### BINDURA UNIVERSITY OF SCIENCE EDUCATION

### FACULTY OF SCIENCE AND ENGINEERING

**AEH 501** 

# Department of Engineering and Physics

# Bachelor of Science Honours Degree in Agricultural Engineering

# Agricultural Machinery Management

3 hours (100 Marks)

### Instructions:



- 1. This paper contains 6 questions
- 2. Answer any FOUR questions, each of which carries 25 marks

### Question 1

a) Explain some of the reasons a farmer would consider going for a short time rental of farm equipment among other options.

[5 marks]

b) Discuss some of the considerations likely to influence your choice of acquiring farm machinery services.

[10 marks]

c) Explain the advantages and disadvantages of custom hiring as a way of acquiring machinery services.

[10 marks]

### Question 2

a) Explain the factors affecting effective field capacity.

[5 marks]

b) Given the following data:

Area to be ploughed	120 ha
Soil resistance	3.62 N/m/cm-depth
Operating speed	8 km/hr
Field efficiency losses	18%
Depth of ploughing	10 cm

i. Calculate the work rate if 40 hours are available per week. [2 marks]

ii. Calculate the swath of the implement,

[2 marks]

iii. Calculate the draft force (N),

[2 marks]

iv. The drawbar power required (Kw).

[2 marks]

c) A self-propelled combine with a 12-row corn head for 75 cm row spacing travels at 5km/h while harvesting maize yielding 12 t/ha. Losses proportional to area total to 5.2 minutes per hectare and are primarily due to unloading grain from the combine. Neglecting any other losses, calculate:

(i) the field efficiency and

[5 marks]

The effective field capacity on:

(ii) an area basis, and

[4 marks]

(iii) material basis.

[3 marks]

# Question 3

A farmer purchased a 35 hp wheel type tractor at a total costs of \$15000 and a 3 bottom plough with 30 cm bottom at \$1500. The fuel consumption of the tractor is 12 l/hr at a plough speed of 5 km/hr.

For tractor: economic life = 10 years

Annual operating hours = 600 hrs

For plough life = 8 years

Interest = 10%

Annual operating hours = 200 hrs

a) Calculate the area ploughed per hour.

[5 marks]

b) Determine the cost of ploughing.

[ 20 marks]

### Question 4

i. Explain the six big losses associated with overall equipment availability.

[6 marks]

ii. The following data in table 1 was extracted form a yoghurt packaging line at a dairy farm.

### Table 1:

Item	Data
Shift length	8 hours
Breaks	(2) 15 minutes (1) 30 minutes
Downtime	47 minutes
Ideal cycle time	5.0 s
Total count	3 854 packets
Rejects	85 packets

### Calculate:

a) The machine availability	[5 marks]
b) Machine performance	[5 marks]
c) The quality factor	[5 marks]
d) Overall equipment effectiveness	[4 marks]

# Question 5

- a) Explain the considerations for leasing farm equipment as a way of acquiring machinery service. [8 marks]
- b) A grain storage company bought a new grain dryer for \$100 000.00, with all funds paid out when the machine is acquired. Over each of the next five years, the machine is expected to require \$10 000.00 annual operational costs and will generate \$50 000.00 of payments from customers. Calculate the payback period. [5 marks]
- c) Wadzanai and Matilda purchased a used S670 John Deere combine jointly, each paying half of the purchase cost of \$ 120 000. The combine is used for 900 ha. 600 ha by Wadzanai and 300 by Matilda. Both provide for their own fuel and labour, and repair costs are divided equally. The custom rate is at \$75/ha.
  - i. A calculate the cost of using this combine for extra activities.

[4 marks]

ii. Calculate the extra ha that will be used by Wadzanai above his 50% share.

[4 marks]

iii. How much is Wadzanai expected to pay Matilda for the extra usage of his share.

[4 Marks]

# Question 6

a) State four considerations for the replacement of manual labour by farm machinery.

[4 marks]

b) Discuss the pros and cons of purchasing used equipment as opposed to new equipment.

[8 marks]

- c) Suppose a farmer plants 150 ha of cotton per year with an average yield of 3000 kg/ha. Currently the farmer has his cotton picked by hand by seasonal labourers at a cost of \$0.011/kg of cotton picked. The cost includes rations and transport. The farmer intends to continue producing cotton in future and is now considering replacing seasonal laborers with a cotton picker. A new cotton picker costs \$6 000 and after a useful life of 5 years he should be able to sell it for \$2 000. The variable costs of the cotton picker are \$1.50/ha, but because cotton has to be picked twice by the cotton picker, they effectively amount to \$3/ha. The mechanical picker also causes yield and quality losses of \$24/ha. Assume an interest rate of 12% on capital investment and 2% of TIH.
  - i. Is the replacement of labor by a cotton picker economicallyjustifiable at the present scale of production? [8 marks]
  - ii. Calculate the minimum scale of production that will makethe replacement justifiable. [5 marks]

Appendix

[AEH 501 Agricultural Machinery Management]

Remaining Salvage Value as a Percentage of New List Price

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# Accumulated Repair Costs as a Percentage of new List Price

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Fertilizer spreader		) (A)	88		.0661	26%	37.8%	40%	47%	55%	03.36
Type of Machine	Accumulated Hours	200	400	000	800	1,000	1,200	1,400	1,600	1,800	2,000
Boom-type sprayer		U. 7.0	12%	21%	31%	41%	52%	63%	70%	888%	101%
Air-nearceneanes		20.0	in ក្	ु <sup>3</sup> क	14%	20%	27%	35 pt	42%	21%	m 1.6
Sean puller-windrower	ier	2%5	ក្ ក	% 60	14.5	20%	27%	35455	42%	% [6]	0 i
Stalk chopper		(i)	3 60	6 4	20%	28%	် (၁) (၁)	(1) (1)	32 T	10 to	9 d l
Forage blower		. o .	of i	on i	100 i	22%	8.20	25 to 15 to	្តំ ភូមិ ភូមិ	\$ 50 p	0 00
Wagon		9 0 F <b>(</b>	9 74	0 00 00 m	2 2	0 0000	2 5 1 7 N C	2000	0 00 Mg (4)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	9 00 00 00 00 00 00 00 00 00 00 00 00 00
Totage Wagon		270	0%0	20.00	# N	g n	0.5 ftm 7.0	6 F R	0	g i	0.
Source: American Society of Agricultural		Engineers	1996.								
of the Property of		1 1 1 1 1 1 1 1	;								-