SCHEME & SYLLABUS

B. TECH.
(PACKAGING TECHNOLOGY)
w.e.f. 2018-2019 Session

CREDIT BASED SYSTEM

Guru Jambheshwar University of Science and Technology
Hisar - 125001
(Haryana)
(Established by State Legislature Act 17 of 1995)
'A' GRADE NAAC ACCREDITED UNIVERSITY

APPLIED SCIENCES FOR PACKAGING

General Course Information	
Course Code: BSC-PKG201-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe comprehensive knowledge of science in packaging arena.	L1
CO 2	Classify technical parameters of printing and packaging materials	L2
CO 3	Apply knowledge of press room environment in printing and packaging organization	L3
CO 4		H1
CO 5	Select suitable instrument for maintaining print standard.	H2
CO 6		H3

UNIT-I

Understanding Colour: Fundamental of colours, Light, Source of Colour, Primary Colours, Secondary Colours, Additive Colours, Subtractive Colour, Spectral Transmission Curves. Introduction to Colour Measurement.

Surface Chemistry - Surface tension, Contact angles, Capillary Action, Interfacial Tension, Hydrophobic & Hydrophilic, Water and Ink Interaction, Emulsification of Ink. Role of Emulsification in Printing. Viscosity. Importance of viscosity in printing.

Effect of light in printing and Packaging - Effect of light on different film and plate coating, Adhesives & Ink-films, Light fastness, Print Characteristics, effect of light on different poly films / Substrates.

UNIT-II

Role of pH and Conductivity in Printing– Definition of pH, Method of determining pH, Importance of pH in Printing & Packaging, pH of paper & Ink, role of pH control in printing &

packaging applications. Conductivity, Fountain Solution & Conductivity, Define conductivity? Need of conductivity measuring conductivity, Application of Conductivity in Printing.

Impact of Environmental Condition in Printing and Packaging: Humidity – Definition, Relative Humidity, Measurement, Control by air conditioning, Role of Relative Humidity in Printing & Packaging, Effect of Relative Humidity in packaging operations. Green Printing, VOC gases, its impacts, Use of chemicals in Printing and its environmental impact.

UNIT-III

Optics & Optical Instruments- Reflection, Transmission, Importance of observer angle in viewing print, Optical illusion in viewing colour, Opacity, Density, Visual Angle, Angular Magnification, Magnifying Glass, Microscopes, safe Light Condition, Introduction to Photographic Cameras and Contact printer, Introduction to Densitometer and Spectro-densitometer. Measuring color, International standards for color evaluation, Delta E and its importance.

Colloids in printing & Packaging - Introduction, Kinds, Properties, Absorption and adsorption, Selective Adsorption, Application in printing and packaging.

Fountain Solution -Introduction, Composition and functions. Role of fountain solution in Printing.

UNIT-IV

Chemistry of Photography & Light Sensitive Materials - Introduction to photo-chemistry, Light Sensitive Material, Types of LSM, Constituents of LSM, Properties. Diazo compounds and its role in image creations.

Polymers and Printing: Monomer, Polymer, Types of Plastics – Thermo-sets & Thermoplastics. Introduction to Natural Polymers, Cellulose Derivatives, Synthetic Polymers, Polythene, Polypropylene, Polyvinyl Plastics.

Text & Reference Books:

1. **Optics** by Brij Lal and Subrahmaniam
2. **Optics** by Ajay Ghatak
3. **Engineering Chemistry** by Jain and Jain
4. **Science and Technology of Printing Material** by Parkash Shetty.
5. **Hand Book of Print Media** – by H. Kippan

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	--	--	--	--	--	--	--	--	1	1	2	2	--
CO2	2	2	--	--	2	--	--	--	1	3	--	--	2	1	--
CO3	1	1	--	--	1	--	--	--	2	--	--	--	2	2	--
CO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	2	1	--	3	--	--	--	--	--	1	1	2	3	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

ENGINEERING SCIENCE FOR PRINTING

General Course Information	
Course Code: ESC-PKG201-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various raw materials used in printing and packaging industry	L1
CO 2	Describe the utilization of paper, inks and other chemicals in printing and packaging industry	L2
CO 3	Apply principles of engineering and sciences in the field of printing and packaging industry	L3
CO 4	Apply principles of engineering and sciences in the field of printing and packaging industry	H1
CO 5		H2
CO 6		H3

UNIT-I

Metals for Platemaking in Printing: Types and characteristics of metal used for type alloys, foundry type, & Hot metal composition. Physical and Chemical properties metals used in printing & packaging industry in relation to printing & packaging application, Lithographic properties of Metals.

Photographic Materials: Main kinds of films and photographic papers used in graphic organization, Cross section of films, Main-base, Stripping, Anti halation Coating, Protective Coating, Paper positive materials, Developers, Reducers, and Intensifiers. **Light sensitive materials for printing image carrier for major printing processes.**

UNIT-II

Substrates for Printing and Packaging: Paper and Non- Paper Substrate used for printing and packaging industry. Types of Plastic Substrate – Polyethylene, Polypropylene, Polyvinyl Chloride

(PVC), Polyethylene tera-phthalate (PET), Polyester, Polystyrene, Cellophane, Metal, Foils, Laminates.

Printing Inks, Coatings & Varnishes for Printing & Packaging Applications: Ingredients used in Printing Inks, Coatings and Varnishes. Colorant – Dyes, Pigment, Vehicles, Additives, Binders, Types of printing Inks – Paste Inks, Liquid Inks, Letter Press Inks, Offset/ Lithographic Inks, Gravure Inks, Flexo-graphic Inks. Constituents of coating & varnishes. Application, advantages and limitations of coatings & Varnishes.

UNIT-III

Cushioning Materials Cushioning materials, Solid vs Loose fill, Foam-in-place, Cushion curves and design, Corrugated as a cushioning material, Economics of design - packaging costs vs product damage.

Adhesives for Printing & Packaging: Adhesion, Types of Adhesive – Animal Glues, Fish Glues, Casin Adhesives, Starch Based Adhesives, and Natural resin Adhesives, Cellulose Adhesives, Rubber based adhesives, Synthetic resin adhesives, Inorganic Adhesives, Hot Melt.

UNIT-IV

Miscellaneous Materials : Different types of rubber used in printing, Book binding Materials – Leather, Cloth, Rexene, Threads, Tapes, Stitching Wire, Covering Materials, Varnishes, Laminates Eye-lets, thermoform.

Text & Reference Books:

1. **Printing Materials** by Bob Thompson
2. **Materials in Printing Process** by L.C. Yong
3. **Printing Technology** by Adams, Faux, Rieber, 5th edition
4. **Hand Book of Print Media** by H. Kippan.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	3	2	-	1	1	1	1	1	3	3	1
CO2	3	3	3	2	3	2	1	1	1	1	1	1	3	3	1
CO3	3	3	2	1	3	2	1	1	1	1	1	1	3	3	1
CO4	3	3	2	2	2	2	2	1	1	1	1	1	3	3	2
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

ELEMENTS OF PACKAGING

General Course Information	
Course Code: PCC-PKG201-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various raw materials used in packaging industry	L1
CO 2	Describe the utilization of Product cycle and elements of package design in packaging industry	L2
CO 3	Apply principles of engineering and sciences in the field of packaging industry	L3
CO 4	Examine most inclusive areas where various materials can be used packaging industry	H1
CO 5		H2
CO 6		H3

UNIT-I

History and evolution of packaging. Basics of Packaging: Introduction, Classification of Packaging, Functions & roles of a packaging, Factors influencing design of a package.

UNIT-II

Packaging Cycle, Product-Package Relationship, Product life cycle curve, Elements of Package Design, types of Packaging - Flexible package, Rigid package & semi-rigid package. Markings on package – Handling marks, routing marks, information marks.

UNIT-III

Cushioning materials – Functions, properties. Classification – space fillers, resilient cushioning materials, non resilient cushioning materials. Introduction to Packaging Media.

UNIT-IV

Carton Production: Carton styles. Folding cartons – Production steps, types. Corrugated containers – classifications, components in a corrugated board, flutes & stages in preparation in corrugated boards. Plastic corrugated boards- features & advantages. Introduction to Innovative Packaging Techniques/ Processes: Gas packaging – MAP & CAP, Vacuum packaging, shrink packaging, stretch wrapping, blister packaging, skin packaging, strip packaging, Aerosol packaging container.

Text & Reference Books:

1. Printing Materials: Bob Tompson
2. Printing Materials: Prakash Sethi
3. Printing Materials: LC Young
4. Materials in Printing Processes
5. Hand Book of Packaging Technology: Walter Saroka

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	3	2	-	1	1	1	1	1	3	3	1
CO2	3	3	3	2	3	2	1	1	1	1	1	1	3	3	1
CO3	3	3	2	1	3	2	1	1	1	1	1	1	3	3	1
CO4	3	3	2	2	2	2	2	1	1	1	1	1	3	3	2
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

ELEMENTS OF PACKAGING LAB

General Course Information	
Course Code: PCC-PKG201-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Define various raw materials used in packaging industry	L1
CO 2	Describe the utilization of Product cycle and elements of package design in packaging industry	L2
CO 3	Apply principles of engineering and sciences in the field of packaging industry	L3
CO 4	Examine most inclusive areas where various materials can be used packaging industry	H1
CO 5		H2
CO 6		H3

List of Experiments -

1. Designing and preparation of various flexible packages.
2. Designing and preparation of various rigid packages.
3. Preparation of Jigged die & unit die for a package design.
4. Study and operation of various packaging machines.
5. Manufacturing of various types of corrugated boards.
6. Cutting, creasing and building up corrugated boxes.
7. Designing & preparation of various designs of paper bags.
8. Testing of raw materials like wood, paper, plastic.
9. Test conducted on Cartons, Corrugated packages, wooden packages.
10. Drop test, Vibration test, inclined impact test, Compression test.
11. Rolling test, Drum test.

