



Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	2405914
2	Title of Examination Paper	Powers electronics and drives
3	Module Code	ACDAG004
4	Date and Time of Examination	22.05.2026 9:30
5	Examination Venue	310
6	Seat Number	7
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	9
2	25
3	15
4	5
5	24
6	2
7	8
8	10
Total	98%

98%
PL 1
8/6/26

1. • Motor has coils in stator 120° apart ✓
 • coils create Rmf ✓
 • Rmf cuts cage, cage acts as closed ckt
 current flows ✓
 • current in cage causes opposing mf ✓
 • opposing mf and Rmf causes rotation of cage ✓
 • Induction motor relies on slip and not fixed speed ✓
 • Induction motor speed dependent on load ✓
 • Sync motor starts same as induction ✓
 • at near full speed current is low torque is from opposing mf and Rmf ✓
 • sync motor speed depends on line frequency ✓

2 250 kVA 6 kV 12 pole pairs 1000 Rpm
 20 pulses

$$\frac{250000}{6000} = 41.6 \text{ A}$$

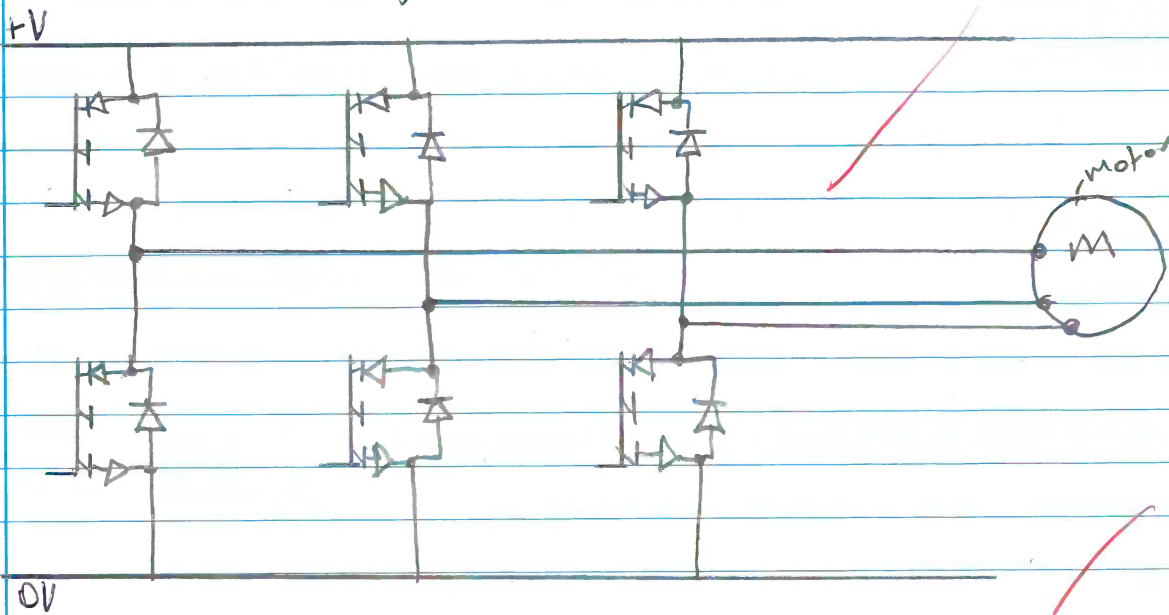
$$f = \frac{1000}{60} \times 12 = 200 \text{ Hz}$$

$$20 \text{ pulses} \times 200 = 4 \text{ kHz}$$

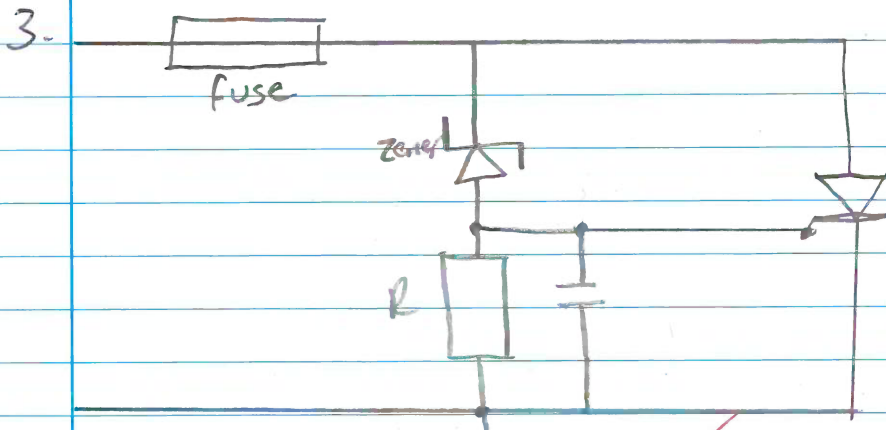
Characteristics	Power bipolar	Mosfet	IGBT
break voltage	< 1kV	< 1kV	> 1kV
Current	< 500A	> 500A	> 500A
Input drive	20-200V	3-10V	4-8V
input impedance	low	High	High
output impedance	low	mid	mid/low
speed	slow	fast	mid
cost	low	mid	High

best use case transistor is IGBT, this is because both power bipolar and mosfet ~~cannot~~ ^{should not} be used above 1kV ✓

