THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

MEC 3102 PRODUCTION TECHNOLOGY I AND PRINCIPLES OF ELECTRICITY & ELECTRONICS II

2018 -2019 ACADEMIC YEAR, TERM II TEST

TIME: TWO HOURS. **CLOSED BOOK**

INSTRUCTIONS

1. **Answer all Questions;**
2. All Questions Carry **Equal Marks**, that is, **20 Marks** per Question.
3. This Test Question Paper has Two (2) pages, including this title page.

QUESTION 1.

(a) Derive an expression for **energy** dissipated on a horizontal milling machine using an up-cut slab mill tool. **Include clearly labeled sketch to clarify your derivation.** Use chip thickness $t = t_{mean} = f_t(a_e/D)^{0.5}$ (Schlesinger formula) in the derivation.

[13 marks]

(b) Calculate the **energy** dissipated in the slab milling process given the following slab milling data:

Tooling:-

Cutter diameter	=	85 mm
Tool depth of cut on workpiece	=	2.5 mm
Tool feed rate against the workpiece	=	30 mm min^{-1}

Workpiece:-

Specific cutting pressure for workpiece material	=	3200 N mm^{-2}
Workpiece width of cut	=	80 mm

[7 marks]

QUESTION 2.

(a) Describe flat surface grinding. Give a sketch to illustrate your answer. *[7 marks]*

(b) **i)** Derive the expression for chip thickness **t** in flat surface grinding. *[10 marks]*

ii) Calculate the chip thickness **t** in flat surface grinding given the following grinding process data:

Grinding wheel diameter	**D**	=	150mm
Depth of cut	**d**	=	0.05 mm
Grit tangential velocity	**V**	=	2400 m min^{-1}
Workpiece feed rate	**v**	=	9.0 m min^{-1}
Grit quantity	**C**	=	6 units per mm^2
Ratio of width to depth of groove cut by grit	**r**	=	11

[3 marks]

QUESTION 3

(a) Derive the expression for **friction energy** dissipated in orthogonal single point cutting. **Use relevant force and velocity vector diagrams in the derivation.**

[14 marks]

(b) Orthogonal single point cutting data from a Lathe Dynamometer Test is as follows:

Measured tangential cutting force	F_c	=	860N
Measured axial force	F_a	=	330N
Rake angle	α	=	10 deg.
Workpiece diameter	D	=	52 mm
Shear plane angle	Φ	=	21deg.
Lathe spindle speed	N	=	125 revs. /min

Calculate the friction energy dissipated in orthogonal single point cutting using the above data and the derivation in **Question 3 (a).** *[6 marks]*

END OF TEST

THE UNIVERSITY OF ZAMBIA
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MEC 3102 PRODUCTION ENGINEERING, ELECTRICITY AND ELECTRONICS

2016 -2017 ACADEMIC YEAR, TERM III

FINAL EXAMINATION

TIME: THREE HOURS. **CLOSED BOOK**

INSTRUCTIONS

1. **Answer Five (5) Questions** Only as Follows:
   Any **Three (3)** Questions from **SECTION A** and **any Two (2)** Questions from **SECTION B**.

2. All Questions Carry **Equal Marks**, that is, **20 Marks** per Question.

3. Questions for **Each Section**, that is, **SECTION A** and **B** are to be answered in **Separate Answer Sheets** which should be **Clearly Labeled** and **Bound Separately**.

4. This Final Examination Question Paper has **Five (5)** pages, including this title page.

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MEC 3102 PRODUCTION ENGINEERING, ELECTRICITY AND ELECTRONICS

2016 -2017 ACADEMIC YEAR, TERM III

FINAL EXAMINATION

TIME: THREE HOURS. **CLOSED BOOK**

INSTRUCTIONS

1. **Answer Five (5) Questions** Only as Follows:
   Any **Three (3)** Questions from **SECTION A** and **any Two (2)** Questions from **SECTION B**.

2. All Questions Carry **Equal Marks**, that is, **20 Marks** per Question.

3. Questions for **Each Section,** that is, **SECTION A** and **B** are to be answered in **Separate Answer Sheets** which should be **Clearly Labeled** and **Bound Separately**.

4. This Final Examination Question Paper has **Five (5)** pages, including this title page.

SECTION A.

QUESTION 1.

(a) Derive an expression for **energy** dissipated on a horizontal milling machine using an up-cut slab mill tool. Include clearly labeled sketch to clarify your derivation. Use chip thickness $t = t_{mean} = f_t (a_e/D)^{0.5}$ (Schlesinger formula) in the derivation. **[13 marks]**

(b) Calculate the **energy** dissipated in the slab milling process given the following slab milling data:

Workpiece:-

Specific cutting pressure for workpiece material	K_c	=	3200 N mm^{-2}
Workpiece width of cut	b	=	80 mm

Tooling:-

Cutter diameter	D	=	85 mm
Tool depth of cut on workpiece	a_e	=	2.5 mm
Tool feed rate against the workpiece	F	=	30 mm min^{-1}

[7 marks]

QUESTION 2.

(a) Derive the expression for **friction energy** dissipated in orthogonal single point cutting. Use relevant force and velocity vector diagrams in the derivation. **[14 marks]**

(b) Orthogonal single point cutting data from a Lathe Dynamometer Test is as follows:

Measured tangential cutting force	F_c	=	860N
Measured axial force	F_a	=	330N
Rake angle	α	=	10 deg.
Workpiece diameter	D	=	52 mm
Shear plane angle	Φ	=	21deg.
Lathe spindle speed	N	=	125 revs. /min

Calculate the friction energy dissipated in orthogonal single point cutting using the above data and the derivation in **Question 2 (a).** **[6 marks]**

QUESTION 3.

(a) Describe flat surface grinding. Give a sketch to illustrate your answer. **[7 marks]**

(b) i) Derive the expression for chip thickness **t** in flat surface grinding. **[11 marks]**

ii) Calculate the chip thickness **t** in flat surface grinding given the following grinding process data:

Grinding wheel diameter	**D**	=	150mm
Depth of cut	**d**	=	0.05 mm

Grit tangential velocity V = 2400 m min^{-1}
Workpiece feed rate v = 9.0 m min^{-1}
Grit quantity C = 6 units per mm^2
Ratio of width to depth of groove cut by grit r = 11

[2 marks]

QUESTION 4.