PACKAGE PRINTING PROCESSES

General Course Information	
Course Code: PCC-PKG203-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various type of printing processes used in packaging industry	L1
CO 2	Describe the utilization/ advantages/ disadvantages of various printing processes used in packaging industry	L2
CO 3	Apply principles of engineering and sciences in the field of packaging industry	L3
CO 4	Examine most inclusive areas where various printing processes can be used packaging industry	H1
CO 5		H2
CO 6		H3

UNIT-I

History and evolution of packaging. Basics of Packaging: Introduction, Classification of Packaging, Brief introduction on History of Printing, sequential developments in package Printing Printing, Package Printing in India, Recent trends in package printing. Basic operations in printing: Pre-Press, Press and Post-press operations.

UNIT-II

Introduction to Printing process; Traditional printing processes, letterpress, lithography, flexo, gravure, screen printing. Digital printing process. Identification of different Print Products- Job suitability of various printing processes. Advantages and dis-advantages of various printing processes. Letterpress process of printing: Introduction, Characteristics of letterpress printing, tools & equipments used in the letterpress department, classification of letterpress printing machines, Pre-make ready & make ready steps, letter press substrates, inks & image carrier.

UNIT-III

Lithographic printing process: Introduction, characteristics of lithographic printing, classification of offset printing, different units of offset machine, pre-make ready & make-ready steps, machine production, introduction of offset plates, inks & substrates. Flexography printing process: Introduction, characteristics of flexography, components of flexo press, flexo plates, flexo presses, introduction to flexo inks & substrates.

UNIT-IV

Gravure printing process: Introduction, characteristics of Gravure, Principles of Gravure printing, basic components of gravure press, brief introduction to image carrier preparation for Gravure printing, Gravure ink & substrate. Screen printing process: Introduction, application of screen printing, tools, equipments & accessories used in screen printing, screen printing process steps, brief introduce to screen inks, substrates & image carriers. Digital printing: Introduction, various, digital printing technologies & Brief introduction to digital inks & substrates.

Text & Reference Books:

1. Letter Press Printing Part 1, 2, By C.S. Misra
2. Printing Technology by Adams, Faux, Rieber, 5th edition
3. Handbook of Print Media, H. Kippan, Springer
4. Lithographers Manual
5. Printing Technology 5edition – by Adams.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	3	2	-	1	1	1	1	1	3	3	1
CO2	3	3	3	2	3	2	1	1	1	1	1	1	3	3	1
CO3	3	3	2	1	3	2	1	1	1	1	1	1	3	3	1
CO4	3	3	2	2	2	2	2	1	1	1	1	1	3	3	2
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

PACKAGE PRINTING PROCESSES LAB

General Course Information	
Course Code: PCC-PKG203-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various type of printing processes used in packaging industry	L1
CO 2	Describe the utilization/ advantages/ disadvantages of various printing processes used in packaging industry	L2
CO 3	Apply principles of engineering and sciences in the field of packaging industry	L3
CO 4	Examine most inclusive areas where various printing processes can be used packaging industry	H1
CO 5		H2
CO 6		H3

List of Experiments -

1. Identification of different tools & equipments used in various printing process.
2. Introduction of different printing process.
3. Schematic diagram of different printing processes.
4. Study of various types of Image carriers for different printing process.
5. Overview pre-make ready & make ready.
6. Study of different printing press.
7. Overview of machine production for multi-colour printing.
8. Study of running & printing faults on different printing process machine.

GRAPHICS DESIGN ESSENTIALS IN PACKAGING

General Course Information	
Course Code: PCC-PKG205-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Outline various graphics designing fundaments	L1
CO 2	Describe graphics designing attributes in packaging	L2
CO 3	Use various softwares for developing design	L3
CO 4		H1
CO 5		H2
CO 6	Create various package designs	H3

UNIT-I

INTRODUCTION TO GRAPHIC DESIGN: Introduction to design, introduction to Graphic Design, Introduction to Printer's design, Concept of Graphic Arts, Concept of Graphic Communications, Understanding steps involve in Graphic Communications and Making the Print work. **FUNDAMENTALS OF DESIGN:** Point, Line, Shape, Tone, value, weight, texture, size, space, etc. **PRINCIPLES OF DESIGN**: Balances, Proportion, Rhythm, Unity, Contrast, Simplicity, Fitness.

UNIT-II

COLOURS IN PACKAGE DESIGN: Introduction of Colour, function of Colour, Physical Dimension of Colour, Responses to Colour, emotional effects of colour. Colour Combination - Colour schemes, Dimension of colour, colour symbolism, Colour Theory- Additive theory, Subtractive theory. Division of Design -Natural, Conventional, Decorative, Geometrical and abstract.

TYPOGRAPHY : Typography -Structure Design and Function, Introduction to 2D & 3D Types, Physical structure of type, type measurement, Introduction to Digital Types, Post Script Fonts, True Type Fonts, Open Type Fonts, Methods of type arrangement, classification of typeface of font designing.

UNIT-III

INTRODUCTION TO TYPE DESIGN : Design style, Grouping of Type Faces, Type Families, Introduction to Indian Type Faces, Function of type Composition, Readability, Legibility, concept of Spacing- Letter Spacing, Word Spacing, Line Spacing, Paragraph Spacing.

PRINT PLANNING OF PACKAGE: Introduction to Layout, Terms in Layout Planning, Stage of Layout Planning, Rough layout, comprehensive and artwork. Understanding of scale and sense of proportion. **ORIGINALS:** Introduction to originals, Type of originals, sizing, masking and cropping.

UNIT-IV

COMPUTERS IN DESIGN: Introduction to Computer in Design, Introduction to Desktop Publishing, Introduction to Desktop Designing. Introduction to Designing Software. Uses, Applications, Advantages and Limitations of Prominent Design Software.

DESIGNING FOR PRINT PRODUCTION: Introduction of Printing Processes for Design Prospective. Selection of an appropriate printing process for printing of a job.

Text & Reference Books:

1. **The Designer's Handbook** by Alistair Campbell
2. **Design & Technology** by Van No strand
3. **Handbook of Advertising Art Production** by Schelmmer.
4. **Art & Production** by N.N. Sarkar.
5. **Advertising, Art & Production** by J. Nath.
6. **A.C. Book (C.D.) so hick, Fundamental of copy and layout**,Crair Book.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	--	3	--	--	--	1	1	1	1	2	2	--
CO2	1	1	1	--	2	--	--	--	1	1	2	2	2	1	--
CO3	2	2	2	--	3	--	--	--	2	2	2	3	2	3	--
CO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	2	2	3	1	3	--	--	--	3	3	2	2	2	3	--

GRAPHICS DESIGN ESSENTIALS IN PACKAGING LAB

General Course Information	
Course Code: PCC-PKG205-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Outline various graphics designing fundaments	L1
CO 2	Describe graphics designing attributes in packaging	L2
CO 3	Use various softwares for developing design	L3
CO 4		H1
CO 5		H2
CO 6	Create various package designs	H3

List of Experiments -

1. Study of Colour, Colour theory, Colour wheel and various Colour Schemes.
2. Study of Designing softwares for various package Design.
3. Study and Practice of knowledge of different computer commands used in Designing softwares.
4. Study of printing considerations for typical designs.
5. Understanding concept of Sizing, Mashing & Cropping of photographs/originals.
6. Enlisting the elements and designing of Visiting Card, Letterhead, Envelop, Bill form, Receipt, Invitation card.
7. Enlisting the elements and designing of Title page of a Book, Magazine Cover page
8. Study of elements and designing of Logo
9. Preparing Artwork for various Packaging applications i. e Cosmetics, Cartons, Corrugations, Pharmaceuticals etc.
10. Study of Flexible and Rigid Package Designs and Printing Considerations.
11. Understanding the impact of colour in packaging

APPLIED SCIENCE FOR PACKAGING MATERIALS

General Course Information	
Course Code: BSC-PKG202-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe numerous packaging materials and its specialties	L1
CO 2	Learn comprehensive knowledge of various packaging materials	L2
CO 3	Interpret technical knowhow required for different packages.	L3
CO 4		H1
CO 5	Select appropriate materials and its importance for packaging applications	H2
CO 6		H3

UNIT - I

Corrugated Board: History, Introduction to Corrugated Board, Board Construction - Liners, Flutes, Laminations or Liners and Fluting Medium, Flute Design and Selection, Manufacturer Joint. Corrugation, Stacking Strength. Requirements for corrugated fibre board boxes for single wall, double wall and triple wall.

Solid Fibre Board and Composite Container: Introduction to Solid Fibre Board, Introduction to Combination Board, Introduction to Composite Container and its types, Advantages to Composite Container, Introduction to Multiwall paper sacks. Advantages and uses of Multiwall paper sacks.

UNIT – II

Glass in Packaging : History, Introduction to Glass Materials, Composition of Glass, Chemical Structure of Glass, Raw Materials used for manufacturing glass containers, Properties of Glass, Types of Glass, Types of glass containers, Uses, Applications Advantages & Disadvantages, Types and Design of Bottles, Closures, Seals. Glass Industry, Market Overview.

Wood Based Packaging: History, Introduction of Wood Materials, Physical Characteristics of wooden Containers, Types of Boxes - Nailed Boxes, Wire bound Boxes, Cleated Box, Wooden

Crates, physical and mechanical properties of timber, Defects of timber, methods of preservation of timber.

