SCHOOL OF ENGINEERING

EXAMINATIONS: NOVEMBER 2017

COURSE AND CODE: PAPER MAKING TECHNOLOGY

DURATION: 2 HOURS

ENCH4PM

TOTAL MARKS: 100
MAXIMUM MARKS: 103

INTERNAL EXAMINERS: MR I KERR

INTERNAL MODERATOR: PROF B SITHOLE

EXTERNAL MODERATOR: DR WJ PAUCK

INSTRUCTIONS:

1. You can choose to answer EITHER Question 10 OR Question 11, ALL other questions should be attempted.

2. Any programmable or non-programmable calculator may be used provided it has been cleared of any information that would subvert the purpose of the examination.

3. Calculations must be shown in sufficient detail to illustrate your understanding of the procedure.
QUESTION 1 - SA Pulp and Paper Industry

a) True or False:

i. Twinsaver produces only tissue paper grades. (1)

ii. PAMSA stands for Paper and Allied Manufacturers of South Africa. (1)

iii. Mondi owns two pulp and paper mills; one in Richard’s Bay and one in Durban. (1)

iv. Plantation owners in South Africa have to pay for the water used by the trees. (1)

v. There’s a direct relationship between the usage of paper and the GDP of a country. (1)

b) What fibre source would a mill situated in Gauteng be using? (1)

c) What type of pulp is used in the production of Newsprint and why would this type of pulp be used in this grade of paper? (3)

TOTAL /9/
QUESTION 2 – The Nature of Wood

a) Discuss the concept of fibre coarseness and how it impacts on the properties of paper.  

(5)

b) In which direction do fibres hygro-expand the most when saturated with water?  

(1)

c) Which chemical component of the fibre is the most important with respect to papermaking?  

(1)

d) In which part of the fibre structure does this component predominate?  

(1)

e) Which type of fibre gives a smoother sheet of paper – hardwood or softwood?  

(1)

f) Which type of fibre gives a higher opacity sheet of paper – hardwood or softwood?  

(1)

g) Explain why refining of chemical pulp reduces the opacity of paper  

(2)

TOTAL /12/
QUESTION 3 – Paper Testing

a) List three factors which affect tensile strength of paper.  
(3)

b) Draw the test apparatus used in the Scott bond (Z-direction test) procedure.  
(5)

c) Draw a graph showing how the change on the long fibre fraction in a sheet of paper impacts on surface roughness, when testing for roughness using the Bendtsen method.  
(3)

TOTAL /11/

QUESTION 4 – Stock Preparation

a) Draw a block flow diagram of a stock preparation system for a paper machine using recycled fibre, virgin fibre (softwood) and broke as raw material sources.  
(5)

b) Which unit process in the stock preparation plant is responsible for developing the fibres?  
(1)

c) What is meant by the term “developing” the fibres? Describe the physical changes that occur in the fibres when they are being “developed”.  
(4)

TOTAL /10/
QUESTION 5 – Approach Flow

a) Draw a flow diagram of the white water short circulation system of a paper machine. (4)

b) What types of screen baskets are typically used in pressure screens? (2)

c) Draw a diagram showing the pressure pulse of a pressure screen rotor. Indicate feed and accept sides and rotation direction of rotor. (3)

TOTAL /9/

QUESTION 6 – Wet end chemistry and paper additives

a) Which characteristics of colloids play a major role in the chemistry of the paper machine wet end? (2)

b) Give two examples of dissolved or colloidal substances that enter the paper machine with the pulp. (2)

c) What is a surfactant? (1)

d) What is a micelle and what is the critical micelle concentration? (3)

e) List two mechanisms by which retention aids cause colloids to flocculate and attach to the paper fibres. (2)

f) Give two advantages of adding calcium carbonate as a filler to the paper. (2)

g) Why is it inadvisable to use calcium carbonate when using a rosin/alum sizing system? (2)

TOTAL /14/
QUESTION 7 – Forming

a) Explain the terms rush and drag, with reference to the forming section of a paper machine. (2)

b) In which position must the jet land on the wire to ensure good drainage? (1)

c) What were the reasons for gap formers being introduced and becoming widely used in the paper industry? (3)

d) Gap former designers employ two main dewatering elements. List these. (2)

TOTAL /8/

QUESTION 8 - Pressing

a) List the forces that occur in a press nip. (2)

b) What are the advantages of an extended nip press? (4)

TOTAL /6/
QUESTION 9 – Drying

a) Draw diagrams showing a two tier (double-felted) and single tier (single-felted) dryer arrangements.  

(6)

b) What are the disadvantages associated with single-felted dryers?  

(2)

c) You are employed as a process engineer on a paper machine. The paper mill manager tells you that the machine is dryer-limited (the speed is limited by its drying capacity). What options would you consider to speed up the machine?  

(4)

TOTAL /12/

QUESTION 10 – Size Press and Coating

a) There are three pond-type size press configurations, list these, identify the preferred configuration and explain why this option is preferred.  

(5)

b) What are the advantages of a film size press over a pond size press?  

(2)

c) What are the two major components of a coating mix?  

(2)

d) List two types of coaters.  

(2)

e) Which coater gives the smoothest surface?  

(1)

TOTAL /12/
QUESTION 11 - Recycling

a) Identify the labels (A and B) for the graph provided below:

(2)

b) List the two types of deinking methods used in the paper recycling industry.

(2)

c) Which of the two methods listed in answer to question 10(b) is applied in South Africa?

(1)

d) What apparatus is found in the recycled paper repulper that is not found in a virgin fibre repulper? Describe the function and the functioning of this apparatus.

(4)

e) List three environmental impacts that are mitigated by recycling paper.

(3)

TOTAL  /12/