EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NJORO CAMPUS

FIRST SEMESTER 2012/2013

THIRD YEAR EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING

AGEN 343: AGRICULTURAL PROCESS ENGINEERING I

STREAM: 2010 (Y3) B. SC. AGEN **TIME:** 2 hours

DAY/TIME: Friday, 8.30 – 11.30 am **DATE:** 11/01/2013

INSTRUCTIONS:

1. The paper contains **FOUR (4)** questions.
2. Attempt **QUESTION 1** and **any other TWO** questions
3. All questions carry equal marks.
4. Shown in parenthesis are marks for each question.
5. **EACH QUESTION SHOULD BE STARTED ON A NEW PAGE.**

QUESTION ONE (COMPULSORY)

(a) Distinguish between operational amplifier and instrument amplifier **(4 marks)**

(b) What is the role of measurements in processing operations? **(2 marks)**

(c) Briefly define the following terms:

(i) Signal conditioning

(ii) Transducer

(iii) Negative feedback **(3 marks)**

(d) Discuss the applications of voltage amplifiers in processing operations. **(6 marks)**

(e) Distinguish between direct recorders and indirect recorders **(2 marks)**

(f) Briefly, discuss the components of an instrument system **(3 marks)**

QUESTION TWO

(a) Outline the important considerations to be borne in mind when selecting a flow meter for measuring flow of carbon dioxide to be used in a bottling plant. **(5 marks)**

(b) A centrifugal pump is moving extracted soybean oil from the expresser to the holding tank through a 25 mm diameter stainless steel pipe. The pump is driven by a 240 V motor using 285 W. Assuming an overall pump and motor efficiency of 65%, calculate the pumping rate in m^3 per minute if the pressure at the suction line is 5 PSI and 32 PSI at the delivery line.

(5 marks)

(c) Briefly outline the classification system for pumps. **(5 marks)**

(d) Derive from first principles and show that the power requirement for a centrifugal pump mechanism is given by:

$$P = q\frac{\gamma}{g} + \left(v_2 V_2 \cos\alpha_2 - v_1 V_1 \cos\alpha_1\right)$$

(5 marks)

QUESTION THREE

(a) With relevant illustrations, compare fan performance in series and parallel configuration.

(4 marks)

(b) Briefly discuss the compensation effect in air moving systems and illustrate with relevant equations the effect of this phenomenon. **(6 marks)**

(c) Briefly outline the distinct advantages of pneumatic conveyors over other mechanical conveying systems. **(4 marks)**

(d) Briefly discuss **any three** size reduction procedures. **(4 marks)**

(e) State kick's law showing the relevant equations. **(2 marks)**

QUESTION FOUR

(a) Design a trough belt conveyor with the following specifications:

- Surcharge angle of 30°
- Conveyor capacity of 2300 Bu of corn per hour.
- Conveyor length is 500 ft long with an incline of 20°. **(10 marks)**

(b) Using design data from **(a)** above, make materials list for the project with relevant assumptions as well as the project bill of quantities. **(4 marks)**

(c) An attrition mill and hammer mill were used to assess the grinding process in a feed manufacturing firm. The results obtained are shown in Table Q4 (c). Analyse these results and with reason, make recommendations as to which mill should be used for processing:

(i) Chick mash

(ii) Dairy meal **(6 marks)**

Table Q4 (c)

Mesh Size	Size of mesh opening (in)	Mass of material retained	
		Attrition mill	Hammer mill
3/8	0.371	20.35	6.35
4	0.185	10.5	2.5
8	0.093	6.3	16.8
14	0.046	4.5	10.2
28	0.0232	6.8	8.7
48	0.0116	2.3	5.0
Pan			

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AGEN 343

Table 8.1 BELT-LOAD CROSS-SECTION AREAS AND MAXIMUM BELT SPEEDS

Belt Width, in.	*Clear Margin (M), in.*	*Total Cross-Section Area, sq ft, for Surcharge Angle A*			*Max. Speed, ft per min*	
		10°	*20°*	*30°*	*Nonabrasive Fine Materials*	*Grain*
14	1.7	0.074	0.096	0.117	300	400
16	1.8	0.101	0.131	0.162	300	450
18	1.9	0.134	0.173	0.214	400	450
20	2.0	0.170	0.220	0.272	400	500
24	2.2	0.257	0.332	0.410	500	600
30	2.5	0.421	0.542	0.669	550	700
36	2.8	0.622	0.803	0.991	600	800
42	3.1	0.869	1.12	1.37	600	800
48	3.4	1.16	1.48	1.83	600	800
54	3.7	1.45	1.90	2.33	600	800
60	4.0	1.83	2.36	2.91	600	800

Conveyor Belt Width, in.	*A*	*B*
14	0.20	0.00140
16	0.25	0.00140
18	0.30	0.00162
20	0.30	0.00187
24	0.36	0.00224
30	0.48	0.00298
36	0.64	0.00396
42	0.72	0.00458
48	0.88	0.00538
54	1.00	0.00620
60	1.05	0.00765