UNIT - III

Metals in Packaging: History, Introduction of Metals - Overview of Extraction Processes, Important Metals in Packaging & their properties (Physical, Chemical & Mechanical), Aluminium based, Conversion processes for Sheets, Aluminium Foil, properties & their applications. Market & Industry Overview

Steel based: Stainless & Galvanized Steel - Coated steels like Tinplate, Tin free Steel, **Metal Cans:** History of Metal Cans, Types of Metal Cans - Three piece & Two piece Cans, Welded & Seamless Cans, Can Dimensioning.

Introduction to Metal Collapsible Tubes - its design, Advantages & Disadvantages. Introduction to Aerosol Containers Classification of Aerosols, Advantages & Disadvantages of Aerosols.

UNIT - IV

Cushioning Materials: Cushioning materials, Factor Considered in cushion design, Need of cushion Packaging, Properties of cushion materials, Solid vs Loose fill, Foam-in-place, Cushion curves and design, corrugated as a cushioning material, Economics of cushion designing and advantages - packaging costs vs product damage.

Biodegradable and Recyclable Packaging Material : Concept of Recyclable Materials for Packaging, Concept of Biodegradable Materials in Packaging, Types of Biodegradable and Recyclable Packaging Materials – Paper, Card, Board, Corn Starch, Biodegradable plastic and its types.

Text & Reference Books:

1. **Hand Book of Paper and Board**, Herbert Holik, Wiley-VCH, 2006
2. **Paper and Paperboard Packaging Technology**, Mark J. Kirwan, Blackwell Publishing, 2005
3. **Encyclopaedia of Packaging Technology -** by K. L. Yam, The Wiley, 3rd ed., Wiley, 2009
4. **Fundamentals of Packaging Technology -** by W. Soroka, 4th ed., IoPP, 2009
5. **Handbook of Package Engineering -** by J. F. Hanlon, 3rd ed., CRC Press, 1998
6. **The Packaging User's Handbook** - by F. A. Paine, Springer, 1990

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	--	--	2	2	--	--	--	1	3	2	1
CO2	2	2	1	--	--	--	2	1	--	--	1	--	3	1	--
CO3	3	2	1	--	--	1	2	2	--	--	--	--	2	2	--
CO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	2	1	--	--	1	2	2	--	--	--	1	--	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	3	1	1

PRE-PRESS TECHNOLOGY

General Course Information	
Course Code: PCC-PKG202-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Define pre-press technology	L1
CO 2	Explain elements used in pre-press	L2
CO 3	Use concept of Colour management	L3
CO 4	Examine different imaging systems	H1
CO 5		H2
CO 6		H3

UNIT-I

Introduction: Introduction to pre-press operations, Brief Introduction of Conventional Pre Press System, Introduction of Digital Workflow. Introduction of modern Pre-Press processes and operations. Introduction of film, positives, negatives. Introduction to line, continuous, halftone originals and positives/ negatives, Introduction to Processing chemicals, Developer, Fixer, Intensifier.

Reproduction Equipment's: Introduction to conventional imaging of originals, sizing and cropping of originals. Introduction to process camera. Introduction to Contact printer. Concept of lens, aperture, exposure (main/ supplementary), concept of a screen and screen, filters. Concept of screen ruling, screen angle, Concept of LPI, DPI, PPI. Dot, types of dots, Theories of dot formation, Pin hole and penumbral theories

UNIT-II

Digital Prepress – Introduction, Digital Pre-Press, Dot Shape, Input and Output Resolution, Under Colour Removal, Grey component replacement. Introduction to Dot formation, Introduction to File Formats, Portable document format (PDF), Introduction to Pre flight

Digital Photography & Digital Proofing: Image capturing with Digital camera, Charge Coupled Device and Complementary Metal Oxide Semiconductor, Scanner designs and models, Digitizing and re-digitizing

UNIT-III

Digital Image Assembly and Data Formats: Assembly and Imposition, Full Sheet Output, Imposition Workflows, Raster Image Processor (RIP), Storage Media and Data Formats.

Colour Management: Definition of Colour, Colour Management and Needs, Colour measuring instruments, Image Reproduction Process using Colour Management. Profiling and Indent, Pre requisites for a computer, suitable for graphics work

UNIT-IV

Digital Image Carrier : Image generation on films (positive/ negative) / Plate for different printing processes of Auto Film/ plate Processor, Trouble-shooting for film/ plates, Quality control aides for film/ plate making, Latest trends and innovations in pre-press.

Computer to Plate Systems: Introduction to Computer Plate systems, Types of Computer to Plate Systems, Colour presets, Convert profile and Assign profile in new jobs. Input profile and output profile, Workflows - PDF and JDF, Printing plates for Digital Imaging, Computer to plate and computer to machine, Pre-press in Non-impact printing process, Toray, Waterless plates, Diffusion process, Electro photography.

Text & Reference Books:

1. **Color and its Reproduction** – Field.G.G (GATF Press)
2. **Typography** – when, who & how – Friedl.E
3. **Image process and materials** 8th Edi – Van Nostrand Reinhold
4. **Computer to Plate – Automating the Printing Industry** – Adams. R. Ramano F.I.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	--	3	--	--	--	3	2	2	2	3	3	--
CO2	1	1	1	--	--	--	--	--	--	1	1	1	1	2	--
CO3	1	2	2	--	3	--	--	--	2	2	2	2	3	2	--
CO4	1	1	1	--	2	--	--	--	2	1	2	1	2	2	--
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

PRE-PRESS TECHNOLOGY LAB

General Course Information	
Course Code: PCC-PKG202-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Define pre-press technology	L1
CO 2	Explain elements used in pre-press	L2
CO 3	Use concept of Colour management	L3
CO 4	Examine different imaging systems	H1
CO 5		H2
CO 6		H3

List of Experiments -

1. Study & Working of Early pre-press systems using process camera.
2. Study & Working of contact printers,
3. Study & Working of Printing down frame.
4. Study & Working of Image setter, exposing unit, processing.
5. Study & Working of CTP. Workflow, exposing unit of CTP.
6. Study & Working of Pre-press software, proofing
7. Study & Working of processing unit of CTP.
8. Study & Working of controlling dot shapes, RIP functions.
9. Study & Working of Color management tools & utilities.
10. Study & Working of QC in Pre-press.

COMPUTER BASED PACKAGE DESIGN

General Course Information	
Course Code: : PCC-PKG204-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe package design concept	L1
CO 2	Recognize colour importance in packaging	L2
CO 3	Use different graphics/package design softwares	L3
CO 4		H1
CO 5		H2
CO 6	Design different packages	H3

UNIT-I

INTRODUCTION TO PACKAGE DESIGN: Introduction to Computer based Design Patterns, Designing Tools, Visualizing, Multi-dimensional Packaging, Design Basics, Types of design. Dummy preparation

UNIT-II

DESIGN FOR PACKAGING: Introduction to Design for Packaging, Requirement for Design of Package. Elements for Packages, Dielines and its placements through computer design. Introduction to various types of Packages and their Dienlines concepts (cutting and creasing) - for Food Packaging, FMCG Packaging, Medicine packaging, Cosmetics Packaging, Innovative Packaging.

VARIABLE DATA IN PACKAGING DESIGN: Barcodes – 2D, 3D Barcodes, QR Codes, Data Metric, Personalized QR Code etc. customization and personalization in Packaging. 3-D modelling in Packaging design

UNIT-III

SOFTWARE FOR GRAPHIC DESIGN: Introduction and Understanding of various Graphic Designing software for Package, and their Uses, Application, speciality, Advantages and Limitations.

SOFTWARE FOR PACKAGE DESIGN: Introduction and Understanding of various Package Designing software for Packaging, and their Uses, Application, speciality, Advantages and Limitations. Introduction and Understanding of various software for Step and Repeat Pattern used for Designing, Cutting, Creasing, Finishing and Value Addition, and their Uses, Application, speciality, Advantages and Limitations. Introduction and Understanding of various Die-cutting/ Die-making software's for Packaging, and their Uses, Application, speciality, Advantages and Limitations. **UNDERSTANDING ELECTRONIC COLOURS:** Colour models, Color gamut, Halftone, duotone and tritons.

UNIT-IV

NEW TRENDS IN PACKAGE DESIGN: Design for Organic Electronic Printing in Packaging applications, New Packaging Design Trends and their features, Value Addition application in Packaging through designing for augmented reality in Packaging. Recent developments in package designing.

Text & Reference Books:

1. **Graphic Design Basics** by Amy E. Arntson
2. **Art and Production** by N.N. Sarkar.
3. **The Art and Techniques of Designing** by Chuck Groth
4. **Packaging Essentials** by Sarah Roncarelli and Candace Ellicott
5. **The Production Manual** : The Graphic Design Handbook by Ambrose/ Harris

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	--	--	--	--	--	--	--	--	--	--	2	2	--
CO2	2	--	--	--	--	--	--	--	--	3	--	--	1	2	--
CO3	--	--	1	--	3	--	--	--	2	--	--	--	2	3	--
CO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	3	--	--	--	--	--	2	--	2	3	2	2	--

COMPUTER BASED PACKAGE DESIGN LAB

General Course Information	
Course Code: PCC-PKG204-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Define pre-press technology	L1
CO 2	Explain elements used in pre-press	L2
CO 3	Use concept of Colour management	L3
CO 4	Examine different imaging systems	H1
CO 5		H2
CO 6		H3

List of Experiments -

1. Study of Computer based original designing for conventional CMYK & Extended colour gamut's.
2. Study of Dummy preparation.
3. Study of Various Package designs for cartons, Corrugations, cosmetics, Pharmaceuticals & flexible food items.
4. Study & collection of Innovative package designs.
5. Study of Software of Package Designs, Die-cutting/ Die-making software.
6. Study & Sampling Value editions of Package Designing.
7. Study of Designs for organic electronic Printing in Packaging applications.
8. Study of DTP and its features.
9. Study of Designing with colours
10. Study of Preparations of Mock-Up of package design.

