope across a load is shown. A permanent magnet moving coil (PMMC) meter connected across the same load reads



(A) 4 V (B) 5 V (C) 8 V (D) 10 V

Q.17 If $x[n] = (1/3)^{|n|} - (1/2)^n u[n]$, then the region of convergence (ROC) of its Z-transform in the Z-plane will be

(A) $\frac{1}{3} < |z| < 3$ (B) $\frac{1}{3} < |z| < \frac{1}{2}$ (C) $\frac{1}{2} < |z| < 3$ (D) $\frac{1}{3} < |z|$

Q.18 A system with transfer function

$$G(s)=\frac{(s^2+9)(s+2)}{(s+1)(s+3)(s+4)}$$

is excited by $\sin(\omega t)$. The steady-state output of the system is zero at

(A) $\omega = 1$ rad/s (B) $\omega = 2$ rad/s
(C) $\omega = 3$ rad/s (D) $\omega = 4$ rad/s

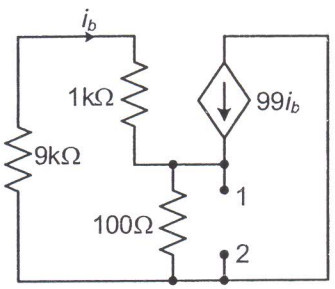
Q.19 The bridge method commonly used for finding mutual inductance is

(A) Heaviside Campbell bridge (B) Schering bridge
(C) De Sauty bridge (D) Wien bridge

Q.20 In the sum of products function $f(X, Y, Z)=\sum(2, 3, 4, 5)$, the prime implicants are

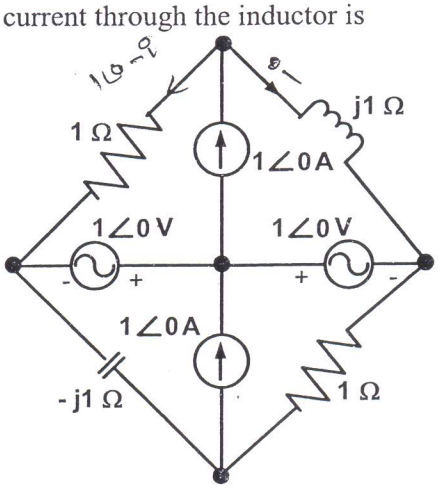
(A) $\bar{X}Y, X\bar{Y}$ (B) $\bar{X}Y, X\bar{Y}\bar{Z}, X\bar{Y}Z$
(C) $\bar{X}Y\bar{Z}, \bar{X}YZ, X\bar{Y}$ (D) $\bar{X}Y\bar{Z}, \bar{X}YZ, X\bar{Y}\bar{Z}, X\bar{Y}Z$

Q.21 The impedance looking into nodes 1 and 2 in the given circuit is



(A) 50 Ω (B) 100 Ω (C) 5 kΩ (D) 10.1 kΩ

Q.22 In the circuit shown below, the current through the inductor is



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