

I. COURSE DESCRIPTION:

This course introduces the final steps in the manufacture of paper and paperboard and the variety of end-use processes that paper and paperboard are subjected to before they are used as consumer products. The first section of the course will deal with finishing, followed by winding, sheeting and packaging, then paper coating and corrugated boards and cartons. A final optional section deals specifically with printing processes.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Demonstrate a knowledge of the calendaring process.**Potential Elements of the Performance:**

- Explain what the calendaring process involves.
- Explain why final paper thickness is important.
- Explain why it is important to build a good reel.
- Explain why paper smoothness is important.
- Explain the difference between a king and a queen roll.
- Explain what a crowned roll is.
- Explain what intermediate rolls are.
- List two ways load is applied in a calendar stack.
- Draw a calendar stack with a specified number of nips.
- Explain what happens to smoothness when the number of nips is increased.
- Briefly explain the difference between Letterpress and Offset printing.
- Describe how nip pressure is measured.
- Explain why mechanical pulp fibres respond more easily to hot calendaring.
- Explain how surface moisture affects calendaring.
- Explain what happens in soft calendaring.
- Name the five process variables that can be controlled in calendaring.
- Explain how calendaring temperature affects sheet roughness.
- Explain what happens when a chilled iron roll is in contact with a hard rubber covered roll.

2. Demonstrate a knowledge of how calendars are controlled and of calendar defects.

Potential Elements of the Performance:

- Explain the statement, "Anything you can measure can be controlled."
 - Name four properties that scanners measure.
 - Name four paper roughness tests.
 - Describe the principle of roughness measurements of paper.
 - Name four process steps that will decrease roughness.
 - Describe what happens to smoothness when calendar nip pressure is increased.
 - describe what happens to burst, tear and tensile as nip pressure increases.
 - List four variables that must be controlled for a successful calendar operation.
 - Name some factors that cause variations in the micro profile of paper.
 - Describe how the micro profile of paper is controlled.
 - Define a floc.
 - Explain what happens to flocs when they are calendared.
 - Explain how the micro profile of a calendar roll is controlled.
 - Explain how MD and CD sheet tensions are controlled.
 - List two ways of controlling nip pressure.
 - Name four calendar defects with causes and results of each.
 - Define broke.
 - Give two reasons why broke should be repulped.
3. Demonstrate a knowledge of supercalendering theory.

Potential Elements of the Performance:

- Describe the main difference between rolls used of calendars and supercalendars.
- Explain how filled rolls cause the paper surface to be glossed.
- Cite the percentage of supercalender applied energy that is that is converted into heat energy.
- List the devices used to maintain machine direction sheet tension during supercalendering.
- List the devices used to maintain cross-machine direction sheet tension during supercalendering.
- Explain why tension control is important during supercalendering.
- List the functions of flyrolls.

- Cite the function of oscillating doctor blades.
- Explain the roll of steam showers.
- Explain the difference between A frame and C frame supercalendars.
- Explain the function of the reversing nip.
- Name three differences between supercalendars used for glassine and printing grades.
- Name the material used to make the surface of a filled roll.
- Explain the purpose of a Shore Durometer.
- Name four important supercalendering variables.
- Explain why sheer forces are important to the degree of paper gloss.
- Name four paper properties affected by repeated calendaring action.

4. Demonstrate a knowledge of supercalendering operations.

Potential Elements of the Performance:

- List the important actions that take place during supercalendar warm-ups.
- Explain how crown compensating rolls assist the warm-up period.
- Explain why nips are inspected.
- Explain the duties of the operator during threading.
- Explain what first and second helpers do during threading.
- Explain what flags indicate in rolls of base paper.
- Explain how automatic control of sheet gloss could be achieved.
- Explain the difference between inherited and process defects.
- List six inherited defects.
- Explain one inherited defect.
- List five process defects.
- Explain two process defects.
- List the hazardous areas of the supercalendar.

5. Demonstrate a knowledge of the theory of winding and the equipment used in winding.

Potential Elements of the Performance:

- Identify and describe five unit processes involved in winding.
- Explain the difference between surface winding and core winding.
- Explain why it is important to compensate for changes in

- inertia during unwinding.
 - Define trim removal.
 - Explain what interweaving is and how it is eliminated.
 - Explain the difference between tension and torque.
 - Explain where a single drum winder might be found.
 - Explain the difference between a duplex winder and a two-drum winder.
 - Explain the function of a combining winder.
 - Define wound-in tension.
 - Explain why wound-in tension is important for roll quality.
 - Explain how wind-up drum diameter effects wound-in tension.
 - Explain how drum arrangement effects wound-in tension.
 - Explain why venta-grooving is used on wind-up drum surfaces.
 - Describe what might happen if high torque is applied during winding of thicker paperboards.
 - Name four different types of spreading systems.
6. Demonstrate a knowledge of how the main winder parameters are controlled and the impact of winder defects.

