

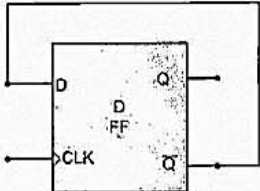
NAME OF THE EXAMINATION: B.E. POWER ENGINEERING SECOND YEAR SECOND SEMESTER
- 2022

SUBJECT: DIGITAL AND POWER ELECTRONICS

TIME: 3 HOURS

FULL MARKS: 100

Answer *Q1* and *any six* questions from the rest

1. Choose the correct option for any TEN questions: (10@1 = 10)
- (i) The decimal equivalent of $(11011.101)_2$ is [CO1]
 a) 27.75
 b) 27.625
 c) 27.525
 d) 27.5
- (ii) An XOR gate produces an output only when its two inputs are [CO1]
 a) different
 b) same
 c) low
 d) high
- (iii) The expression \overline{ABC} can be simplified to [CO4]
 a) $\overline{A} \cdot \overline{B} \cdot \overline{C}$
 b) $\overline{A} + \overline{B} + \overline{C}$
 c) $AB + BC + CA$
 d) $AB + \overline{C}$
- (iv) The flip-flop shown in Fig. logically behaves as [CO2]
 a) a D flip-flop
 b) a R-S flip-flop
 c) a T flip-flop
 d) a J-K flip-flop
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- (v) What type of register would have a binary number shifted in one bit at a time and have all the stored bits shifted out one at a time? [CO2]
 a) Parallel-in Parallel-out
 b) Parallel-in Serial-out
 c) Serial-in Serial-out
 d) Serial-in Parallel-out
- (vi) Output frequency of a mod-16 counter clocked from a 20 kHz source is [CO2]
 a) 10 kHz
 b) 1.25 kHz
 c) 160 Hz
 d) 625 Hz
- (vii) If a 10-bit ring counter has an initial state 1101000000, what is the state after the second clock pulse? [CO2]
 a) 1101000000
 b) 0011010000
 c) 1100000000
 d) 0000000000
- (viii) A silicon-controlled rectifier (SCR) is a/an [CO3]
 a) unijunction device
 b) device with two junctions
 c) device with three junctions
 d) device with four junctions
- (ix) RC snubber circuit is used in SCR to [CO3]
 a) limit the rate of rise of current in SCR
 b) limit the rate of rise of voltage across SCR

- c) limit the conduction period
d) delay the firing angle
- (x) Chopper control for DC motor primarily provides variation in [CO5]
a) supply voltage to the motor
b) supply frequency to the motor
c) supply current to the motor
d) supply polarity to the motor
- (xi) In a single phase, half wave, controlled rectifier if the input voltage is $400 \sin 314t$, the average output voltage for a firing angle of 60° is [CO4]
a) $100/\pi$
b) $200/\pi$
c) $300/\pi$
d) $400/\pi$
- (xii) A cycloconverter is a _____ [CO5]
a) one stage power converter
b) one stage voltage converter
c) one stage frequency converter
d) one stage current converter
- 2 (a) Convert $(0.75)_{10}$ to binary using successive multiplication method (3) [CO1]
(b) Convert $A72E_{16}$ to Octal equivalent (3) [CO1]
(c) Add 724_{10} with 158_{10} using 8421 BCD (4) [CO1]
(d) Subtract the following decimal numbers using the 12-bit 2's complement arithmetic: $125.3 - 46.7$ (5) [CO1]
- 3 (a) State De Morgan's theorem (2) [CO1]
(b) Simplify algebraically: $\overline{A \cdot B} + \overline{A} + A \cdot B$ (3) [CO1]
(c) Implement XOR gate using minimum number of NAND gates (3) [CO1]
(d) Write the Boolean expression for the logic diagram below. (3+4) [CO1]
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- Simply the Boolean expression as much as possible and draw the logic diagram that implements the simplified expression
- 4 (a) Expand the following expression to a standard SOP form: $F = A + B\bar{C} + AB\bar{D} + ABCD$ (5) [CO1]
(b) Obtain the MAX terms of $F = A(\bar{A} + B)(\bar{A} + B + \bar{C})$. What are its MIN terms? (5) [CO1]
(c) Minimize the following Boolean expression using K-map and then verify algebraically: $Y = \bar{A}B + \bar{A}B$ (5) [CO1]
- 5 (a) Realize D flip flop using S-R flip flop (4) [CO2]
(b) What is shift register? Implement Parallel in Serial out (PISO) shift register using D flip flops. (5) [CO2]
(c) Design a 3-bit edge-triggered binary UP ripple counter using T flip-flops. (6) [CO2]
- 6 (a) Describe the different modes of operation using static V-I characteristics of thyristor. What is the effect of gate current on this characteristic? (4+2) [CO3]
(b) Draw and explain the operation of R-C firing circuit for SCR. (4) [CO3]

- (c) How di/dt and dv/dt protections are achieved in SCR? (5) [CO3]
- 7 (a) Why does an SCR not conduct when positive voltage is applied to it? Explain how a gate pulse can make it conducting. (2+3) [CO3]
 (b) With the help of two transistor model describe the turn-on process of a thyristor (5) [CO3]
 (c) Draw the relevant circuit and explain the complementary commutation process for turning OFF a SCR. (5) [CO3]
- 8 (a) How many SCRs are required for a full-wave controlled rectifier? Explain its operation briefly. (4) [CO4]
 (b) For a single-phase half-wave ac voltage controller feeding a resistive load, draw the waveforms of source voltage, gating signals, output voltage, source and output currents and voltage across SCRs. Describe its working with reference to the waveforms drawn. (6) [CO4]
 (c) What is cyclo-converter? Explain the operation of a single phase cyclo-converter with suitable figures and diagrams. (5) [CO5]
- 9 (a) Explain with the help of circuit diagram, the principle of operation of step-up chopper. (5) [CO5]
 (b) In a DC chopper, the average load current is 30 A, chopping frequency is 250 Hz. Supply voltage is 110 V. Calculate the ON and OFF periods of the chopper if the load resistance is 2 ohms (5) [CO5]
 (c) Draw the circuit diagram of a half-bridge voltage source inverter. Why are feedback diodes used in anti-parallel with SCRs in inverters? (5) [CO5]
- 10 Write short notes on *any three*: (3@5=15)
 (a) Astable multivibrator using IC 555 [CO2]
 (b) Operation of a 4-bit synchronous bidirectional counter using J-K flip-flops [CO2]
 (c) Construction, operation and applications of TRIAC [CO3]
 (d) Derivation of mathematical expressions for output voltage in terms of duty cycle for a step-up and a step-down chopper. [CO5]
 (e) Voltage control of a single-phase inverter by PWM technique [CO5]

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