

**SECTION A: 80 MARKS**  
**BAHAGIAN A: 80 MARKAH**

**INSTRUCTION:**

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

**ARAHAN:**

*Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab SEMUA soalan.*

**QUESTION 1**

**SOALAN 1**

CLO1  
C1

- a) State **FOUR (4)** parts of a DC generator.

*Nyatakan EMPAT (4) bahagian utama bagi penjana AT.*

[4 marks]  
[4 markah]

CLO1  
C2

- b) Differentiate the two types of DC shunt generators which is self-excited and separately-excited, in terms of their equivalent circuits.

*Bezakan dua jenis litar penjana pirau AT iaitu ujaan diri dan ujaan berasingan, dari segi litar setara.*

[6 marks]  
[6 markah]

CLO1  
C3

- c) A 4 pole, long shunt compound lap wound generator supplies 25kW at a terminal voltage of 500V. The armature resistance is  $0.03\Omega$ , series field resistance is  $0.04\Omega$  and shunt field resistance is  $200\Omega$ . If the speed is 1200 rpm, flux per pole is  $0.02\text{Wb}$  and the brush voltage drop may be taken as 1.0V. Use appropriate circuit diagram, calculate the emf generate and number of conductors.

*Sebuah penjana pirau panjang 4 kutub berbelitan jenis tindih membekalkan 25 kW pada voltan terminal 500V. Rintangan anker sebanyak  $0.03\Omega$ , rintangan siri sebanyak  $0.04\Omega$  dan rintangan pirau sebanyak  $200\Omega$ . Jika kelajuan motor 1200rpm, jumlah fluk per kutub sebanyak  $0.02\text{Wb}$  dan susutan voltan berus mungkin mengambil sebanyak 1.0V. Guna rajah yang sesuai, kirakan dge terjana dan bilangan pengalir.*

[10 marks]  
[10 markah]

## QUESTION 2

## SOALAN 2

- CLO1  
C1 a) State **TWO (2)** types of A.C. generator rotor and specify its ability.  
*Nyatakan DUA (2) jenis rotor penjana A.U. dan tentukan keupayaannya.*

[4 marks]  
[4 markah]

- CLO1  
C2 b) Explain the principle operation of AC generator in Figure 2(b) from point 1 to point 3.  
*Terangkan prinsip kendalian bagi sebuah penjana AU dalam rajah 2(b) dari titik 1 hingga titik 3.*

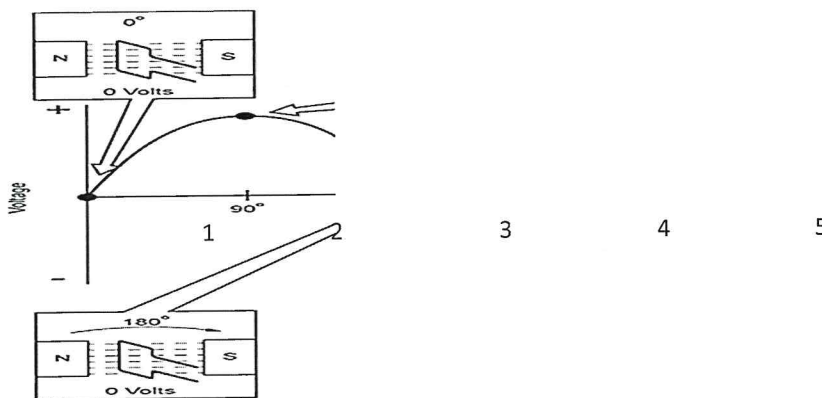


Figure 2(b)/ Rajah 2(b)

[6 marks]  
[6 markah]

- CLO1  
C3 c) A 6 pole, 3 phase A.C. generator has 340 conductors in armature winding and flux distribution of 17.5mWb. The generator is producing frequency at rated 60Hz. Calculate:  
*Sebuah penjana A.U. 3 fasa, 6 kutub, gegelung angker mempunyai 340 pengalir dan agihan urat daya magnet ialah 17.5mWb. Penjana ini menghasilkan frekuensi pada kadar 60Hz. Kirakan:*

- i. The speed of this generator.  
*Kelajuan penjana ini.*
- ii. The number of poles when the frequency is decreased to 20 Hz,  
*Jumlah kutub yang diperlukan penjana jika frekuensi berkurang kepada 20Hz,*

- iii. The rms voltage generated in single phase system

*Voltan ppgd yang terjana dalam sistem satu fasa.*

- iv. The line voltage if the A.C. generator is star connection.

*Voltan talian sekiranya penjana AU bersambung secara bintang.*

[10 marks]  
[10markah]

### QUESTION 3

#### SOALAN 3

CLO1  
C1

- a) For a three phase induction motor:

*Bagi motor aruhan tiga fasa:*

- i. Define slip

*Nyatakan maksud gelincir.*

- ii. Give the slip mathematical equation.

*Berikan ungkapan matematik bagi gelincir.*

[4 marks]  
[4 markah]

CLO1  
C2

- b) Give **THREE (3)** differences between Squirrel Cage rotor and Slip Ring rotor in a three phase induction motor.