(a) Give an outline of Resistance Spot Welding (RSW) technology. Include a labeled sketch to illustrate RSW tool/workpiece setting. What are the main uses for RSW? **[10 marks]**

(b) i) What are advantages and disadvantages of RSW technology? **[8 marks]**

ii) The following data relates to the RSW process at a steel product manufacturing plant:

Steel resistivity R = 400 ohms
Spot welding time t = 50×10^{-6} sec
Current I = 60 amps

Calculate the heat energy generated at the spot weld area. **[2 marks]**

SECTION B.

QUESTION 5.

(i) For the circuit shown in Fig.Q.5-1

(a) Determine the relationship between the output Z and the inputs A, B and C. **[3 marks]**

(b) Construct a truth table for the function. **[4 marks]**

(ii) The gate network shown in Fig.Q.5-2 has three inputs A, B and C. Find the an expression for the output Z and simplify the expression. **[6 marks]**

(iii) Obtain a simplified logic expression for the Karnaugh map shown in Fig. Q.5-3. **[7 marks]**

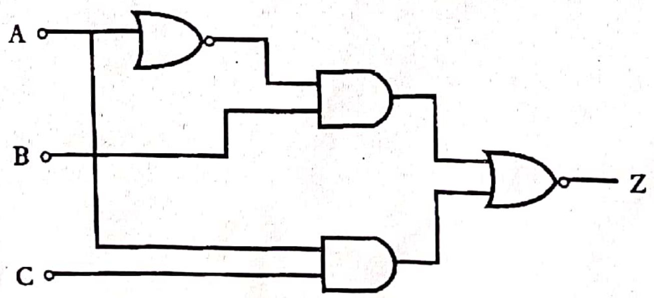

Fig.Q.5-1

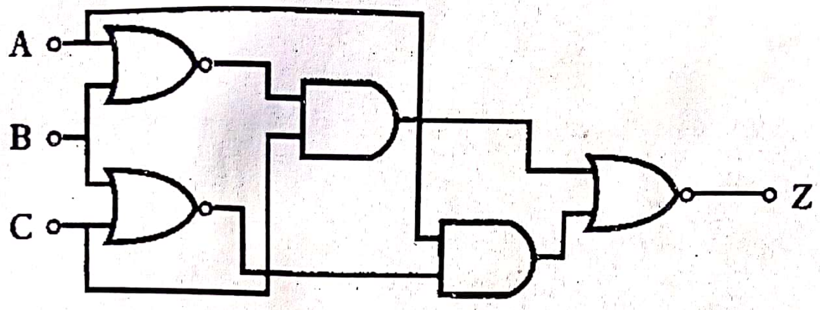

Fig.Q.5-2

(c)

DC \ BA	00	01	11	10
00	1	0	0	1
01	0	1	1	0
11	0	1	1	0
10	1	0	0	1

Fig.Q.5-3

QUESTION 6.

(i) .A wire, 100 mm long, is moved at a uniform speed of 4 m/s at right angles to its length and to a uniform magnetic field. Calculate the density of the field if the e.m.f. generated in the wire is 0.15 V. If the wire forms part of a closed circuit having a total resistance of 0.04Ω, calculate the force on the wire in newtons. **[6 marks]**

(ii) A d.c. shunt motor has an armature resistance of 0.5 Ω and is connected to 200 V supply. If then armature current taken by the motor is 20 A.

(**a**) What is the back-electromotive force generated at the armature. **[3 marks]**

(b). What is the effect of **(1)** inserting a resistor in the field circuit; **(2)** inserting, a resistor in the armature circuit if the armature current is maintained at 20 A? **[4 marks]**

(iii) A d.c. series motor, connected to 440 V supply, runs at 600 r/min when taking a current of 50 A. Calculate the value of a resistor which, when inserted in series with the motor, will reduce the speed to 400 r/min, the gross torque being then the half its previous value.

The resistance of the motor is 0.2 Ω. Assume the flux to be proportional to the field current. **[7 marks]**

QUESTION 7.

(i) State a case in which a three-phase three wire system and a three-phase four wire system are respectively used; for instance in residential area . **[4 marks]**

(i) Show that the total active power in a three-phase system is the same for a star-connected balanced load and for a delta-connected balance load. **[4 marks]**

(ii) In a three-phase four-wire system the line voltage is 400 V and non-inductive loads of 10 kW, 8 kW and 5 kW are connected between the three line conductors and the neutral as in Fig. Q-7.
Calculate the current in each line. **[4 marks]**

(iii) For a certain load, one wattmeter indicated 20 kW and the other 5 kW after the voltage circuit of this wattmeter had been reversed. Calculate the active power and the power factor of the load.

(a) the active power of the load **[4 marks]**

(b) the power factor of the load **[4 mark]**

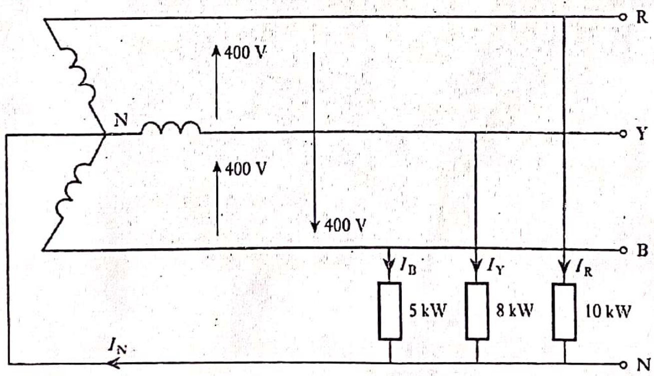

Fig. Q.7

END OF EXAMINATION

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DEPARTMENT OF MECHANICAL ENGINEERING

MEC 3102 PRODUCTION ENGINEERING, ELECTRICITY AND ELECTRONICS

2017 -2018 ACADEMIC YEAR, TERM II

FINAL EXAMINATION

TIME: THREE HOURS. **CLOSED BOOK**

INSTRUCTIONS

1. **Answer Five (5) Questions** Only as Follows:
   Any **Two (2)** Questions from **SECTION A** and **any Two (2)** Questions from **SECTION B,** and an **additional One (1) Question** from either **Section A or B**.
   A total of Five (5) Questions should be answered.

2. All Questions Carry **Equal Marks**, that is, **20 Marks** per Question.

3. Questions for **Each Section,** that is, **SECTION A** and **B** are to be answered in **Separate Answer Sheets** which should be **Clearly Labeled** and **Bound Separately**.

4. This Final Examination Question Paper has Five (5) pages, including this title page.

SECTION A

QUESTION 1.