Potential Elements of the Performance:

- Name the four areas of winder control.
- Explain why roll hardness is important to the end user.
- Name the four variables that control roll structure.
- Explain how uniform roll hardness is achieved.
- Explain what is meant by torque differential.
- Name which of the two wind-up drums the paper is wrapped around.
- Explain when high riding roll loading is important.
- Name the four winding attributes that influence tension control.
- Explain the purpose of the load cell in tension control.
- List the range of speed differences involved in torque differential in a two-drum winder.
- Name two things that could happen if all the parts of a winder are not in correct alignment.
- Explain what a Smith needle is used for and how it is used.
- Explain how a Beloit density profiler works.
- Explain what the “J” line test tells us.
- Name the paper roll defect caused by caliper variations.
- Name four causes of holes in wound paper.
- Name three causes of snap-offs.
- Define web instability.
- Explain the cause of roll deformation.

- Explain how a moisture wrinkle is caused during storage.
- Explain why it is important to get rid of loose paper from around the winder.
- Describe one problem caused by defective splicing.
- List the costs to a paper mill when rolls are rejected by the end-user.
- Name the problem caused by dusty or linty rolls.

7. Demonstrate a knowledge of sheeting and packaging.

Potential Elements of the performance:

- Explain what is meant by sheeting efficiency.
- Explain the purpose of a backstand.
- Name four advantages of a shaftless roll stand.
- Explain where you might find a turret-type roll stand.
- Explain the function of a decurler.
- Name three improvements to paper that can be caused by paper conditioning.
- Describe how a slitter works.
- Explain the purpose of a draw roll.
- Explain the operation of a fly knife.
- Explain where the bed knife is located on a cutter.
- Name three advantages of using a dual rotary cutter.
- Name the conditions under which an oscillating bed knife cutter would be used.
- Explain the difference between tandem and overlapping delivery of cut sheets.
- Explain the purpose of a layboy.
- Explain why sheets of paper are trimmed.
- List the number of sheets of paper in a modern reem.
- Explain the function of a header machine.

8. Demonstrate a knowledge of basic paper coating.

Potential Elements of the Performance:

- Define paper coating.
- Name the five qualities used to define grades of coated paper.
- Define LCW and C2S.
- Explain the difference between cohesion and adhesion.
- Describe the difference between letterpress and gravure printing.
- Describe the offset lithography printing process.

- Describe the problem caused by lithographic inks.
 - Explain why label stock is only coated on one side.
 - Describe the coating problem caused by poor paper formation.
 - Explain the TEA test and TEA.
 - Describe the coating problem caused by a highly porous base paper.
 - Explain why base paper brightness is important in coating.
 - Explain the purpose of an optical brightener.
 - Describe the effect of coating on opacity.
 - Explain the purpose of the Dennison wax pick test.
 - Name the three most important white coating pigments.
 - Describe the advantage of titanium dioxide as a coating.
 - Name three general classes of binders used in coating.
 - Explain what is meant by casein shock.
 - Explain the difference between casein and soy protein binders.
 - Name four properties that styrene-butadiene binders give to coated papers.
 - Name the advantages of polyvinyl acetate binders.
 - Explain why defoamers are used in coating mixtures.
 - Name one additive that will improve the folding endurance of a coating.
 - Explain why coating leveling is important and what can be done to improve this feature.
 - Name the additives that can be used to improve pick resistance.
9. Demonstrate a knowledge of the preparation and application of coatings.

Potential Elements of the Performance:

- Name four key operations for the preparation of coatings having consistent quality.
- Define coating colour.
- Explain the purpose of a Kady mixer.
- Explain the advantage of using latex as a binder.
- Explain why it is important to use a calibrating tank in coating.
- Explain how a pressure filter works in coating.
- Explain the purpose of a Sweco screen.
- Name the coating quality that would require the use of TiO₂.
- Explain the purpose of an applicator roll, a back-up roll and an air knife.
- Explain the purpose of a dip roll and name the type of coater where it is found.

- Explain the purpose of gate rolls.
- Name the advantage of a blade coater.
- Explain how blade coaters can be used to make C2S paper.
- Explain the operation of a short dwell coater.
- Name the advantage gained by the use of cast coating.
- Explain the operation of an air flotation dryer.