PAPER SUBSTRATE IN PACKAGING

General Course Information	
Course Code: PCC-PKG206-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various fibrous and non-fibrous materials used in packaging	L1
CO 2	Describe the utilization of non-fibrous materials in packaging	L2
CO 3	Apply principles of recycling in the field of printing and packaging industry	L3
CO 4	Examine most inclusive areas where paper can be used in printing and packaging industry	H1
CO 5	Select and evaluate properties of paper used in packaging	H2
CO 6		H3

UNIT - I

Introduction, Paper fibres, strengths and durability, absorbency, dimensional stability. Paper manufacture - Stage1 - pulp preparation, mechanical pulp, refiner mechanical pulp, thermo mechanical pulp, chemical processes-sulfate or Kraft process, sulfite process, combined chemical & mechanical process. Bleaching: Stage 2- stock preparation, non-fibrous additives, fillers or loading. Stage 3- refining the pulp, pulp freeness, refiners, pulp cleaning. Paper manufacturing process - paper making machine. Wet-end, Head box and slice. Fibre orientation. Angular flow. MD: CD ratio. Wire section. Forming wires. Press and drier sections.

UNIT – II

Calendaring and Finishing- Hard calendaring, soft nip calendaring, super calendaring, machine glazing, paper coatings. Paper recycling process, Recycling importance and benefits, Problems in recycling, fibre preparation- screening, centrifugal cleaning, flotation, washing, deinking plant function, continuous drum pulper, pre-screening and cleaning, primary flotation, cleaning, fine screening, thickening, dispersing, brightness control, washing, thickening and storage.

UNIT - III

Characteristics of paper. Printing process requirement. Paper varieties for printing. Printing defects associated with paper. Curling, wavy and tight edges, Problems with Picking, Blocking-in-the-pile, linting, dusting, powdering. Influence of moisture and RH on paper and boards. Paper storage – Requirement, Variables affecting paper storage. Print quality achievable on different types of paper, Measurement and calculations: Paper sizes.

UNIT - IV

Paper properties and printing problems-Introduction, printability, runnability. Surface and directional properties of paper & board-substance, caliper, bulk, compressibility, surface smoothness/ roughness, air permeance, static and dynamic friction. Surface strength and internal bond strength - picking, fluffing, splitting. Strength properties - stiffness, folding endurance, bursting strength, tear resistance. Optical properties - gloss, brightness, whiteness, yellowness and tint indices, flurescence, opacity.

Text & Reference Books:

1. Printing materials science & technology - Bob Thompson-PIRA
2. Materials in Printing Processes- LC Young
3. Printing materials-Prakash Sethi
4. Sheet-fed Offset Technology-Anjan Kumar Baral

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	--	2	3	2	1	3	3	3	2
CO2	3	2	1	2	3	2	--	2	3	3	2	3	3	3	2
CO3	2	2	3	2	3	2	1	1	3	2	3	3	3	3	3
CO4	3	3	2	2	3	2	1	1	2	2	2	3	3	2	2
CO5	3	3	2	3	3	2	2	2	3	2	3	3	3	3	2
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

PAPER SUBSTRATE IN PACKAGING LAB

General Course Information	
Course Code: PCC-PKG206-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various fibrous and non-fibrous materials used in packaging	L1
CO 2	Describe the utilization of non-fibrous materials in packaging	L2
CO 3	Apply principles of recycling in the field of printing and packaging industry	L3
CO 4	Examine most inclusive areas where paper can be used in printing and packaging industry	H1
CO 5	Select and evaluate properties of paper used in packaging	H2
CO 6		H3

List of Experiments -

1. Study and making of Handmade Paper.
2. Study and Testing of GSM, Caliper and bulk of various paper and boards.
3. Study and Testing of Strength Properties (Tensile, Tearing and Bursting Strength) of various paper, card and paperboard grades.
4. Study and Testing of Moisture, Cobb (Water Absorbency), Curling, Ash content, Stiffness, of various papers.
5. Study of finding CD and MD of various papers and boards.
6. Study of Optical Properties (Gloss, Opacity, and Brightness) of various papers.
7. Study of Light Fastness testing of various paper and card grades.
8. IGT printability testing of various paper, card and paper board grades.
9. Rub resistance test for various papers.

POLYMERS IN PACKAGING

General Course Information	
Course Code: PCC-PKG208-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Define various Polymers used in packaging industry	L1
CO 2	Describe the utilization of various polymers in packaging industry	L2
CO 3	Apply principles of engineering and sciences in the field of packaging industry	L3
CO 4	Examine most inclusive areas where various polymers can be used in packaging industry	H1
CO 5		H2
CO 6		H3

UNIT-I

Plastics: Introduction, Distinction between plastics, fibres and elastomers, classification of synthetic polymers, techniques of polymerization, processing techniques of plastics. Co-Extrusion: Cast film co-extrusion, Blow film co-extrusion, raw materials, support materials, bonding agents, application of co-extruded film.

UNIT-II

Polyethylene: LDPE: Manufacturing, Effect of density, LDPE resins, additives, conversion techniques, properties, applications, developments, LLDPE: Introduction, Manufacturing, Properties, Processing, Modifications, Conversion, Material Handling, Application, HDPE: Introduction, Injection Moulding, Applications, Blow moulding, Extrusion, compression moulding and applications, HMHDPE: Introduction, Production, Properties, Applications, Examples. Polypropylene: Introduction, Properties, Applications, Polypropylene copolymers, BOPP: Basic Categories of film, Qualities.

UNIT-III

Polystyrene: Properties, Grades, Processing: injection moulding, extrusion, sheet forming, applications. PVC, Nylon, Polyester: PVC: Introduction, Properties, Applications, Nylon: Introduction, Process, Technology of Co-extrusion, Applications, Polyester: Introduction, Properties, applications.

UNIT-IV

Miscellaneous Polymers: Expanded Polyethylene: Properties and applications, Plastic Woven Sacks: Material, Method, construction, use, Polycarbonate: Introduction, application in packaging. Testing on Plastics: Introduction, Scope, and Preparation of sample, solubility test, melting behaviour, approximate density, Ignition test, Dry distillation test, chemical colour identification test, pyrolysis test, refractive index, basic equipments, and other testing measures for individual plastics.

Text & Reference Books:

1. Printing Materials: Bob Tompson
2. Printing Materials: Prakash Sethi
3. Printing Materials: LC Young
4. Materials in Printing Processes
5. Hand Book of Packaging Technology: Walter Saroka

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	3	2	-	1	1	1	1	1	3	3	1
CO2	3	3	3	2	3	2	1	1	1	1	1	1	3	3	1
CO3	3	3	2	1	3	2	1	1	1	1	1	1	3	3	1
CO4	3	3	2	2	2	2	2	1	1	1	1	1	3	3	2
CO5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Packaging Technology

(3rd Year)

Department of Printing Technology
Guru Jambheshwar University of Science & Technology, Hisar
'A' Grade NAAC Accredited

COLOUR MANAGEMENT IN PACKAGING

General Course Information	
Course Code: PCC-PKG301-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe concept of colour management and its application.	L1
CO 2	Compare different colour models and their importance in printing and packaging	L2
CO 3	Operate different colour measuring instruments	L3
CO 4	Comparison different print characteristics/parameters.	H1
CO 5	Evaluate different print characteristics using colour measuring instruments	H2
CO 6		H3

UNIT-I

Colour Science: Defining Colour, fundamentals of Colour, Colour and Light, Colour vision and perception, Metamerism, Color vision Testing, Additive and subtractive colour theory **Colour Management**: Introduction, WYSIWYG, and need for colour management, Three Cs of color management, colour management systems, colour management workflow, models of colour management, Color Spaces - device dependent and independent color spaces.

UNIT-II

Colour definition and measurement: Colour dimensions, Munsell Color system, defining colour by measurement: Spectral reflectance, CIE colour standards: illuminants, CIE standard observer, Tristimulus values, Chromaticity Values, Color Temperature, memory colour, **Colour Measuring instruments**: Density and densitometer, colorimeter and spectrophotometer.

UNIT-III

Measurement of Print Characteristics: Colour density, Dot Gain (TVI): Dot area measurements using Murray Davies equation and Yule-Nielson equation, Slur and doubling, characteristics curve

for dot area and dot gain, Print contrast: relative print contrast measurement, Ink trapping: trapping measurement, Hue error, percent grayness and measurement. **Various elements required for different print characteristics**: Print control strip, Ink colour and film thickness elements, trapping elements, gray balance elements, slur and doubling elements.

UNIT-IV

Colour Models: Munsell, CIE Lab Model, Define Delta E. Demonstrate how to calculate it and how to use it, RGB colour model, CMYK colour model, HSV colour model, YIQ colour model, HLS colour model, HSI colour model, Conversion between colour models. **Colour Separation in Printing:** Need of colour separation, methods of colour separation: direct colour separation, indirect colour separation and electronic colour separation, Concept of UCR, GCR.