(a) Describe the process known as surface grinding. In what ways is the surface grinding process similar to milling? Include sketch(es) to illustrate your answer.

What are the composition and coding factors associated with grinding tools?

[12 marks]

(b) (i) Give an outline of the types of cutting materials used in the manufacture of grinding tools. *[4 marks]*

(ii) Give an outline of bonding materials used in the manufacture of grinding tools. **[4 marks]**

QUESTION 2.

(a) Derive the expression for **shear energy** dissipated in orthogonal single point cutting. *[14 marks]*

(b) Orthogonal single point cutting data from a Lathe Dynamometer Test is as follows:

Measured tangential cutting force	F_c	=	850 N
Measured axial force	F_a	=	327 N
Rake angle	α	=	10 deg.
Workpiece diameter	D	=	50 mm
Shear plane angle	Φ	=	20.2 deg.
Spindle speed	N	=	125 rev/min

Calculate the shear energy dissipated in orthogonal single point cutting using the above data and the derivation in Question 2 (a). *[6 marks]*

QUESTION 3.

(a) Describe flat surface grinding. Give a sketch to illustrate your answer. *[7 marks]*

(b) i) Derive the expression for chip thickness **t** in flat surface grinding. *[10 marks]*

ii) Calculate the chip thickness **t** in flat surface grinding given the following grinding process data:

Grinding wheel diameter	**D**	=	160 mm
Depth of cut	**d**	=	0.035 mm

Grit tangential velocity $V = 2000\ m\ min^{-1}$
Workpiece feed rate $v = 8.0\ m\ min^{-1}$
Grit quantity $C = 4$ units mm^2
Ratio of width to depth of groove cut by grit $r = 13$

[3 marks]

QUESTION 4. I have not answered ↓

(a) Derive an expression for **energy** dissipated on a horizontal milling machine using a slab mill tool. Include clearly labeled sketch to clarify your derivation. Use chip thickness $t = t_{mean} = f_t (a_e/D)^{0.5}$ (Schlesinger formula) in the derivation. Kissinger

[14 marks]

(b) Calculate the **energy** dissipated in a slab milling process given the following slab milling data:

Tooling:-

Cutter diameter	=	80 mm
Tool depth of cut on workpiece	=	2 mm
Tool feed rate against the workpiece	=	29 mm min^{-1}

Workpiece:-

Specific cutting pressure for workpiece material	=	3000 N mm^{-2}
Workpiece width of cut	=	70 mm

[6 marks]

Yes!!

SECTION B

QUESTION 5.

(i) A mild steel ring has a mean circumference of 500 mm and a uniform cross-section area of 300 mm^2.
Calculate the m.m.f. required to produce a flux of 500 μWb. **[5 marks]**

(ii) A flux of 0.5 mWb is produced in a coil of 900 turns wound on a wooden ring by a current of 3 A. Calculate:

(a) The inductance of the coil. **[5marks]**

(b) The average value of the e.m.f. induced in the coil when a current of 5 A is switched off, assuming the current to fall to zero in 1 ms. **[5 marks]**

(c) The mutual inductance between the coils, if a second coil of 600 turns was uniformly wound over the first coil. **[5 marks]**

QUESTION 6.

(i) With the aid of a diagram explain the difference between a lap-winding and a wave-winding. **[6 marks]**

(ii) A d.c. motor has an armature resistance of 0.5 Ω and is connected to 200 V supply. If then armature current taken by the motor is 20 A what is the back-electromotive force generated at the armature. **[2 marks]**

(iii) A six-poles armature is wound with 498 conductors. The flux and the speed are such that the average generated e.m.f. generated in each conductor is 2 V. The current in each conductor is 120 A. Find:

(a) The total current and the generated e.m.f of the armature if the winding is connected: **(1)** wave; **(2)** lap. **[6 marks]**

(b) The total electrical power generated in each case. **[6 marks]**

QUESTION 7.

(i) **(a).** Convert **26_{10}** into binary; **$A013_{16}$** to decimal; and **7046_{10}** to hexadecimal. **[3 marks]**

(b) In the **Figure Q.7-1**, a power source a lamp and a number of switches are used to represent a logical expression. Derive an expression for the following arrangement using AND, OR and NOT operations. **[4 marks]**

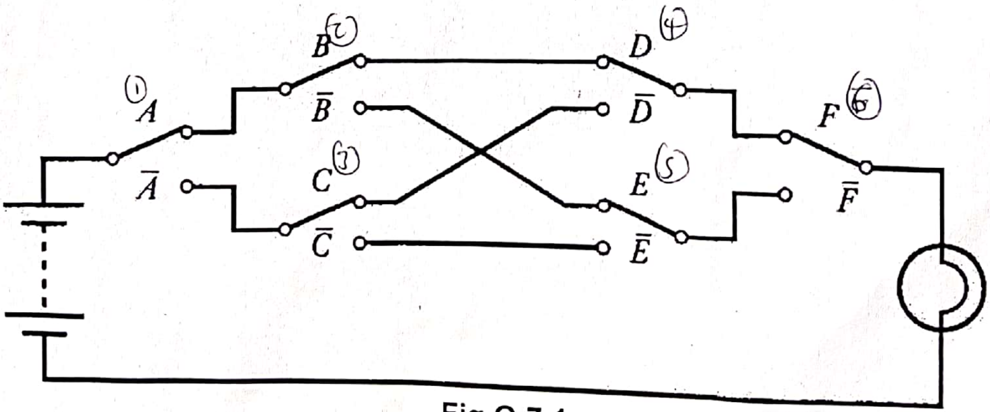
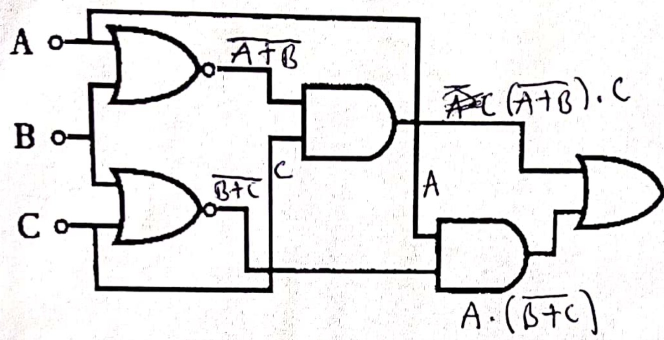


Fig.Q-7.1

(c). If the circuit given in **(b)** was described by a truth table, how many rows would the table require? **[1 marks]**

