

Resonant Converters & Power Electronics Applications (Drives, SMPS)



Multiple Choice Questions

Q.1 A 3-phase wound rotor induction motor is controlled by a chopper-controlled resistance in its rotor circuit. A resistance of $2\ \Omega$ is connected in the rotor circuit and a resistance of $4\ \Omega$ is additionally connected during OFF periods of the chopper. The OFF period of the chopper is 4 ms. The average resistance in the rotor circuit for the chopper frequency of 200 Hz is

- (a) $26/5\ \Omega$ (b) $24/5\ \Omega$
(c) $18/5\ \Omega$ (d) $16/5\ \Omega$

[ESE-2001]

Q.2 For low-speed high-power reversible operation, the most suitable drives are

- (a) Voltage source inverter fed A.C. drives
(b) Current source inverter fed A.C. drives
(c) Dual converted fed D.C. drives
(d) Cycloconverter fed A.C. drives

[ESE-2011]

Q.3 In a switched mode power supply (SMPS), after conversion of A.C. supply to a highly filtered D.C. voltage, a switching transistor is switched ON and OFF at a very high speed by a pulse width modulator (PWM) which generates very high frequency square pulses. The frequency of the pulses is typically in the range of

- (a) 100 Hz - 200 Hz (b) 500 Hz - 1 kHz
(c) 2 kHz - 5 kHz (d) 20 kHz - 50 kHz

[ESE-2002]

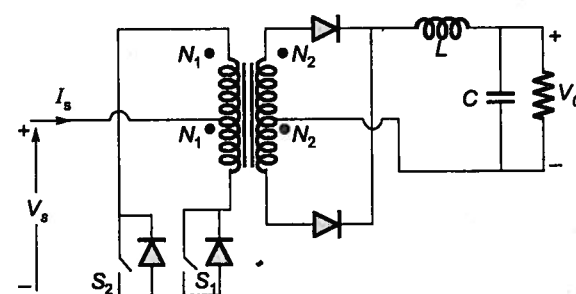
Q.4 What are the advantages of switching power supplies over linear power supplies?

1. The devices operate in linear/active region.
2. The devices operate as switches.
3. Power losses are less.

Select the correct answer using the code given below:

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

Q.5 In push-pull type DC-DC converter the output voltage V_o is given by



- (a) $V_o = 2 \frac{N_2}{N_1} V_s \left(\frac{t_{ON}}{t_{ON} + t_{OFF}} \right)$
(b) $V_o = \frac{N_2}{N_1} V_s \left(\frac{t_{ON}}{t_{ON} + t_{OFF}} \right)$
(c) $V_o = 2 \frac{N_2}{N_1} V_s \left(\frac{t_{ON}}{t_{OFF}} \right)$
(d) $V_o = \frac{N_2}{N_1} \cdot V_s \left(\frac{t_{ON}}{t_{OFF}} \right)$

[ESE-2010]

Q.6 Resonant mode power supplies in comparison to square mode ones

- (a) have smaller component count

- (b) have negligible power loss
(c) do not cause over voltages
(d) slower in control action

Q.7 Resonant converters are basically used to

- (a) generate large peak voltages
(b) reduce the switching losses
(c) eliminate harmonics
(d) convert a square wave into a sine wave



Numerical Data Type Questions

Q.8 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 (number of poles = 2)
 $V: 415\text{ V}$, $\text{Ph} : 3$, $f : 50\text{ Hz}$, $N : 2850\text{ rpm}$.

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 ____ rpm.

[GATE-2003]

Q.9 A three-phase, 440 V, 50 Hz A.C. mains fed thyristor bridge is feeding a 440 V D.C., 15 kW 1500 rpm separately excited D.C. motor with a ripple free continuous current in the D.C. link under all conditions, neglecting the losses, the power factor of the A.C. mains at half the rated speed is ____.

[GATE-2007]

Q.10 A D.C. chopper is used in regenerative braking mode of a D.C. series motor. The D.C. supply is 600 V, the duty cycle is 70%. The average value of armature current is 100 A. It is continuous and ripple free. The value of power feedback to the supply is ____ kW.

[ESE-2009]

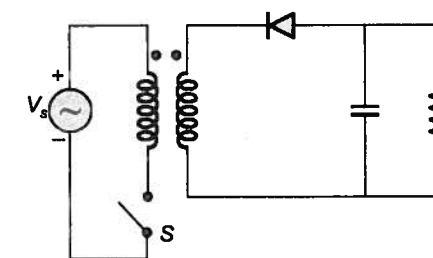
Q.11 A D.C. series motor has parameter $R_a = 3\ \Omega$ and $R_f = 3\ \Omega$. The motor speed is varied by a semi controlled bridge rectifier. The firing angle is 45° and average speed of the motor is 1450 rpm. The applied A.C. voltage to the bridge is $330 \sin \omega t$. If the armature current of motor is 5 A, the torque of the motor is ____ N-m.

Q.12 A separately excited D.C. motor of 220 V, 100 A, 2100 rpm has armature resistance as $0.1\ \Omega$ and inductance as 5 mH. The motor is fed by a chopper which is operating from a D.C. supply of 250 V. If the chopper operating with 0.4 duty ratio, the speed of motor at rated torque is ____ rpm.