Text & Reference Books:

1. Colour Control in Lithography by Kelvin Tritton.
2. Understanding Color Management by Abhay Sharma
3. Art & Production by N.N. Sarkar.
4. Printing Technology by Adams, Faux, Rieber, 5th Edition

Course Articulation Matrix:

Course Code: PCC- PKG301-T Nomenclature: COLOUR MANAGEMENT IN PACKAGING															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	--	2	1	--	--	--	1	1	--	1	1	2	--
CO2	1	1	2	2	1	--	--	--	1	1	1	2	1	1	--
CO3	1	--	1	1	3	--	--	--	3	2	2	2	2	3	--
CO4	2	2	1	2	2	--	--	--	2	1	2	2	1	2	--
CO5	2	1	1	2	2	--	--	--	2	1	1	2	1	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

COLOUR MANAGEMENT IN PACKAGING LAB

General Course Information	
Course Code: PCC- PKG301-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)**
	Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70) Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe concept of colour management and its application.	L1
CO 2	Compare different colour models and their importance in printing and packaging	L2
CO 3	Operate different colour measuring instruments	L3
CO 4	Comparison different print characteristics/parameters.	H1
CO 5	Evaluate different print characteristics using colour measuring instruments	H2
CO 6		H3

List of Experiments

1. Understanding the concept of Subtractive theory and need of Color Management in Printing and Packaging.
2. Understanding concept of Colour Separation and its need.
3. Study Direct Colour Separation.
4. Study Indirect Colour Separation.
5. Study Electronic Colour Separation.
6. Understanding UCR (under Color Removal) and GCR (Gray Component Replacement).
7. Study different Color management model.
8. Study of colour measurement instruments.
9. Study working of scanner.

Course Articulation Matrix:

Course Code: PCC- PKG301-P Nomenclature: COLOUR MANAGEMENT IN PACKAGING LAB															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
Program Outcome (PO)													PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	--	2	1	--	--	--	1	1	--	1	1	2	--
CO2	1	1	2	2	1	--	--	--	1	1	1	2	1	1	--
CO3	1	--	1	1	3	--	--	--	3	2	2	2	2	3	--
CO4	2	2	1	2	2	--	--	--	2	1	2	2	1	2	--
CO5	2	1	1	2	2	--	--	--	2	1	1	2	1	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

RIGID PACKAGING MACHINES

General Course Information	
Course Code: PCC-PKG303-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	To define rigid packaging	L1
CO 2	To describe corrugations boards and its types	L2
CO 3	To demonstrate various metals and their applications in rigid packaging	L3
CO 4	To distinguish utilization of different rigid packaging substrates	H1
CO 5	To evaluate suitability of various range of substrates for rigid packaging	H2
CO 6		H3

UNIT-I

Rigid Packaging: Introduction to rigid packages, Classification of Rigid Packages according to materials used: Paper, Paper board, Corrugated Board, Plastic, Glass, Metal etc.

Carton Packages: Introduction to Paper and Paper board based rigid packaging, machinery used for paper board packages : Die Cutting machines, Collection, Punching machine, Perforating machines, Creasing machines, Folding Machines, Gumming & Pasting machine, Sealing machine, Gathering machine and packaging

UNIT-II

Corrugation: Introduction to corrugation board, Types of Corrugated boards, flutes and its types, Corrugating machines.

*Metal***:** Introduction to metal packaging, common formats of Metal cans: Three Piece can, Two Piece Can, Manufacturing of welded cans: Three Piece welded cans, two piece single drawn and multiple drawn cans, two pieces drawn and wall ironed cans, two piece impact extruded cans

UNIT-III

Plastic: Introduction to Rigid Plastic packaging, Container Moulding processes- Extrusion process and its applications, Sheet extrusion/ thermoforming process- thermoforming process, thermoformed multilayer barrier containers, openable containers, Injection moulding- basic injection moulding process, injection moulding development, co-injection moulding, selective foaming.

Blow Moulding: Extrusion-Blow moulding (EBM)- EBM machine configurations, Co-extrusion blow moulding, Injection Blow Moulding, Injection-stretch blow moulding (ISBM), ISBM process variations- two stage ISBM, single stage ISBM, One and a Half Stage ISBM. Heat-set PET bottles, Multilayer Barrier bottles, ISBM Polypropylene containers.

UNIT-IV

Glass: Introduction to glass packaging, forming glass containers: Blow-and-blow, press-and-blow, narrow neck press-and-blow.

Wood: Introduction to wood based packaging, Nailed boxes, Wirebound boxes and crates, Baskets, Barrels

Text & Reference Books:

1. Anne Emblem and Henry Emblem; Packaging Technology – Fundamentals, materials and processes, Woodhead Publishing, 2012
2. F. Hannay; Rigid Plastics Packaging – Materials, Processes and Applications, Rapra Technology ltd, 2002
3. Joseph F. Hanlon, Robert J. Kelsey, Hallie E. Forcinio; Handbook of Package Engineering, 3rd edition, Technomic publishing, 1998.
4. EIRI Board of Consultants & Engineers; Hand-Book of Packaging Technology, Printed and Published by Sudhir Gupta for "Engineers India Research Institute".
5. Packaging Technology (Educational Volumes) Vol-3 by Indian Institute of Packaging

Course Articulation Matrix:

Course Code :PCC-PKG303-T						Course Title: RIGID PACKAGING MACHINES									
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	1	2	3	2	1	3	3	3	2
CO2	3	2	1	2	3	2	1	2	3	3	2	3	3	3	2
CO3	3	2	2	1	3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	1	3	3	2	3	1	3	3	2	3	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	2	3
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

RIGID PACKAGING MACHINES LAB

General Course Information	
Course Code: PCC-PKG303-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	To list various paperboards for rigid packaging	L1
CO 2	Describe and understand corrugation making machines	L2
CO 3	To apply extrusion and moulding machine knowledge in rigid packaging	L3
CO 4	To distinguish between various rigid packaging machines	H1
CO 5	To select suitable machine for rigid packaging	H2

List of Experiments:

1. Study of paperboard rigid package
2. Study of corrugated board and packaging machines
3. Study of extrusion machine
4. Study of injection moulding machine
5. Study of blow moulding process and machine
6. Study of glass and its types
7. Study of wood packaging and its types.
8. Study of metal packaging

Course Articulation Matrix:

Course Code : PCC-PKG303-P					Course Title: RIGID PACKAGING MACHINES LAB										
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	1	2	3	2	1	3	3	3	2
CO2	3	2	1	2	3	2	1	2	3	3	2	3	3	3	2
CO3	3	2	2	1	3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	1	3	3	2	3	1	3	3	2	3	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	2	3
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

PHARMACEUTICAL & COSMETICS PACKAGING

General Course Information	
Course Code: PCC-PKG305-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Extensive knowledge of various aspects of pharmaceutical Packaging	L1
CO 2	Extensive knowledge of various aspects of cosmetic Packaging	L2
CO 3	Deal with various pharmaceutical and cosmetics packaging aspects.	L3
CO 4	Know about different substrates being used in pharmaceutical and cosmetics packaging	H1
CO 5	Study number of troubleshooting techniques to be encountered in pharmaceutical and cosmetics packaging.	H2
CO 6		H3

UNIT-I

Introduction to packaging of pharmaceutical products, Classification of pharmaceuticals. Introduction to glass, Selection of glass as packaging materials for the pharmaceutical products, Advantages and disadvantages of glass containers, Properties of glass, Production of glass, Types of glass, Manufacturing of Glass containers, testing of glass containers.

UNIT-II

Study of glass & plastics as materials for containers and rubber as a material for closure-their merits and demerits, Material used for packaging of Injectable such as Aluminum, Paper and Board. Introduction to Aerosol Packaging and its types. Plastic- Introduction, the Structure of Polymers, Raw Materials of Plastics, Types of Plastics.

UNIT-III

Packaging of pharmaceutical products- Orals ' Introduction to packaging material used for Oral products such as Rigid and Semi-rigid products(Glass containers, Aluminum tube/ tinplate

container, plastic container) , flexible Packaging material (Paper, cellulosic films, Aluminum foil, Blister pack-Introduction to blister package, Blister design parameters, Materials, , Types of Blisters, Advantages and disadvantages of Blister Packaging, Types of Problems/ Defects, Blister Packing Machine.

UNIT-IV

Introduction to packaging of Cosmetics, Study of Soda Glass, Sulphated glass, neutral glass, and Borosilicate glass as material for packaging of cosmetics. Cosmetic- classification, advantage and disadvantage, scope.

Study of physical and chemical properties of ingredients used in Cosmetics. Formulation and Development of- Hair care products like Shampoo, colorants, Hair Removers, Hair gel, Hair oils. Growth of the Cosmetic Industry in India.

Text & Reference Books:

1. Remington's Pharmaceutical Sciences.
2. The Extra Pharmacopoeia-Martindale
3. Indian Institute Of Packaging -Packaging Technology (volume -4)
4. Cosmetic Science and Technology Vol. I, II, III by Sagarin
5. New Cosmetic Science
6. Industrial Pharmacy by Leon Lachman
7. Perfume: History & chemistre By D.D. Wasule
8. Indian Herbs by Chopra
9. Wealth of India, published by CSIR
10. D. A. Dean, Roy Evans, Ian Hall. Pharmaceutical packaging technology. Tylor and Francis.
11. Edward J. Bauer, Pharmaceutical Packaging Handbook. Bausch and Lomb, Rochester, New York, USA.
12. Wilmer A. Jenkins, Kenton R. Osborn. Packaging drugs and pharmaceuticals.