(ii) The gate network shown in **Fig.7.2** has three inputs A, B and C. Find the an expression for the output Z and simplify the expression. ***[6 marks]***



$(A+B).\bar{C} + \bar{A}(B+C)$

Fig.Q-7.2 $Z = \bar{C}.(A+B) + \bar{A}(B+C)$

(iii) Obtain the simplified logic expression for the Karnaugh map shown in **Fig Q-7.3.** ***[6 marks]***

$A.\bar{C} + B\bar{C} + \bar{A}B + \bar{A}C$

DC \ BA	00	01	11	10
00	(0) 1	(1) 0	(3) 1	(2) 0
01	(4) 0	(5) 0	(7) 1	(6) 1
11	(12) 0	(13) 0	(15) 0	(14) 0
10	(8) 1	(9) 1	(11) 1	(10) 0

$Z = \overline{\overline{(A+B)}.C + A.(\overline{B+C})}$

$\overline{(\bar{A}.\bar{B})\,C} + \bar{A}.(\overline{\bar{B}.\bar{C}})$

$(\bar{A}.\bar{B})\,\bar{C} + \bar{A}.(\bar{\bar{B}}.\bar{\bar{C}})$

$(A.B).\bar{C} + \bar{A}.(B.C)$

$A.B.\bar{C} + \bar{A}.B.C$

$B(A.\bar{C} + \bar{A}.C)$

Fig.Q-7.3

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
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DEPARTMENT OF MECHANICAL ENGINEERING

ME3102 MACHINE TOOLS AND PRINCIPLES OF ELECTRICITY II
MID-TERM III TEST, MAY, 2015

TIME: TWO HOURS. **CLOSED BOOK**
ANSWER: ALL QUESTIONS.
All questions carry equal marks (that is, 20 marks each).

QUESTION 1.

(a) (i) What assumptions should be made with respect to Merchant's cutting theory? *[4 marks]*
(ii) Give clearly labeled diagrams for workpiece geometry, force and velocity vectors associated with Merchant's cutting theory. *[6 marks]*

(b) Orthogonal single point cutting data from a Lathe Dynamometer Test conducted at the UNZA Machine Tools Laboratory is as follows:

Tangential cutting force	F_c	=	3.384 kN
Axial force	F_a	=	1.177 kN
Cutting velocity	v_c	=	25.5 m min^{-1}
Rake angle	α	=	20 deg.
Shear plane angle	Φ	=	23.5 deg.

Calculate the **Shear Energy** dissipated in single point cutting experiment using the above data. *[10 marks]*

QUESTION 2.

(a) Compare and contrast **up-cut** and **down-cut** slab milling processes as relates to machining of metals. Give clearly labeled sketches to illustrate your answer; include graphs of **force** versus **chip length** for the milling processes. *[7 marks]*

(b) (i) **Derive** an **expression** for **energy** dissipated in **up-cut** slab milling. Include clearly labeled sketch(es) to clarify your derivation. *[8 marks]*

(ii) **Calculate** the **energy** dissipated in an **up-cut** slab milling process given the following milling data:

Workpiece:-

Specific cutting pressure for workpiece material	K_c = 2800 N mm^{-2}
Workpiece width of cut	b = 65 mm
Tooling	
Cutter diameter	D = 75 mm
Tool feed rate against the workpiece	F = 27 mm min^{-1}
Tool depth of cut on workpiece	a_e = 1.5 mm

[5 marks]

R = 35 .

QUESTION 3.

(a) Give brief outlines of the functions in machine tool design of the listed machine tool members/components. Give labeled sketches to illustrate your answer for question (a).

(i) Frames *[6 marks]*

(ii) Slides *[6 marks]*

(b) Give brief outlines of the fundamental principles that must be incorporated in the design and manufacture of the above listed machine tool members / components to ensure attainability of the desired functions for the components. *[8 marks]*

QUESTION 4.

(a) Give an outline of the key coding parameters used for grinding wheel specification. *[6 marks]*

(b) (i) Derive the expression for chip thickness t associated with the abrasive machining technology known as flat surface grinding. *[10 marks]*

(ii) Calculate the chip thickness **t** in flat surface grinding given the following grinding process data:

Grinding wheel diameter	D	=	140 mm
Depth of cut	d	=	0.025 mm
Grit tangential velocity	V	=	1900 m min^{-1}
Workpiece feed rate	v	=	6.0 m min^{-1}
Grit quantity	C	=	3 units mm^{-2}
Ratio of width to depth of groove cut by grit	r	=	9

10^3 31.67 m/s / 0.1 m/s

[4 marks]

END OF TEST

$t = \sqrt{\frac{4v}{CrV}} \sqrt{\frac{d}{D}}$

1900 m/min

0.14

3 units mm^{-2}

$1 m^2 = (1000 mm)^2$

$mm^2 = m^2$

$1 \times 10^{-6} m^2$

Scanned by CamScanner

(a) (i) What assumptions should be made with respect to Merchant's cutt theory? (4 marks)

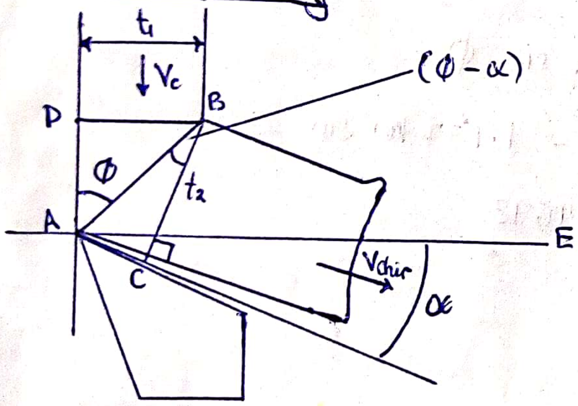
Solution

- Tool is sharp, that is, no nose or flank forces
- Two dimensional deformation, that is, no side spread, implying no material flow in ZX plane, material flow only in YX plane
- Uniformly distributed stresses on the shear plane; material undergoes plastic deformation through shearing on the ~~[struck]~~ shear plane due to forces imparted on work piece by tool
- The principle of least work is applicable

(ii) Give clearly labeled diagrams for workpiece geometry, Forces and Velocity vectors associated with Merchant's cutting theory