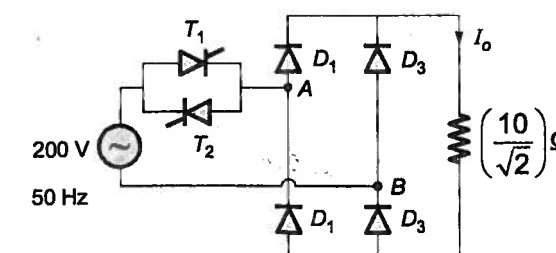
Q.13 A six pulse cyclo-converter, fed from 3-phase, 400 V, 50 Hz source, is delivering a load current of 40 A to a single-phase resistive load. The source has an inductance of 1.2 mH per phase. The rms value of load voltage for firing angle delay of 0° is ____ V.

Q.14 A separately-excited dc motor, operating from a single-phase half-controlled bridge at a speed of 1400 rpm, has an input voltage of $330 \sin 314t$ and a back emf 80 V. The SCRs are fired symmetrically at $\alpha = 30^\circ$ in every half cycle and the armature has a resistance of $4\ \Omega$. The motor torque will be ____ Nm.

Q.15 For the isolated buck boost converter as shown in the circuit below, the output voltage is to be 35 V at a duty cycle of 30%. The DC input is obtained from a front end rectifier without voltage doubling fed from a 115 V AC. The peak forward blocking voltage of the switching element is ____ V.



Q.16 In the following circuit. The RMS value of load current in amps by assuming $\alpha = 90^\circ$ is ____ (in amp).





Conventional Questions

Q.17 A capacitor is connected across an ac regulator feeding inductor (TCR). Input is at 230 V, 50 Hz and inductive reactance (X_L) = 10 Ω ; capacitive reactance (X_C) = 10 Ω . Calculate the net VAR supplied by the circuit at $\alpha = 135^\circ$.

[ESE-2013]

Q.18 Explain forward converter with relevant waveforms. What is the need of tertiary winding in the forward converter?

Q.19 A 250 V separately excited DC motor has armature resistance of 2.5 ohms. When driving a load at 600 r.p.m. with constant torque, the armature takes 20 A. The motor is controlled by a DC chopper operating with a frequency of 400 Hz and an input voltage of 250 V DC. What should be the value of duty ratio, if it is desired to reduce the speed from 600 r.p.m. to 400 r.p.m.? Also find the motor speed at rated current and a duty ratio of 0.5, if the motor is regenerating.

[ESE-2002]



Try Yourself

T1. In a 3- ϕ to 1- ϕ cyclo converter employing 3-pulse positive and negative group converters, if the input voltage is 200 V per phase, the fundamental rms value of output voltage would be

- (a) $\frac{600}{\pi}$ V (b) $300\sqrt{3}$ V
(c) $\frac{300\sqrt{3}}{\pi}$ V (d) $\frac{300}{\pi}$ V

[Ans: (c)]

T2. A six pulse cyclo-converter, fed from 3-phase, 400 V, 50 Hz source, is delivering a load current of 40 A to a single-phase resistive load. The source has an inductance of 1.2 mH per phase.

The rms value of load voltage for firing angle delay of 0° is _____.

- (a) 320.42 V (b) 371.78 V
(c) 346.12 V (d) 399.24 V

[Ans: (b)]

T3. A single phase voltage controller has input voltage of 230 V, 50 Hz and a load of $R = 15 \Omega$. For 8 cycles ON and 6 cycles OFF the average thyristor currents is

- (a) 4.2 A (b) 3.9 A
(c) 3.24 A (d) 6.4 A

[Ans: (b)]

T4. A DC chopper is used for regenerative braking of a separately excited dc motor. The dc supply voltage is 400 V. The motor has $r_a = 0.2 \Omega$, $K_m = 1.2$ V-s/rad. The average armature current during regenerative braking is kept constant at 300 A with negligible ripple. If the duty cycle of chopper is 60% then the minimum and maximum permissible braking speeds are respectively

- (a) 477 rpm and 3660 rpm
(b) 314 rpm and 4126 rpm
(c) 512 rpm and 3660 rpm
(d) 477 rpm and 4126 rpm

[Ans: (c)]

T5. In a speed controlled dc drive, the load torque is 40 N-m. At time $t = 0$, the operation is under steady state and the speed is 500 rpm. Under this condition at $t = 0^+$, the generated torque is instantly increased to 100 Nm. The inertia of the drive is 0.01 Nm-sec²/rad. The friction is negligible.

The time taken for the speed to reach 1000 rpm is _____ ms.

[Ans: (87.30)]

T6. A 220 V, 1500 rpm, 10 A separately excited dc motor has an armature resistance of 1 Ω . It is fed from a single phase fully controlled bridge rectifier with an ac source voltage of 230 V, 50 Hz. Assuming continuous load current, the motor speed at the firing angle of 30° and torque of 5 Nm is _____ rpm.

[Ans: (1254)]

T7. SMPSs are superior to linear power supplies in respect of

- (a) size and efficiency
(b) efficiency and regulation
(c) regulation and noise
(d) noise and cost.

[Ans: (a)]

T8. Consider the following statements:

Switched mode power supplies are preferred over the continuous types, because these are

1. suitable for use in both AC and DC
2. more efficient
3. suitable for low power circuits
4. suitable for high power circuits

Of these statements, the correct is

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

[Ans: (c)]