Course Articulation Matrix:

Course Code: PCC- PKG305-T Nomenclature: PHARMACEUTICAL & COSMETICS PACKAGING															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	--	--	--	2	1	1	2	2	2	--
CO2	2	1	2	2	1	--	--	--	2	1	1	3	2	1	--
CO3	2	2	1	2	3	--	--	--	3	2	2	3	1	3	--
CO4	2	3	1	3	2	--	--	--	3	1	1	2	2	2	--
CO5	2	3	2	2	3	--	--	--	2	1	2	1	2	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

INDUSTRIAL TRAINING PRESENTATION - I

General Course Information	
Course Code: PROJ-PKG301-P Course Credit: 3.0 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab Work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** For the end semester examination, the presentation will be done by the students and Viva-Voce examinations will be conducted by External Examiner (preferably from Industry).

For industrial exposure of the students with latest technology and to make them understand the workflow in the industry, training in the Industry forms a compulsory and significant aspect. Students will be trained in industry for a period of 4 weeks during the earlier semester vacations. Their performance will be periodically assessed by the staff in charge from the department and a coordinator industry. After completion of the training period the students will submit a detailed report dully signed with industry coordinator. There will be a viva-voce at the end of the training and grades will be awarded along with the semester examination. The selection of industry for training should be printing, packaging and allied industry (Technical Support in relation with printing and packaging).

DIGITAL PRINTING PROCESS

General Course Information	
Course Code: PEC-PKG151-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	To define various techniques used in Digital print production	L1
CO 2	To describe the Computer to Technologies	L2
CO 3	To interpret the Digital printing processes	L3
CO 4	To examine most inclusive areas where Digital Printing used in printing industry	H1
CO 5	To identify printing challenges in Digital printing	H2
CO 6	To develop knowledge about recent trends, future implications and applications of Digital Printing Presses to both consumers and printing & packaging industry	H3

UNIT-I

Digital Prepress: Structure of Digital Printed Products; Quality Requirements; Digital Photography; Digitizing Originals; Sheet Assembly and Imposition; RIP; Storage Media; Networks; Data Formats; Color Management; Digital Proof; Film Production and Platemaking

UNIT-II

Computer to Press/ Direct Imaging: Computer to Press/ Direct Imaging with Removal of the Master for each Print Job; Computer to Press/ Direct Imaging Printing Systems; Expansion and Comparison of Systems; Computer to Press/ Direct Imaging Systems with Re-Imageable Master; Concepts for Re-imageable Masters with Material Application/Ablation; Re-imageable Printing Plate Systems without Material Application.

Computer to Print: Printing Systems based on Electro photography; Printing Systems based on Ionography, Magnetography and Inkjet; Design Principles of Computer to Print Systems; Digital Printing- Overview and its principles.

UNIT-III

Overview, principles and basic components of NIP Technologies: Electro photography; Ionography; Magnetography; Inkjet; Thermography; Electrography; Photography and X-Graphy

UNIT-IV

Variety of Applications: customization and direct marketing, Print-on-Demand (POD), variable data printing (VDP), distribute-and-print, remote publishing (Web2Print), wide-format printing, specialty applications (particularly of inkjet) like 3D printing, printing on microscopic items etc.
Trends in Digital Printing: evolution of technologies, current market share of different technologies, promising developments (e.g. Xerox iGen3, HP Z-series inkjet printers with in-built spectrophotometer etc), Digital Printing Presses.

Text & Reference Books:

1. Frank Cost, "Pocket guide to digital Printing", Delmar Publishers, 1997.
2. Brett, G, Digital Prepress Technologies, Leatherhead: Pira International, 2001.
3. H. Kipphan, Handbook of Print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg, 2001.
4. Howard M Fenten. Frank. J. Romano.- On Demand Printing

Course Articulation Matrix:

Course Code : PEC- PKG151-T				Course Title: DIGITAL PRINTING PROCESS										
1: Slight /Low 2: Moderate/Medium 3: Substantial/High														
	Program Outcome (PO)											PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	3	1	1	1	3	2	3	3	3	3	2
CO2	2	2	1	2	3	2	1	2	3	3	2	3	3	3	2
CO3	3	2	1	2	3	3	2	2	3	3	2	3	3	2	2
CO4	3	3	2	3	3	2	3	2	3	2	3	3	3	2	2
CO5	2	3	3	3	3	2	1	1	2	2	2	3	3	3	1
CO6	3	1	1	3	3	3	3	3	3	3	3	3	3	3	3

HYBRID PRINTING TECHNOLOGY

General Course Information	
Course Code: PEC-PKG152-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Overview of Printing Methods and Technologies	L1
CO 2	Describe concept of Hybrid Printing and its application.	L2
CO 3	Describe Hybrid Printing Systems combining Conventional Printing Technologies	L3
CO 4	Understand Radiation curing	H1
CO 5	Compare different Hybrid Techniques for In-line and off-line Print Production	H2
CO 6		H3

UNIT-I

Overview of Printing Methods and Technologies, Combination Variants of Hybrid Printing Systems.

UNIT-II

System Concepts and Examples of Implementations. Hybrid Printing Systems combining Conventional Printing Technologies, Hybrid Printing Systems combining NIP Technologies,

UNIT-III

Hybrid Printing Systems combining Conventional and NIP Technologies, Hybrid Printing Systems combining Computer to Press/Direct Imaging with NIP Technologies, Hybrid Printing Systems combining Conventional Printing Technologies with Computer to Press Technologies

UNIT-IV

Hybrid Techniques for In-line Print Production, Hybrid Techniques for Off-line Print Production

Text & Reference Books:

1. Hand Book of Print Media by Hemlet Kiphon
2. Printing Technology by Adams, Faux, Rieber, 5th Edition

Course Articulation Matrix:

Course Code: PEC- PKG152-T Nomenclature: HYBRID PRINTING TECHNOLOGY															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	--	--	--	2	1	1	2	1	3	--
CO2	2	1	1	3	1	--	--	--	2	1	2	1	1	2	--
CO3	1	1	2	1	3	--	--	--	3	1	2	3	2	3	--
CO4	2	3	2	1	2	--	--	--	2	2	1	2	1	2	--
CO5	2	2	1	3	2	--	--	--	2	3	1	3	1	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

OFFSET TECHNOLOGY

General Course Information	
Course Code: PCC- PKG153-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	To study and explain the various categories of offset press and the principles behind it.	L1
CO 2	To describe the various units of a sheet fed offset press.	L2
CO 3	To demonstrate five units of the offset press	L3
CO 4	To explain and indicate various print trouble shooting.	H1
CO 5	To analyse the various print quality factors and their implications	H2
CO 6	To explain ISO Standards for sheet-fed offset printing	H3

UNIT-I

History of lithography, print media and classification of printing organizations. Recent trends in offset press technology. Basic principles of sheet fed offset printing. Construction and categories of sheet fed offset press. Safe handling of tools, equipment and materials in offset press department. Various units of a sheet fed offset press and their basic functions.

UNIT-II

Feeding unit: Functions of the feeding section, sheet feeding types, feeding cycle, components of feeder, sheet conveying mechanisms, sheet detectors, sheet register, front lay and side lay, sheet insertion systems, grippers. Inking unit: role and function of inking system, different parts of inking system, split duct techniques, types of rollers in the inking system, setting of the rollers, care and maintenance of rollers, different inking systems.

UNIT- III

Dampening system: role and function of the dampening system, fountain solution, pH and conductivity of the fountain solutions, role of water in fountain solution, role of alcohol or alcohol substitutes in fountain solution, different rollers in the dampening system, roller coverings, doctor dwell, desensitizing the metal rollers, different dampening systems, care and maintenance of the dampening system. Printing unit; different cylinders and their construction, cylinder gears, cylinder gap, bearers, undercut, cylinder packing, patching, printing pressures. Pre-make ready and make ready. Progressive print out.

UNIT-IV

Delivery section: role and function of delivery section, transfer cylinder, sheet transfer, sheet delivery, short and extended delivery systems, sheet control devices, anti-set off spray powder unit. Machine productions. Troubleshooting. Printing machine maintenance. Quality control in sheet fed offset press and introduction to ISO 12647-2 standards.

Text & Reference Books:

1. Sheet Fed Offset Technology by Prof. Anjan Kumar Baral.
2. Printing Process by Prof. Anjan Kumar Baral.
3. Hand Book of Print Media by H. Kippan.

Course Articulation Matrix:

Course Code: PCC- PKG153-T Nomenclature: OFFSET TECHNOLOGY															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	1	2	3	2	1	3	3	3	2
CO2	3	2	1	2	3	2	1	2	3	3	2	3	3	3	2
CO3	3	2	2	1	3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	1	3	3	2	3	1	3	3	2	3	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	2	3
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

PRINT FINISHING TECHNIQUES

General Course Information	
Course Code: PCC-PKG302-T Course Credit: 3 Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe various binding materials used in printing	L1
CO 2	To explain various print finishing and binding operations	L2
CO 3	To use appropriate binding style for appropriate job	L3
CO 4	To differentiate numerous print finishing operations	H1
CO 5	To select appropriate materials during print finishing and book binding	H2
CO 6		H3

UNIT - I

Introduction: Binding, Print Finishing, book binding, classification of binding organization, latest developments in print finishing, importance of Book Binding **Book binding**: parts of book, Operations during bookbinding: pre-forwarding operations, forwarding operations, finishing operations. **Paper:** British Standard Paper Sizes, International Paper Sizes, RA & SRA Sizes. Advantages of ISO Paper Sizes. Regular and odd subdivisions of paper sizes, multiple sizes.