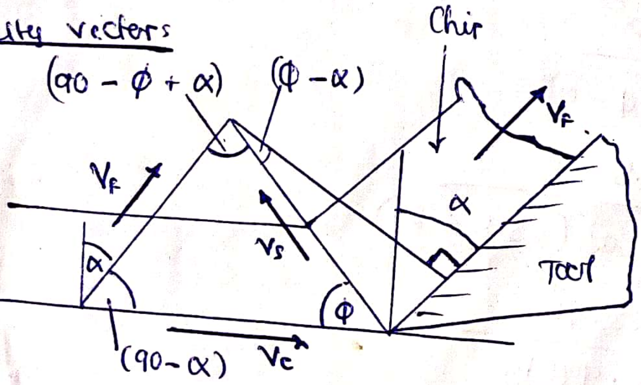
Solution

Workpiece geometry



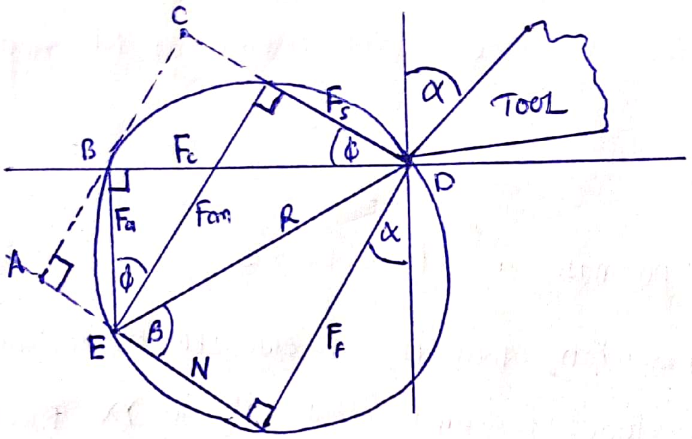
α - Rake angle
ϕ - Shear angle
t_1 - uncut chip thickness
t_2 - cut chip thickness

Velocity vectors



V_c - cutting velocity
V_F - friction velocity
V_s - shear velocity

Force vectors



Fc - Cutting Force

Fcm - Compressive force on the Shear plane

Fs - Shear force on shear surface

Ff - Friction Force along rake angle

N - Normal Force on chip

Fa - Axial force

(b)

Data

$F_c = 3.384$ KN $\alpha = 20$ deg

$F_a = 1.177$ KN $\phi = 23.5$ deg

$V_c = 25.5$ m.min^{-1}

$$F_s = F_c \cos\phi - F_a \sin\phi$$

$$= 3.384 \cos 23.5 - 1.177 \sin 23.5$$

$$= 3.10333 - 0.4693$$

$$= 2.634 \text{ KN}$$

$$V_s = \frac{V_c \cos\alpha}{\cos(\phi - \alpha)}$$

$$= \frac{25.5 \cos 20}{\cos(23.5 - 20)}$$

$$= \frac{23.962}{0.99814}$$

$$= 24 \text{ m min}^{-1}$$

$$\therefore W_s = F_s V_s$$

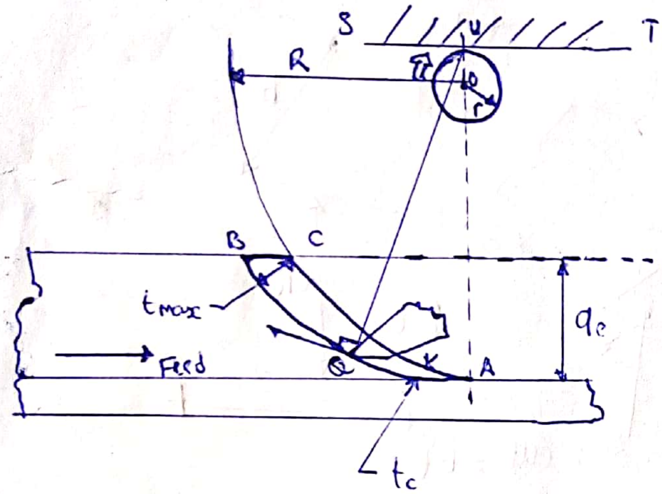
$$= (2.634)(24)$$

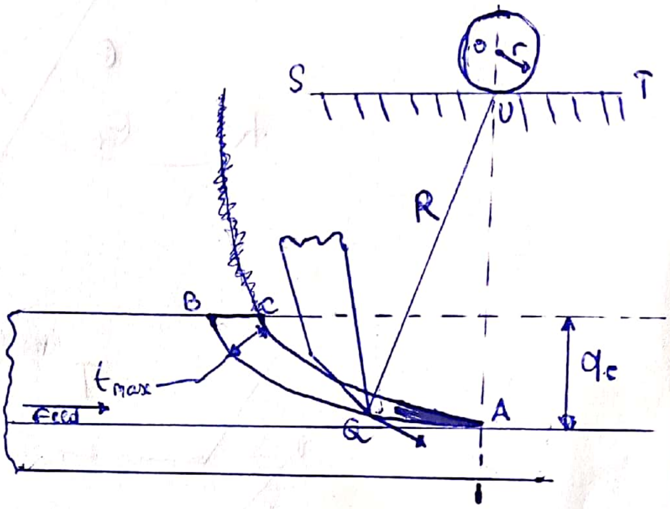
$$= 63.216 \text{ KJ/min}$$

QUESTION 2

(a) Compare and contrast up-cut and down-cut slab milling process as related to machining of metals. Give clearly labeled sketches to illustrate your answer; include graphs of force versus chip length for milling processes.

Solution





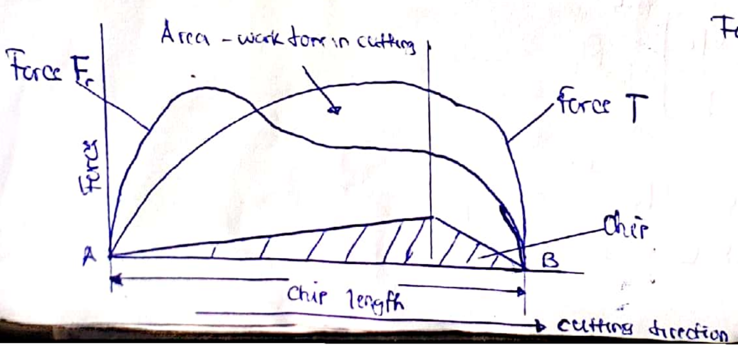
Compare

- Chip lies between two (2) trochoids, that is AB and AC
- For the trochoid, centre of curvature of Q is at U, that is
- The velocity of Q relative to workpiece is at right angle to UQ