2 cont'd Push pull ckt diagram for IGBT



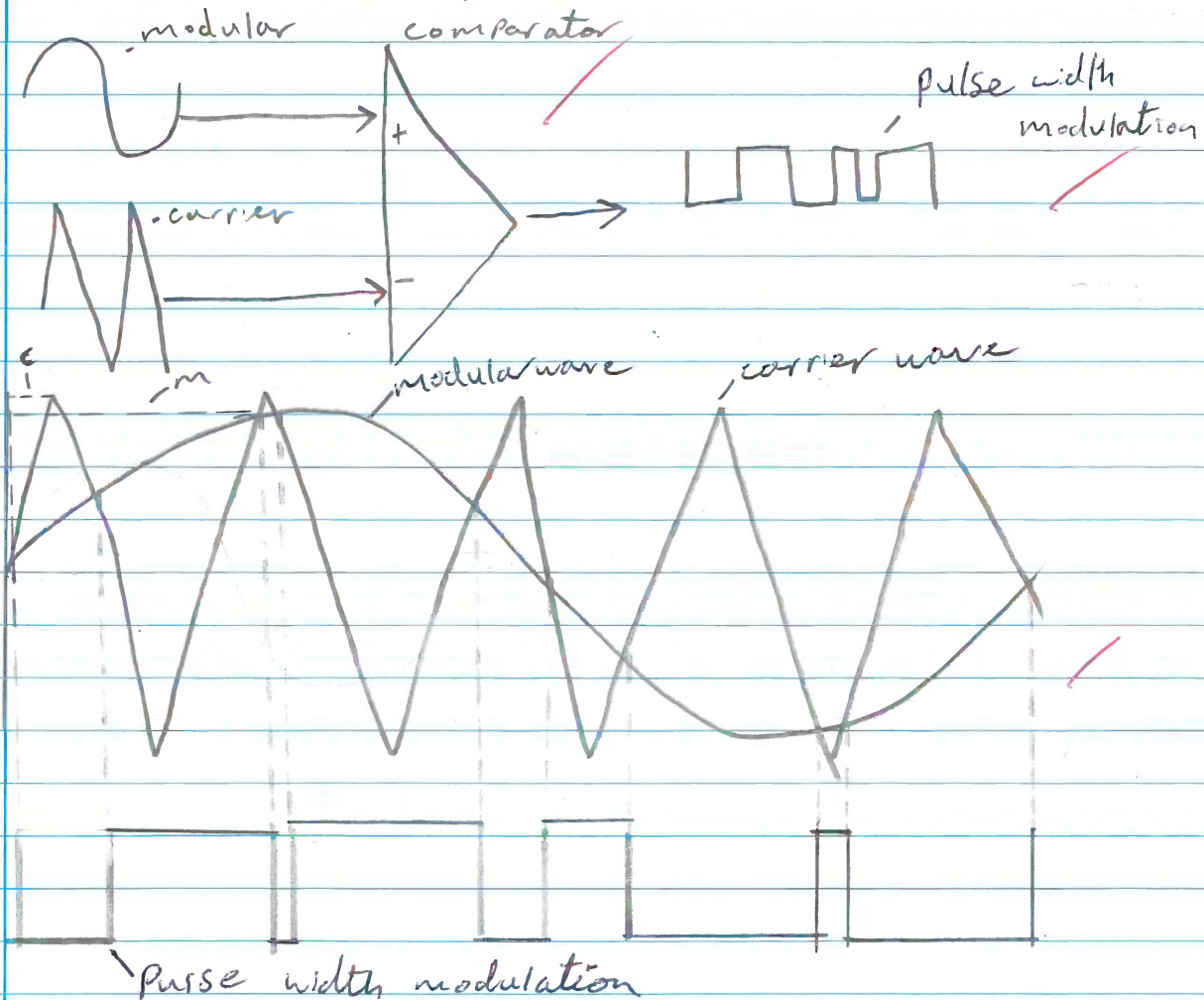
During operation, PWM signal sent to ckt, during positive cycle top set of transistors will operate. During negative half wave bottom transistors will operate. Diodes are in ckt to stop back emf.



During normal operation zener does not conduct, open circuit between anode and cathode of thyristor. If there is over voltage the zener will conduct, the thyristor will conduct, current becomes too large and fuse is blown which protects connected equipment.