Book Binders Tools: forwarding tools, finishing tools, **Binding Room Equipment's**: - Laying Press, Standing Press, Sewing Frame, Glue Pot, Board Cutting. **Book Binders Materials:** Board - kinds of boards. Reinforcing Materials. Securing Materials, Covering Materials, Adhesives- factors governing the choice of adhesives, use of adhesives in print finishing, effect of wet adhesives, theories of adhesives, principles of adhesives, solvent based adhesives, water based adhesives, pressure sensitive adhesives, types of adhesives, adhesion- physical, specific. Miscellaneous Materials.

UNIT – II

Pre- Forwarding Operations: Jogging, Counting, Cutting, Slitting, Trimming, Single knife guillotine machine: Paper cutting machine, **Folding**: Hand folding - folding to paper, folding to print, lump folding, style of folding, Binders Aids, Puckering, Folding Schemes, Machine Folding - knife principles, buckle principle, combination of knife & buckle, folding & machine direction, advancements & developments on folding machine, folding machine paper feeders, tips for smoother folding. **Tipping-in**, Attachment of Plates. **Gathering** - Single Sheet Gathering, In-setting, **Collating** - Collating Marks.

UNIT - III

Securing Methods: Wire Stitching, wire stitching machine, Thread Sewing - letterpress binding, & stationery binding, saddle sewing, side/flat sewing, French sewing, sewing on tapes, sewing on cords, sewing two sections on, whip sewing, stub-binding. Adhesive Binding/Perfect Binding – advantages, quality control in adhesive binding, lay-flat adhesive binding, Mechanical Binding - loose leaf binding - traditional styles used, spiral binding, wire 'o' binding, plastic comb binding, case binding.

End Papers: Purposes, Kinds of end Papers, Quality of Paper Required for Pasting End Papers. Pressing, Gluing the Spine, Smashing the Spine, trimming the Book Edges, Rounding- Advantages, Rounding Machine. Backing - Backing Machine. Lining - Advantages. Head-Tail Bands, Caps, Book Marker. Method of Attaching Head & Tail Bands. Covering - Covering Styles, Pasting Down, Pressing, Inspection.

UNIT – IV

Finishing Processes: Cover Decoration, Print Finishing Operations: embossing, debossing, blind embossing, gold blocking(foil stamping), die printing, thermography, velvet printing, marbling, varnishing, graining, laminating, gumming, gluing, punching, perforating, applique, Indexing, Edge Decoration - requirement, coloring the edges, marbling edges, edge guilding, round corner cutting. Numbering - folio numbering, double numbering, duplicate numbering, principle of rotary numbering, skip numbering, automatic numbering.

Binding & Finishing Machines: Study of Various Modern Machines, Modern Guillotines - Single Knife Guillotines, Three Knife Trimmers, Knife Grinding Machine. Gold Blocking/Foil Stamping Machine. Wire Stitching Machine. Laminating Machine, Smashing Machine. Back Gluing Machine. Roller Gliding Machine. Inline Rounding Machine. Lining Machine. Modern Lining Machine. Casing in Machine. Case Making Machine.

Text & Reference Books:

1. **Binding And Finishing - Ralph Lyman**
2. **Binding And Finishing Part-1 – BD Mendiratta**
3. **Binding Finishing Mailing - T. J. Tedesco**

4. **Introduction to Printing and Finishing - Hugh M Speirs**
5. **Finishing Process in Printing - A. G. Martin.**

Course Articulation Matrix:

Course Code: PCC- PKG302-T Nomenclature: PRINT FINISHING TECHNIQUES															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	--	--	--	1	2	1	2	1	2	--
CO2	1	2	1	2	1	--	--	--	2	2	1	3	1	2	--
CO3	1	1	2	2	3	--	--	--	2	1	2	2	2	2	--
CO4	2	2	1	3	2	--	--	--	1	2	3	2	2	2	--
CO5	2	2	2	3	1	--	--	--	2	2	1	3	2	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

PRINT FINISHING TECHNIQUES LAB

General Course Information	
Course Code: PCC- PKG302-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe various binding materials used in printing	L1
CO 2	To explain various print finishing and binding operations	L2
CO 3	To use appropriate binding style for appropriate job	L3
CO 4	To differentiate numerous print finishing operations	H1
CO 5	To select appropriate materials during print finishing and book binding	H2
CO 6		H3

List of Experiments

1. Preparation of Saddle sewing booklet
2. Preparation of Side sewing booklet
3. Preparation of Centre stitched booklet
4. Preparation of Side stitched booklet
5. Preparation of quarter bound book by - French sewing method
6. Preparation of half bound book by -Tape sewing method
7. Preparation of half bound book by -Cord sewing method
8. Preparation of writing pad.
9. Preparation of Receipt books with numbers in duplicate & triplicate.
10. Preparation of following type of Mechanical binding - Spiral wire binding, Wire 'O' binding.
11. Study of various controls, operations and mechanisms of the following Machines: Folding Machine, Guillotine Machine, Cutter and Creaser, Varnishing Machine, Laminating Machine, Sewing & Stitching Machine, Miscellaneous Machine.
12. To study various print finishing operation used for print finishing and binding.

Course Articulation Matrix:

Course Code: PCC- PKG302-P Nomenclature: PRINT FINISHING TECHNIQUES LAB															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
Program Outcome (PO)													PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	--	--	--	1	2	1	2	1	2	--
CO2	1	2	1	2	1	--	--	--	2	2	1	3	1	2	--
CO3	1	1	2	2	3	--	--	--	2	1	2	2	2	2	--
CO4	2	2	1	3	2	--	--	--	1	2	3	2	2	2	--
CO5	2	2	2	3	1	--	--	--	2	2	1	3	2	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

INK TECHNOLOGY IN PACKAGING

General Course Information	
Course Code: PCC-PKG304-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe concept of Printing Ink and its application.	L1
CO 2	Compare different Drying Mechanisms and their importance in printing and packaging	L2
CO 3	Understand different properties of Packaging Inks	L3
CO 4	Comparison of different printing inks	H1
CO 5	Evaluate different print characteristics of Packaging inks	H2
CO 6		H3

UNIT-I

Introduction: Classification of inks- water based inks, solvent based inks. Ingredients in ink- Pigments- types and their properties, carbon black, inorganic pigments, organic pigments, physical characteristics of organic pigments. Vehicles- vehicles for liquid inks, vehicles for paste inks, UV curing vehicles. Additives- driers extenders, anti-oxidants, waxes. Security inks.

UNIT-II

Drying Mechanisms: Physical drying, absorption drying, chemical drying, oxidation polymerization drying, radiation drying and curing, Microwave drying, infrared drying.

UNIT-III

Properties of Inks: Optical Properties of inks, Physical properties of Inks. Rheology of inks, Ink transfer requirements and ink distribution.

Viscosity - Newtonian flow, units of viscosity, viscosity & temperature, factors influencing viscosity, simple low viscosity inks, complex high viscosity inks. Ink requirements for printing processes – offset, letterpress, flexography, gravure, screen printing

UNIT-IV

Radiation Curing: - introduction, radiation curing inks, curing considerations, Chemistry of UV curing- photo initiation, propagation, termination. Cationic curing, electron beam curing.

Text & Reference Books:

1. Paper and Ink Technology by Bob Thomson
2. Hand Book of Print Media by Hemlet Kiphon
3. Complete Technology book on Printing Inks by NIIR Board

Course Articulation Matrix:

Course Code: PCC- PKG304-T Nomenclature: INK TECHNOLOGY IN PACKAGING															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	--	--	--	1	2	1	2	1	2	--
CO2	1	2	3	1	1	--	--	--	2	1	2	2	2	1	--
CO3	2	1	2	1	3	--	--	--	3	1	1	3	2	3	--
CO4	2	2	2	2	2	--	--	--	2	2	1	3	1	2	--
CO5	2	2	1	3	2	--	--	--	3	2	1	2	1	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

INK TECHNOLOGY IN PACKAGING LAB

General Course Information	
Course Code: PCC- PKG304-P Course Credit: 1.5 Contact Hours: 3/week, (L-T-P:0-0-3) Mode: Practical & Lab work Examination Duration: 3 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Internal practical evaluation is to be done by the course coordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	Describe concept of Printing Ink and its application.	L1
CO 2	Compare different Drying Mechanisms and their importance	L2
CO 3	Understand different properties of Packaging Inks	L3
CO 4	Comparison of different printing inks	H1
CO 5	Evaluate different print characteristics of Packaging inks	H2
CO 6		H3

List of Experiments

1. Various samples of Paper and their study.
2. Different samples of Inks and their study.
3. Lightfastness test.
4. Machine Direction and Cross Direction of paper.
5. Effect of Humidity and Temperature on paper.
6. Ink Viscosity Test and Ink tackiness Test
7. Printed samples of different printing processes and their study.
8. Introduction to various chemicals used in printing.

Course Articulation Matrix:

Course Code: PCC- PKG304-P Nomenclature: INK TECHNOLOGY IN PACKAGING LAB															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
Program Outcome (PO)													PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	--	--	--	1	2	1	2	1	2	--
CO2	1	2	3	1	1	--	--	--	2	1	2	2	2	1	--
CO3	2	1	2	1	3	--	--	--	3	1	1	3	2	3	--
CO4	2	2	2	2	2	--	--	--	2	2	1	3	1	2	--
CO5	2	2	1	3	2	--	--	--	3	2	1	2	1	2	--
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

FMCG PACKAGING

General Course Information	
Course Code: PCC-PKG306-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes: -

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define FMCG packaging	L1
CO 2	To describe the FMCG packaging process and their applications	L2
CO 3	To apply CAP and MAP for various food grades	L3
CO 4	To examine FMCG packaging applications	H1
CO 5	To select suitable materials for packaging recycling applications	H2
CO6		H3

UNIT-I

Active and Intelligent Packaging: Active packaging techniques, intelligent packaging techniques, Current use of novel packaging techniques, Consumers and novel packaging.