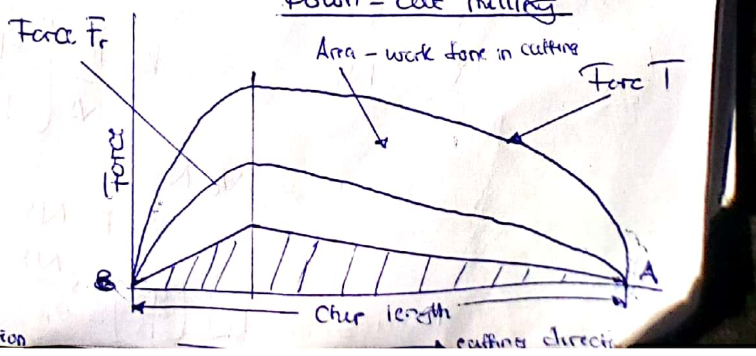
Contrast

- Up-cut milling chip from A to B, whereas down-cut milling chip from B to A
- In down cut-milling, the path length BA is shorter than path AB for Up-cut milling
- In down cut milling, t_{max} occurs almost at start of cut

up-cut milling

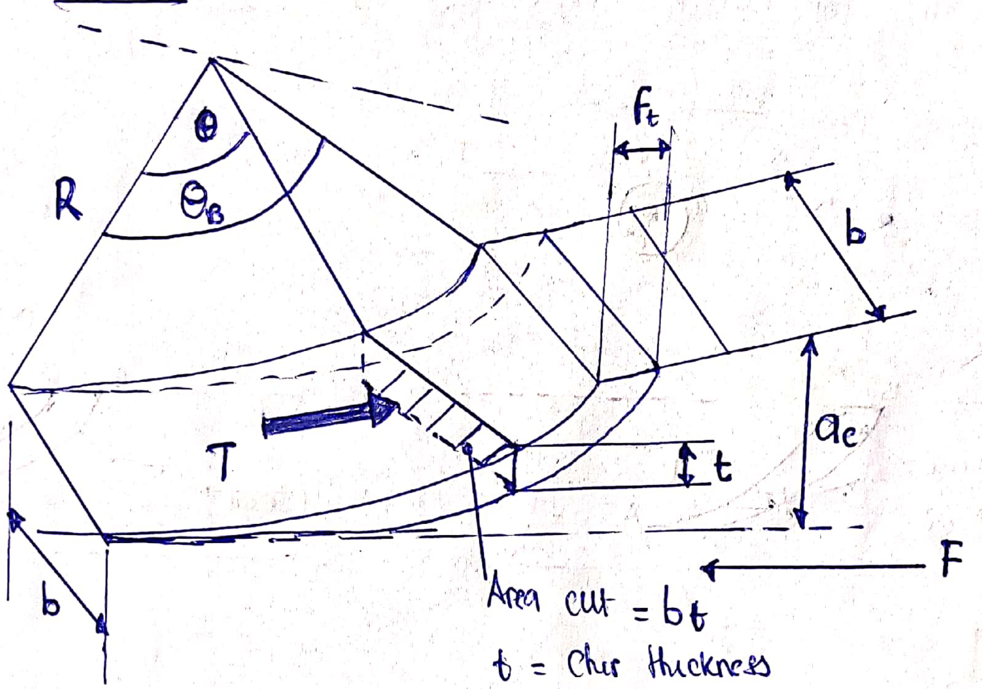


Down-cut milling



(ii) (1) Derive an expression for energy dissipated in up-cut slab milling. Include clearly labeled sketch(es) to clarify your derivation

Solution



$T = K_c b t$

W_c = Torque × Angle turned

W_c = Force × Distance × Angle turned

$$W_c = K_c b t \int_0^{\theta} R \, d\theta$$

$$W_c = R b K_c t \, \theta_B$$

$$t = t_{mean} = f_t \sqrt{\frac{a_e}{D}}$$

$$f_t = \frac{F}{NS}$$

Then

$$W_c = R b K_c \frac{F}{NS} \left[\frac{a_e}{D}\right]^{0.5} \theta_B$$

$$\text{Power} = W_c NS$$

$$= R b K_c F \frac{NS}{NS} \left[\frac{a_e}{D}\right]^{0.5} \theta_B$$

$$\text{Power} = R b K_c F \left[\frac{a_e}{D}\right]^{0.5} \theta_B$$

ii)

Para

$K_c = 2800 \, N \, mm^{-2}$

$b = 65 mm$

$D = 95 mm$

$F = 27 \, mm \, min^{-1}$

$a_e = 1.5 mm$

$$Power = R b K_c F \left[\frac{a_e}{D}\right]^{0.5} \theta_B$$

$$\theta_B = \cos^{-1} \frac{R - a_e}{R}$$

$$= \cos^{-1} \frac{37.5 - 1.5 mm}{37.5}$$

$$\theta_B = \cos^{-1}(0.96) = 16.3^\circ$$

$$\frac{16.3 \times \pi}{180} = 0.284 \, rad$$

$$= R b K_c F \left[\frac{a_e}{D}\right]^{0.5} \theta_B$$

$$= (37.5)(65)(2800)(27)\left[\frac{1.5}{95}\right]^{0.5} 0.284 \, rad$$

$$= 7401159.399$$

Abrasive Material
- Type
- Size
- hardness

Bond Material
- Strength (Grade)
- structure
- Porosity

QUESTION 4

(a) Give an outline of the key coding parameters used for grinding wheel specifications

Solution

~~M = Number of Grits/mm section of circumference~~

~~v = Workpiece speed ($m \, min^{-1}$)~~

~~V = Grinding wheel cutting speed (tangential) ($m \, min^{-1}$)~~

~~C = Number of effective grits/mm^2 of grinding wheel surface~~

~~r = ratio of width to depth of a groove cut by a Grit~~

~~d = depth of cut on workpiece (mm)~~

~~D = grinding wheel diameter (mm)~~

(b)(i) Derive the expression for chip thickness associated with the abrasive machining technology known as flat surface grinding