10. Demonstrate an understanding of corrugated board and cartons.

Potential Elements of the Performance:

- Name the three raw materials for corrugated board.
- Name the two additives that control a corrugated board's ability to resist bending.
- Explain why board thickness is such an important contributor to board stiffness.
- Explain the term proportional limit.
- Name the prime raw material for virgin linerboard.
- Explain why a mill would make a two-layer linerboard.
- Name the most important pulping process for the manufacture of corrugating medium.
- Explain why virgin medium can be effectively corrugated.
- Define the term "Bogus linerboard".
- Explain the purpose of a pulper in the manufacture of linerboard.
- Explain the purpose of a junker.
- Name two important problems associated with the use of OCC for the manufacture of linerboard.
- Name two types of adhesive used in making corrugated board and briefly explain why each is used.
- Explain the difference between single wall and double wall corrugated board.
- Explain the importance of corrugating ratio.
- Explain the function and purpose of a the preconditioning station on a corrugator.
- Explain why linerboard is preheated in a corrugator.
- Briefly explain what happens in the singlefacer.
- Briefly explain what happens in the doublefacer.
- Explain the purpose of a duplex slitter/cutter.
- Name five attributes of carton design to be considered prior to manufacture.
- Explain the term register as used in carton conversion.
- Define flexographic printing.
- Explain how flat crush strength is related to flute height and

number of flutes.

- State what can be predicted from the short column crush test.
- State the purpose of the pin adhesion test.
- Explain why it is important to know about a board's coefficient of friction.
- Name the part or parts of a carton which will have the highest resistance to crush loading and explain why.

11. Demonstrate an understanding of paperboard and packages.

Potential Elements of the Performance:

- Define consumer packaging.
- Name the main raw materials used for the manufacture of solid paperboards.
- Name the reasons why multi-ply paperboards are different from solid paperboards.
- Name the two important factors that control board stiffness.
- Explain what happens at the neutral axis of a board during bending.
- Name the two parts of a bending board subjected to the greatest stress.
- Explain how a fourdrinier machine can be used to make a three layer board.
- Explain the main difference between counterflow and uniflow vat formers.
- Explain how vat formers differ from an ultraformer.
- Explain what a point is in terms of paperboard.
- Explain why a counterflow vat will give board of high caliper but poor formation.
- Explain why an underliner is used on some grades of multi-ply board.
- Explain the operation of a multi-channel headbox.
- Name the two factors that control the choice of furnish for a multi-ply board.
- Explain why different furnishes are used for the backliner of a multi-ply board.
- Explain why aluminum foil might be laminated to paperboard.
- Explain the operation of an extrusion coater.
- Explain the difference between dies used for cutting or dies used for scoring.
- Explain why ply separation is important for good folding of board.
- Explain why ply bond is an important test for multi-ply board.

12. Demonstrate an understanding of absorbent paper products.

Potential Elements of the Performance:

- Define capillary volume of a sheet of paper.
- Calculate the number of micrometres in a given number of centimetres.
- Calculate the bulk and density of a sheet of paper.
- Explain why groundwood fibres are denser than bleached kraft fibres from the same species.
- List three methods of increasing bulk in a paper sheet.
- Explain the difference between pick-up and lick-up felts.
- Define a yankee cylinder.
- Explain what machine glazed paper is.
- Explain the purpose of an after-dryer.
- Define a square sheet.
- Explain the operation of a periformer.
- Explain why wet sheets preferentially transfer from a rough to a smooth surface.
- Explain how a creping doctor increases sheet bulk.
- Explain how creping increases tensile energy absorption.
- Explain why traditional fourdrinier/yankee machines are unsuitable for making low density sheets.
- Define evaporative load.
- Explain through-drying.
- Explain how a papridryer works.
- Name the type of pulp best suited for the strength component and the type best suited for the softness component.
- List the problems that might occur when using BCTMP and secondary fibres in consumer tissues.
- Explain the purpose of a multi-roll creel.
- State the purposes of tissue, copolymer, nonwoven, fluff, and plastic backing as diaper components.

13. Demonstrate a knowledge of printing terminology and equipment.

Potential Elements of the Performance:

- List the three basic components of any printing process.
- Explain the difference between direct and indirect printing processes.
- Explain the main difference between letterpress and gravure printing technology.
- Explain how lithography differs from either letterpress or gravure printing.

- Explain why the invention of printing was an important event in world history.
- Name five components of a printing press.
- Explain what is meant by a perfecting press.
- Describe the function of the plate cylinder, the impression cylinder, the blanket, and the fountain solution.
- Explain why a doctor blade is needed on a gravure press.
- Explain the purpose of a linotype machine.
- Explain the process of making a letterpress plate using photochemical techniques.
- Explain the advantage of halftone printing.
- Define colour separation.
- List the four process colours used in colour printing.
- Describe the functions of vehicles used in inks.
- Define ink viscosity, tack and opacity.
- Explain why paper smoothness is an important characteristic for offset lithographic printing.
- Explain why pick resistance is an important property of offset lithographic printing.
- Explain the meaning of dimensional stability as it refers to paper or paperboard.
- Define ink receptivity.

