Q.1 (a) $P = 8$, Lap wound, $A = P$, $N = 450$ rpm

$E_g = 260$ V $\phi = 0.02751$ wb

No. of slots = 140

$$E_g = \frac{\phi Z N P}{60 A} \quad (01)$$

$$\therefore E_g = \frac{\phi Z N}{60} \Rightarrow Z = \frac{E_g \cdot 60}{\phi \cdot N} = \frac{260 \times 60}{0.02751 \times 450} = 1260 \quad (03)$$

$$\text{conductors / slot} = \frac{1260}{140} = 9 \quad (01)$$

(b) $E_b = V - I_a R_a$ (01)

$\therefore V = E_b + I_a R_a$

$\therefore V \cdot I_a = E_b I_a + I_a^2 R_a$ (01)

$P_{in} = P_{arm} + P_{cu}$

$P = T\omega \Rightarrow P_{arm} = T \cdot \omega = \frac{2\pi N T}{60}$ (01)

$E_b \cdot I_a = \frac{2\pi N T}{60}$ (01)

$$\therefore \frac{\phi Z \cancel{N} P}{\cancel{60} A} = \frac{2\pi \cancel{N} T}{\cancel{60}}$$

$$\therefore T = \left(\frac{1}{2\pi}\right)\left(\frac{PZ}{A}\right)\phi \cdot I_a = 0.159\left(\frac{PZ}{A}\right) \cdot \phi \cdot I_a \quad (02)$$

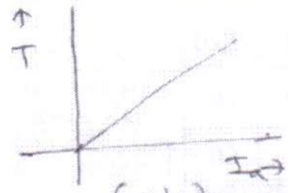
(c) Appropriate applications

i) D.C. shunt motor (02)

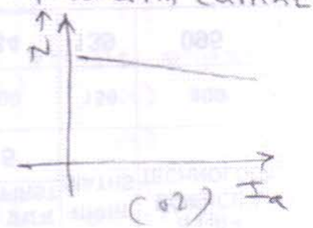
ii) D.C. series motor (02)

OR

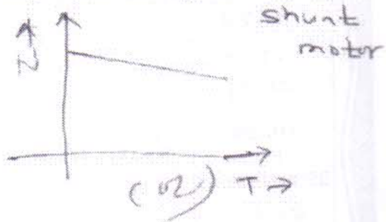
Q.2 (a) Torque-arm current Speed-arm current Speed-torque D.C shunt motor



(01)



(02)



(02)

(b) $P = 4$, wave wound $A = 2$, slots = 65, cond./slot = 6

$Z = 65 \times 6 = 390$, $\phi = 0.02$ wb, $R_a = 0.15\,\Omega$

$V = 250$ volts, $I_a = 60$ A $E_b = V - I_a R_a = (250) - (60)(0.15)$

$\therefore$ $E_b = 241$ volts (03)

$$E_b = \frac{\phi Z N P}{60 A} \quad (01)$$

$$\therefore N = \frac{E_b \cdot 60 \cdot A}{\phi \cdot Z \cdot P} = \frac{241 \times 60 \times 2}{0.02 \times 390 \times 4}$$

$\therefore$ $N = 926.92$ rpm ≈ 927 rpm (02)

$= 4$, Lap $A = P$, $Z = 600$, $N = 1200$, $\phi = 24\times10$ ...

$E_g = \frac{\phi Z N P}{60 A}$ (01)

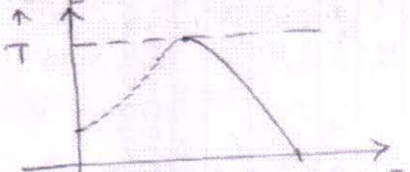
$\therefore \quad = \frac{24\times10^{-3} \times 600 \times 1200}{60 \times 4} = 72$ Volts. (01)

ii) For wave wound $A = 2$

$E_g = \frac{\phi Z N P}{60 A} = \frac{24\times10^{-3}\times 600 \times 1200}{60\times 2} = 144$ Volts (02)

Q.3 (a) Any six significant points of differentiation between slip ring and squirrel cage induction motor (01 each)

(b) Torque-slip characteristics of 3phase induction motor



Correct Explaination (01)

(c) $V = 440$ V, $f = 50$ Hz, $P = 4$

i) $N_s = \frac{120 f}{P} = \frac{120\times50}{4} = 1500$ rpm (01)

ii) $N = N_s(1-S) = (1500)(1-0.04) = (1500)(0.96) = 1440$ rpm (01)

iii) $f_r = sf = (0.03)(50) = 1.5$ Hz (01)

iv) $f_r = sf = f = 50$ Hz (01)

OR

Q.4 (a) Resistance split phase single phase induction motor

i) Circuit diagram (02)

ii) advantages (02)

iii) Disadvantages (01)

iv) Applications (01)

(b) Advantages of squirrel cage rotor (02)

Advantages of slip ring rotor (02)

(c) $V = 440$ V, $f = 50$, $P = 6$

i) $N_s = \frac{120 f}{P} = \frac{120\times 50}{6} = 1000$ rpm (01)

ii) $N = N_s(1-S) = 1000(1-0.04) = 960$ rpm (01)

iii) $f_r = sf$ $\quad S = \frac{N_s - N}{N_s} = \frac{1000-900}{1000}$ ~~×100~~ $= 0.1$ or 10%. (01)

iv)

$= (0.1)(50)$

$f_r = 5$ Hz (01)

Q.5

a → ii
b → iv
c → iv
d → iii
e → ii

(2 each)

f → ii
g → iii
h → i
i → i
j → ii

(2 each)