Solution

$$Area = S \cdot t$$

$$Area = \frac{s\,2v}{NV}\sqrt{\frac{d}{D}}$$

$$A_{grit} = \frac{bt}{2}$$

ratio :- $r = \frac{b}{t}$; $b = r \cdot t$

$$A_{grit} = \frac{(r \cdot t)t}{2} = \frac{rt^2}{2}$$

Total projected area for N grits on the surface

$$Area\,(total) = \frac{rt^2 Ns}{2}$$

$$\therefore \quad Area = \frac{s\,2v}{NV}\sqrt{\frac{d}{D}} = \frac{rt^2 Ns}{2}$$

$$t^2 = \frac{2\,s\,2v}{r\,s\,N^2 V}\sqrt{\frac{d}{D}}$$

$$t = \sqrt{\frac{4v}{rN^2V}\sqrt{\frac{d}{D}}}$$

By definition $C = N^2$

$$t = \sqrt{\frac{4v}{rcV}\sqrt{\frac{d}{D}}}$$

Scanned by CamScanner

Data

$D = 140\,mm = 0.14\,m$

$d = 0.025\,mm = 2.5 \times 10^{-5}\,m$

$V = 1850\ m\ min^{-1}$

$v = 9.5\ m\ min^{-1}$

$C = 5\ units\ mm^{2}$

$= 5 \times 10^{-6}\ units\ m^{-2}$

$1m^2 = 1000\,mm^2$

$1m^2 = 1000000\,mm^2$

$x \quad 5$

$$t = \sqrt{\frac{4v}{rCV\sqrt{\frac{d}{D}}}}$$

$$= \sqrt{\frac{4(9.5)}{15(5\times10^{-6})(1850)\sqrt{\frac{2.5\times10^{-5}}{0.14}}}}$$

$= 1.913$

Question 4

Data given:

Diameter of Cutter = 100 mm.
Number of Cutting teeth = 10.
Speed of Cut = 24 m min^{-1}.
table feed = 80 mm/min.
depth of Cut = 4 mm.

$$\text{Spindle Speed} = \frac{\text{Cutting Speed}}{(\text{Diameter of Cutter})\pi}$$

$$= \frac{24000\text{ mm min}^{-1}}{(100\text{ mm})\pi}$$

$$= 76.39\text{ rev/min.}$$

(3)

$$f_t = \frac{\text{feed table}}{\text{Spindle speed} \times \text{no of teeth}}$$

(1)

$$= \frac{80}{76.39 \times 10} = 0.1047\text{ mm}$$

(2)

$$t_{max} = 2f_t\left(\frac{a_e}{D}\right)^{0.5}$$

(2)

$$= 2 \times 0.1047\left(\frac{4}{100}\right)^{0.5}$$

$$= 0.042\text{ mm}$$

(2)

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

MEC 3102 PRODUCTION ENGINEERING, ELECTRICITY AND ELECTRONICS

2017 -2018 ACADEMIC YEAR, TERM II

FINAL EXAMINATION

TIME: THREE HOURS. **CLOSED BOOK**

INSTRUCTIONS

1. **Answer Five (5) Questions** Only as Follows:
   Any **Two (2)** Questions from **SECTION A** and **any Two (2)** Questions from **SECTION B,** and an **additional One (1) Question** from either **Section A or B.**
   A total of Five (5) Questions should be answered.

2. All Questions Carry **Equal Marks**, that is, **20 Marks** per Question.

3. Questions for **Each Section,** that is, **SECTION A** and **B** are to be answered in **Separate Answer Sheets** which should be **Clearly Labeled** and **Bound Separately**.

4. This Final Examination Question Paper has Five (5) pages, including this title page.

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QUESTION 1.

SECTION A

(a) Describe the process known as surface grinding. In what ways is the surface grinding process similar to milling? Include sketch(es) to illustrate your answer.

What are the composition and coding factors associated with grinding tools?

[12 marks]

(b) (i) Give an outline of the types of cutting materials used in the manufacture of grinding tools. **[4 marks]**

(ii) Give an outline of bonding materials used in the manufacture of grinding tools. **[4 marks]**

✓QUESTION 2. (done)

(a) Derive the expression for **shear energy** dissipated in orthogonal single point cutting. *[14 marks]*

(b) Orthogonal single point cutting data from a Lathe Dynamometer Test is as follows:

Measured tangential cutting force	F_c	=	850 N
Measured axial force	F_a	=	327 N
Rake angle	α	=	10 deg.
Workpiece diameter	D	=	50 mm
Shear plane angle	Φ	=	20.2 deg.
Spindle speed	N	=	125 rev/min

Calculate the shear energy dissipated in orthogonal single point cutting using the above data and the derivation in Question 2 (a). **[6 marks]**

QUESTION 3. (done)

(a) Describe flat surface grinding. Give a sketch to illustrate your answer. *[7 marks]*

(b) i) Derive the expression for chip thickness **t** in flat surface grinding. *[10 marks]*

ii) Calculate the chip thickness **t** in flat surface grinding given the following grinding process data:

Grinding wheel diameter	**D**	=	160 mm
Depth of cut	**d**	=	0.035 mm

Grit tangential velocity	**V**	=	2000 m min^{-1}
Workpiece feed rate	**v**	=	8.0 m min^{-1}
Grit quantity	**C**	=	4 units mm^2
Ratio of width to depth of groove cut by grit	**r**	=	13

[3 marks]

QUESTION 4.

done

(a) Derive an expression for **energy** dissipated on a horizontal milling machine using a slab mill tool. Include clearly labeled sketch to clarify your derivation. Use chip thickness $\mathbf{t = t_{mean} = f_t (a_e/D)^{0.5}}$ (Schlesinger formula) in the derivation.

[14 marks]

(b) Calculate the **energy** dissipated in a slab milling process given the following slab milling data:

Tooling:-

Cutter diameter	=	80 mm
Tool depth of cut on workpiece	=	2 mm
Tool feed rate against the workpiece	=	29 mm min^{-1}

Workpiece:-

Specific cutting pressure for workpiece material	=	3000 N mm^{-2}
Workpiece width of cut	=	70 mm

[6 marks]

SECTION B

QUESTION 5.

(i) A mild steel ring has a mean circumference of 500 mm and a uniform cross-section area of 300 mm^2 .
Calculate the m.m.f. required to produce a flux of 500 μWb. ***[5 marks]***

(ii) A flux of 0.5 mWb is produced in a coil of 900 turns wound on a wooden ring by a current of 3 A. Calculate:

(a) The inductance of the coil. ***[5marks]***

(b) The average value of the e.m.f. induced in the coil when a current of 5 A is switched off, assuming the current to fall to zero in 1 ms. ***[5 marks]***

(c) The mutual inductance between the coils, if a second coil of 600 turns was uniformly wound over the first coil. ***[5 marks]***

QUESTION 6.