- 4 magnetic field in stator produced by permanent magnets ✓
 • rotor windings ^{coils} in stator rotated by prime mover ✓
 • windings ^{coils} cut MF and induce voltage ✓
 • currents transferred by brushes and commutator ✓
 • currents not true DC ✓
 • smoothness depends on amount of coils in rotor and amount of segments in commutator ✓

- 5a a PWM encoded sinusoidal wave form can be generated by use of a modulator wave -sin and a carrier wave -triangle with a comparator. when triangle wave is low PWM is high, when triangle wave is high PWM is low ✓



- 5b Torque of a synchronous ac motor is controlled when the amplitude of both the sinusoidal and triangle waves are manipulated, amplitude increases torque increases, amplitude decreases, torque decreases. Speed can also be changed, speed is changed by changing the frequency of the sinusoidal wave.
- increased frequency - higher speed, decreased frequency - decreased speed

(24)

10

6 6 poles - 3 pole pairs 50 Hz

$$Rpm = \frac{f \times 60}{\text{pairs}} = \frac{50 \times 60}{3} = 1000 Rpm$$

2

7a emf max

$$N = 1600 \text{ turns} \quad B = 0.75 T \quad A = 150 \text{ mm} \times 250 \text{ mm}$$

$$NB A \omega$$

$$A = (150 \times 10^{-3} \times 250 \times 10^{-3}) = 37.5 \times 10^{-3}$$

$$\omega = 2\pi f$$

$$\frac{120 \times 3000}{60} = 50 \text{ Hz}$$

$$1600 \times 0.75 \times (37.5 \times 10^{-3}) \times 2 \times \pi \times 50 = 14137.16694 V$$

4.

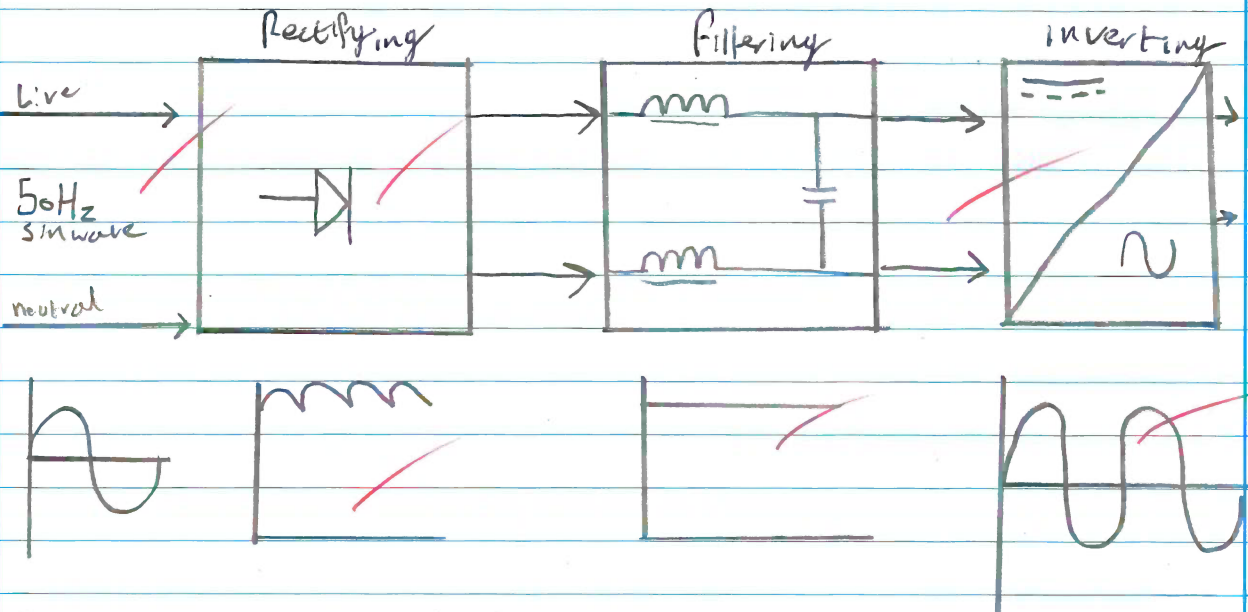
7b Flux

$$\text{Flux} = BA$$

$$\text{Flux} = 0.75 \times (37.5 \times 10^{-3}) = 28.125 \text{ mWb}$$

4

8a



- Incoming ac is rectified - to create choppy DC
- choppy DC is then filtered to create true DC
- DC is then inverted to the required Amplitude and frequency for the connected component

8b changing the speed of a motor can be done by manipulating the frequency, as frequency increased acceleration occurs, frequency ramped down deceleration occurs. torque is also manipulated by changing current/voltage to desired value as motor decelerates current/voltage increased to keep torque maintained. as motor accelerates current/voltage decreased to maintain torque



Examiner Only

Question No.



Rhif y Cwestiwn

Arholwr yn unig