14. Demonstrate an understanding of the various forms of non-contact printing processes.

Potential Elements of the performance:

- Describe the major difference between non-impact and impact printing.
- Explain the function of the heating crystals in a thermal printer's print head.
- Explain how the printed image is formed on thermal printer paper.
- Explain why thermal printers are not used in high impact situations.
- Explain the complex nature of paper used in electro-sensitive printers.
- Name the paper mill instrument where you might find electro-sensitive printing.
- Name the main problem in magnetic printing and what causes it.
- Explain how the latent image is formed on the photosensitive drum of a Xerox copier.
- Explain why it might be difficult to remove Xerox copier ink

during deinking.

- Name two advantages of ink jet printing.
- Explain why the overall print speeds of non-impact printing methods are low when compared to commercial printing.
- Give two reasons for the differences in printing qualities between paperback and art books.
- List four paper quality factors that are important for non-impact printing.

15. Demonstrate a knowledge of the performance characteristics of paper and board.

Potential Elements of the Performance:

- Define the terms runnability and printability as they pertain to printing.
- Explain why flatness is important in sheet fed stock.
- List two causes of curl in paper.
- Explain how increased moisture content causes wrinkles in sheet-fed paper.
- Explain why paper for offset printing must be free of surface contaminants.
- List four causes of wrinkles in paper.
- List three results of holes, tears or wrinkles in paper.
- Describe any coating defect and its cause.
- Explain why sheet porosity is important in web fed presses.
- Explain why even winding of rolls is important to printing.
- List the problems that can be caused by poor placement or loose winding.
- Explain whether coated or uncoated paper gives better print quality and why.
- List and explain three important printability characteristics of paper for letterpress.
- List and explain three important printability characteristics of paper for lithography.
- Name and explain the most important printability characteristic of paper for gravure.

16. Demonstrate a knowledge of tests used to evaluate the printing quality of paper.

Potential Elements of the Performance:

- Define printing smoothness.
- Define ink receptivity.

- Name the term that means the opposite of ink receptivity.
- Give two reasons for the lack of correlation between air-leak smoothness tests and printing smoothness.
- Explain how the number of breaks in the printed surface relates to printing smoothness.
- Explain how the Gurley Densitometer measures air permeability.
- Explain the principle of the ink receptivity test.
- Define percent transfer.
- Define print mottle.
- Explain why any test that measures picking resistance is important to the letterpress process.
- Define the term linting.
- Explain the importance of linting to offset printing.
- Define the term strike-through.
- Explain why Parker Print-Surf results correlate more closely to gravure print quality than do other smoothness tests.

III. TOPICS:

1. Calendaring
2. Calendaring Control and Defects
3. Supercalendaring Theory
4. Supercalendaring Operations
5. Winding Theory
6. Winding Operations
7. Sheeting and Packaging
8. Basic Paper Coating
9. Coating Preparation and Application
10. Corrugated Board and Cartons
11. Paperboard and Packages
12. Absorbent Paper Products
13. Printing Terminology and Equipment
14. Non-Contact Printing Processes
15. Performance Characteristics of Paper and Paperboard
16. Tests for Printing quality of Paper

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Bethune, Jack and Sugden, Adam, Finishing and Converting, Course Manual PPE 368, Sault College of Applied Arts and Technology, Sault Ste. Marie, 2002

V. EVALUATION PROCESS/GRADING SYSTEM:

A final grade for this course will be based on the results of four tests weighted equally.

For testing purposes, the course will be divided as follows:

Test #1 on Module 1
 Test #2 on Module 2
 Test #3 on Module 3
 Test #4 on Module 4

Since there could be some students whose job specialization is on quality and customer relations, those students may wish to substitute Module 5 for Module 3. These students will still be tested on four modules and the final grade will be based on four tests. Any deviation from the standard four tests must be arranged in writing with the instructor within the first week of the course.

The following semester grades will be assigned to students in all credit courses:

<u>Grade</u>	<u>Definition</u>	<u>Grade Point Equivalent</u>
A+	90 - 100%	4.00
A	80 - 89%	4.00
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 - 59%	1.00
F(Fail)	49% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field/clinical placement or non-graded subject areas.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject areas.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty	

Under unusual circumstances, students with a final grade of 45-49% could be permitted to write a supplementary exam for a maximum possible grade of "D", provided they obtain a minimum grade of 60% in two of the regular tests.

VI. SPECIAL NOTES:Special Needs:

If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your instructor and/or the Special Needs office. Visit Room E1204 or call Extension 493, 717, or 491 so that support services can be arranged for you.

Retention of course outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Rights and Responsibilities*. Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course outline amendments:

The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students will be required to provide a transcript and course outline related to the course in question.