*Berikan TIGA (3) perbezaan diantara pemutar Sangkar Tupai dan pemutar*

*Gelang Gelincir dalam motor aruhan tiga fasa.*

[6 marks]  
[6 markah]

CLO1  
C3

- c) A three phase induction motor 10 HP, 4 poles operates at 415V, 50Hz. If the motor rotates at 1350rpm speed at full load condition, calculate:

*Sebuah motor aruhan tiga fasa 10HP, 4 kutub beroperasi pada 415V, 50 Hz. Jika motor tersebut berputar pada kelajuan 1350 psm pada beban penuh, kirakan:*

- i. Synchronous speed,  $N_s$   
*Kelajuan segerak,  $N_s$*
- ii. Slip percentage.  
*Peratus gelincir.*
- iii. Frequency of current rotor when at starting condition.  
*Frekuensi pemutar bila pada keadaan mula.*
- iv. Frequency of current rotor at full load condition.  
*Frekuensi pemutar bila pada keadaan beban penuh.*

[10 marks]  
[10 markah]

**QUESTION 4****SOALAN 4**CLO1  
C1

- a) State **TWO(2)** characteristic of auxiliary winding and main winding in single phase induction motor
- Nyatakan DUA(2) ciri-ciri bagi belitan tambahan dan belitan utama di dalam motor aruhan fasa tunggal.*

[4 marks]

[4 markah]

CLO1  
C2

- b) Explain **TWO (2)** functions of motor control components listed below.
- Terangkan DUA (2) fungsi komponen-komponen kawalan motor yang disenaraikan di bawah.*

i. Push Button  
*Punat Tekan*

ii. Timer Delay Relay  
*Geganti Lewat Pemasa*

iii. Contactor  
*Sesentuh*

[6 Marks]

[6 markah]

CLO1  
C3

- c) Sketch schematic diagram for Direct Online Forward AC Motor Control.
- Lakarkan gambarajah skematik untuk kawalan motor jenis Penghidup AU Talian Terus Mara.*

[10 Marks]

[10 markah]

**SECTION B: 20 MARKS**  
**BAHAGIAN B: 20 MARKAH**

**INSTRUCTION:**

This section consists of **ONE (1)** essay question. Answer **ALL** question.

**ARAHAN:**

*Bahagian ini mengandungi SATU (1) soalan esei. Jawab SEMUA soalan.*

CLO1  
C3

**QUESTION 1**

**SOALAN 1**

A long shunt compound DC motor 14HP, 220V driven to the speed 1250rpm, has winding armature resistance, series wound resistance and shunt field resistance with a total of total 0.05 $\Omega$ , 0.03 $\Omega$  and 220 $\Omega$ . Percentage the overall efficiency at the above load is 88%, calculate:

*Sebuah motor majmuk pirau panjang AT 14HP, 220V berputar pada kelajuan 1250psm, mempunyai rintangan belitan angker, rintangan belitan siri dan rintangan medan pirau masing-masing berjumlah 0.05 $\Omega$ , 0.03 $\Omega$  dan 220 $\Omega$ . Peratusan jumlah kecekapan pada beban adalah 88%, kirakan:*

- i. back e.m.f of the DC machine  
*d.g.e balikan pada mesin AT*
- ii. armature torque  
*daya kilas angker*
- iii. output(shaft) torque  
*daya kilas keluaran(aci)*
- iv. total Copper losses  
*Jumlah kehilangan copper*
- v. iron and friction losses  
*kehilangan besi dan geseran*

[20 marks]

[20 markah]

**SOALAN TAMAT**



## FORMULA DET30043 – ELECTRICAL MACHINES

DC MACHINE	AC MACHINE
$Z = 2CN_c$	$N_s = \frac{120f_s}{P} \text{ rpm}$
$E_g / E_b = V_t \pm V_a \pm V_s \pm V_{\text{brush}} \text{ volt}$	$\%S = \frac{N_s - N_r}{N_s} \times 100\%$
$E = \frac{\phi P n Z}{a} \text{ volt}$	$N_{\text{slip}} = N_s - N_r \text{ rpm}$
$I_{\text{sh}} = \frac{V_t}{R_{\text{sh}}} \text{ amp (shunt machine)}$	$f_r = s f_s \text{ Hz}$
$I = \frac{P}{V_t} \text{ amp}$	$P = \sqrt{3} V_L I_L \cos\phi \text{ watt (3 phase)}$
$I_a = I_f \pm I_{\text{sh}}$	$E_p = 2.22 k_p k_d f \phi Z \text{ v/phase}$
$T_a = \frac{E_b I_a}{2\pi n} \text{ Nm}$	$E = \sqrt{(V_t \cos\phi + I_a R_a)^2 + (V_t \sin\phi \pm I_a X_a)^2} \text{ v/phase}$ $= V \phi L_0^0 + (I_a L - \theta)(R_a + jX_s)$
$T_{\text{sh}} = \frac{P_{\text{out}}}{2\pi n} \text{ Nm}$	Rotor Cu loss = $\frac{s}{1-s} \times P_m$
$P_{\text{out}} = V_t I_f = P_{\text{in}} - P_{\text{tot.loss}}$	rotor input = mechanical power developed + Rotor Cu loss Stator input = rotor input + stator losses
$\% \text{ Efficiencies, } \% \eta = \frac{P_{\text{out}}}{P_{\text{in}}} \times 100\%$	$\% \text{ Efficiencies, } \% \eta = \frac{P_{\text{out}}}{P_{\text{in}}} \times 100\%$