(i) With the aid of a diagram explain the difference between a lap-winding and a wave-winding. **[6 marks]**

(ii) A d.c. motor has an armature resistance of 0.5 Ω and is connected to 200 V supply. If then armature current taken by the motor is 20 A what is the back-electromotive force generated at the armature. **[2 marks]**

(iii) A six-poles armature is wound with 498 conductors. The flux and the speed are such that the average generated e.m.f. generated in each conductor is 2 V. The current in each conductor is 120 A. Find:

(a) The total current and the generated e.m.f of the armature if the winding is connected: (**1**) wave; (**2**) lap. **[6 marks]**

(b) The total electrical power generated in each case. **[6 marks]**

QUESTION 7.

(i) **(a).** Convert **26_{10}** into binary; **$A013_{16}$** to decimal; and **7046_{10}** to hexadecimal. **[3 marks]**

(b) In the **Figure Q.7-1**, a power source a lamp and a number of switches are used to represent a logical expression. Derive an expression for the following arrangement using AND, OR and NOT operations. **[4 marks]**

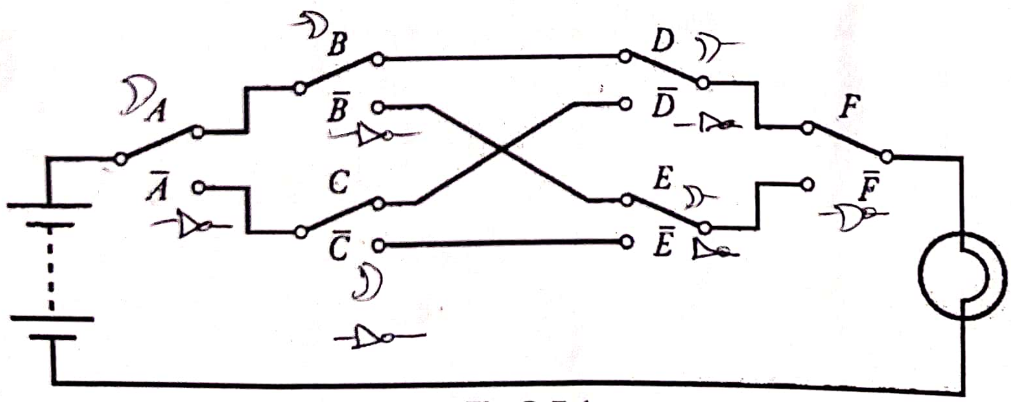

Fig.Q-7.1

(c). If the circuit given in **(b)** was described by a truth table, how many rows would the table require? **[1 marks]**

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(ii) The gate network shown in **Fig.7.2** has three inputs A, B and C. Find the an expression for the output Z and simplify the expression. ***[6 marks]***

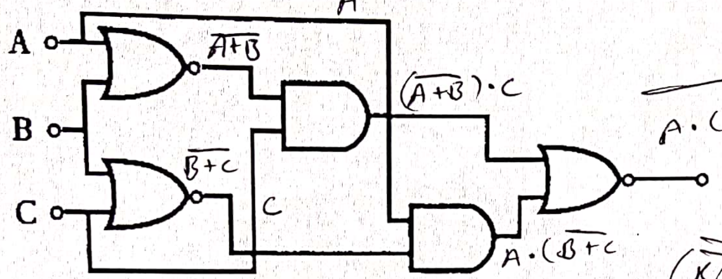

Fig.Q-7.2

(iii) Obtain the simplified logic expression for the Karnaugh map shown in **Fig Q-7.3.** ***[6 marks]***

DC \ BA	00	01	11	10
00	(0) 1	(1) 0	(3) 1	(2) 0
01	(4) 0	(5) 0	(7) 1	(6) 1
11	(12) 0	(13) 0	(15) 0	(14) 0
10	(8) 1	(9) 1	(11) 1	(10) 0

Fig.Q-7.3

END OF EXAMINATION

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ME3102 PRODUCTION ENGINEERING, ELECTRICITY AND ELECTRONICS
MID-TERM II TEST, SEPTEMBER, 2018

TIME: TWO HOURS. CLOSED BOOK
ANSWER: ALL QUESTIONS.
All questions carry equal marks (that is, 20 marks each).

QUESTION 1.

(a) Give brief outlines of the functions in machine tool design of the listed machine tool members/components. Give labelled sketches to illustrate your answer for question (a) *ii)*.

i) Frames **[6 marks]**
ii) Slides **[6 marks]**

(b) Give brief outlines of the fundamental principles that must be incorporated in the design and manufacture of the above listed machine tool members / components to ensure attainability of the desired functions for the components?

[8 marks]

QUESTION 2.

(a) Derive the expression for **friction energy** dissipated in orthogonal single point cutting. Use relevant force and velocity vector diagrams in the derivation.

[14 marks]

(b) Orthogonal single point cutting data from a Lathe Dynamometer Test is as follows:

Measured tangential cutting force	F_c = 860N
Measured axial force	F_a = 330N
Rake angle	α = 10 deg.
Workpiece diameter	D = 52 mm
Shear plane angle	Φ = 21deg.
Lathe spindle speed	N = 125 revs. /min

Calculate the friction energy dissipated in orthogonal single point cutting using the above data and the derivation in **Question 2 (a).** ***[6 marks]***

QUESTION 3

(a) Derive the expressions for the **compressive force** (F_{cm}) acting on the shear plane in accordance with Merchant's theory of metal cutting and also derive the expression of the **shear angle (Ø)** in single point orthogonal turning. Include appropriate sketches in your answer. ***[10 marks]***

(b) In orthogonal single point turning, calculate the **compressive stress** on the shear plane, given the following machining data:

Tooling:-

Rake angle	α	= 15 deg.
Depth of cut	**d**	= 2.0 mm.
Tool feed per revolution	**f**	= 0.3 mm rev^{-1}.
Cutting velocity	v_c	= 25 m min^{-1}.

Forces:-

Cutting force in direction of cutting velocity	F_c	= 4509 N.
Cutting force in direction of tool feed	F_a	= 1851 N.

Workpiece:-

Chip thickness	t_2	= 0.48 mm.

[10 marks]

END OF TEST

QUESTION 2

(a) for ACV

30% < rock aggregate is considered worthless for any means of construction

Reason

The relationship between the ACV and strength of aggregate is an inverse relation, the higher the ACV the weaker the aggregate and vice versa

For Abrasion value