Oxygen, ethylene and other Scavengers: Oxygen scavenging technology, selecting the right type of oxygen scavenger, Ethylene scavenging technology, Carbon dioxide and other scavengers.

UNIT-II

Antimicrobial food packaging: Antimicrobial agents, constructing an antimicrobial packaging system, Factors affecting the effectiveness of antimicrobial packaging

Non-migratory bioactive polymers (NMBP) in Food Packaging: Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, Applications of polymers with immobilized bioactive compounds.

UNIT-III

Time-temperature indicators (TTIs): Defining and classifying TTIs, Requirements for TTIs, The development of TTIs, Maximizing the effectiveness of TTIs, Using TTIs to monitor shelf-life during distribution

The use of freshness indicator in packaging: Compounds indicating the quality of packaged food products, Freshness indicators, Pathogen indicators, other methods for spoilage detection

Moisture regulation: Silica gel, Clay, Molecular sieve, Humectants salts, Irreversible adsorption.

UNIT-IV

Developments in modified atmosphere packaging (MAP): Novel MAP gases, testing novel MAP applications, Applying high O_2 MAP

Recycling packaging materials: The recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, Using recycled plastics in packaging

Text & Reference Books:

1. Novel Food Packaging Techniques

Course Articulation Matrix:

Course Code: PCC- PKG306-T Nomenclature: FMCG PACKAGING															
1: Slight /Low 2: Moderate/Medium 3: Substantial/High															
	Program Outcome (PO)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	1	2	3	2	1	3	3	3	2
CO2	3	2	1	2	3	2	1	2	3	3	2	3	3	3	2
CO3	3	2	2	1	3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	1	3	3	2	3	1	3	3	2	3	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	2	3
CO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

SCHEME & SYLLABUS

B.TECH.
(PACKAGING TECHNOLOGY)
4th year
w.e.f.Session- 2019-20

CREDIT BASED SYSTEM
(70:30)

Guru Jambheshwar University of Science and Technology
Hisar - 125001
(Haryana)
(Established by State Legislature Act 17 of 1995)
'A' GRADE NAAC ACCREDITED UNIVERSITY

B. TECH (PACKAGING TECHNOLOGY) 7th Semester

Subject Area	Subject Code	Subject Name	Teaching Schedule			Credits
			L	T	P	
PE-3	BTPK-701-L	ED/Sales & Marketing/Package Economics & Value Engineering	3	1	-	3.5
PC-16	BTPK-702-L	Converting Process for Packaging	3	1	-	3.5
PC-17	BTPK-703-L	Quality Control & Waste Management	3	-	-	3.0
PC-18	BTPK-704-L	Packaging of Industrial and Hazardous Goods	3	-	-	3.0
PC-19	BTPK-705-L	Plastic & Polymer Manufacturing	3	-	-	3.0
PC-20	BTPK-706-L	Supply Chain & Logistic Management in Packaging	3	-	-	3.0
PC-16	BTPK-702-P	Converting Process for Packaging lab	-	-	3	1.5
PC-17	BTPK-703-P	Quality Control & Waste Management Lab	-	-	3	1.5
PC-19	BTPK-704-P	Packaging of Industrial and Hazardous Goods Lab	-	-	3	1.5
PW-4	BTPK-707	Plastic & Polymer Manufacturing lab	-	-	3	1.5
PW-5	BTPK-708	Project Work-I	-	-	-	-
PW-6	BTPK-709	Industrial Training Presentation-II	-	2	-	N.C
Total			18	4	12	25
Total (Overall)			**34**			**25.0**

8th Semester

Subject Area	Subject Code	Subject Name	Teaching Schedule			Credits
			L	T	P	
PE-3	BTPK-801-L	Green Printing	3	1	-	3.5
PE-4	BTPK-802-L	Latest Trends in Packaging	3	1	-	3.5
PE-5	BTPK-803-L	Bulk & Industrial Packaging	3	1	-	3.5
PE-6	BTPK-804-L	Packaging Machinery Maintenance	3	2	-	4.0
PC-	BTPK-804-P	Packaging Machinery Maintenance Lab	-	-	3	1.5
PW-6	BTPK-805	Project Work-II	-	9	9	9
Total			12	14	12	25
Total (Overall)			**38**			**25.0**

ED/SALES & MARKETING/ PACKAGE ECONOMICS & VALUE ENGINEERING

General Course Information	
Course Code: BTPK -701-L **Course Credit: 3.5**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 4/week, (L-T-P:3-1-0) **Mode:** Lectures and Tutorials **Examination Duration:** 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcome:

1. Knowledge of basic concept of entrepreneurship development in packaging industry
2. Knowledge about various business planning processes
3. Knowledge about different kind of firms and models for a new business
4. Thorough knowledge of marketing and sales to increase business.

Unit- 1

Entrepreneurship: A Perspective: Recognition of the need for entrepreneurship and self-employment development, Entrepreneurship spirits, Significance of entrepreneur in Economic Development, Scope and trends of small enterprises, Small business/enterprise-the driving force for national growth, Types of small enterprises

Economic, social and psychological need for entrepreneurship, characterization, qualities and pre-requisites of entrepreneur, Selection of a potential entrepreneur, Identifying & Evaluating Business opportunities.

Green Protocol & Entrepreneurship

Legislation and environment- Green Entrepreneur- Interdependent dimensions Economy, Environment and Society- Environmental Values- Five Steps for a green entrepreneurs journey- Sketch & Set, Build, Test, Implement and Measure and Improve.

Unit- 2

Quick Start Method: Methods and Procedures to start and expand one's own business, life cycle of new business, Franchises, creating your own franchise, multilevel marketing schemes, buying an existing business.

Business Planning Process: Why is a good business plan required? Business Plan-the major benefits, sub plan, Business plan-blue print to success and financing, Small manufactures business plan, Feasibility Study, Preparation of Feasibility Reports, Project Reports.

Unit- 3

Forms of Ownership: Different forms of ownership-sole propriety ship, partnership, joint stock company, Selling, Selling your venture, planning for succession, Valuation of a business, Responsibility of a good employer, Risk management, What risks does your business face?

Instructional Models: Govt. support to new enterprise, incentives, sources of finance. Entrepreneurship Development Centre, Role of Govt. and promotional agencies in entrepreneurship development, Entrepreneurship development programmes, Role of various institutions in developing entrepreneurship in India.

Unit- 4

Marketing: Introduction to marketing, meaning, objective of marketing, Traditional and Modern concept of marketing, difference between marketing and selling. Types of Market, Importance of Marketing, Functions of marketing. **Modern theories in sales management.**

Sales management: Introduction, definition, benefits of selling activities, elements of sales management, objective of sales management.

Recommended Books :

Entrepreneurship Development - Colombo Plan Staff College for Technician Education.
Entrepreneurship Development & Management - **Jose Paul, N. Ajith Kumar**.
Entrepreneurship Development Programmes & Practices - **Jasmer Singh Saini**.
Marketing management
Sales Management
Create your green business- Roman Farreny, Ariadna Benet & luis Morales.

CONVERTING PROCESS FOR PACKAGING

General Course Information	
Course Code: BTPK -702-L **Course Credit: 3.5**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 4/week, (L-T-P:3-1-0) **Mode:** Lectures and Tutorials **Examination Duration:** 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objective: To develop knowledge of students about various converting process for packaging, their working and applications.

UNIT-I

Conversion Process: - Flexible packaging manufacturing; Paper bags – types, manufacture, Composite cans –manufacturing, applications; Fibre drums. Multiwall paper sacks - types, manufacture; Rigid boxes, Folding Cartons – Design, Manufacturing; Solid fibreboard packaging, Paperboard based liquid packaging, Moulded pulp containers. **Machine and equipments used in flexible packaging.**

UNIT-II

Packaging of Accessories and Spares - Skin, Blister and Shrink, Packaging: Skin Packaging: Introduction and advantages, Blister Packaging: Introduction, advantages and equipment attached, Shrink packaging: Introduction and Advantages. Stretch Wrapping and Systems: Introduction, Pilfer-proof packs, pallet stretch wrapping, Material used and advantages.

Strip Packaging: Introduction, Machinery, operating skills, selection of material, machine speed. Blister Packaging: Introduction, Materials, Forming a blister, blister design, continuous blister packing.

UNIT-III

Form - Fill - Seal Machine (systems): Vertical and horizontal FFS Machines, Pouch types, Filling operation, Pouch material and its selection. Developments in Packaging of Stand-Up Pouches: Developments in materials, properties and functions.

Blow Moulding Machines: Introduction, concept, Extrusion blow moulding machine, Co-extrusion blow moulding. High Flow PEs - a New Trend in Injection Moulded Containers; Plastic Packaging applications, advantages, forms, advantages of injection moulded thin all containers over thermoformed containers, Properties and benefits of PE's, MAP Machine and CAP.

UNIT-IV

Corrugating Board: - Corrugated Board: Corrugated Board construction - Flutes/Single, Double, Triple Wall, Board grades, Manufacture, Adhesive Bond, Specifications, Flat Crush/Edge Crush Tests Box Certificates. Box Layout, Types, Manufacture/Scoring Allowances, Optimization, Economy. Compression Test, McKee Formula/ECT, Inserts/Partitions, Stack Height, Pallet Patterns, Banding/Strapping/Taping, Corrugated Board Pallets, Corrugated Board Cushions. **Technological advancements in methods and machine used in corrugated printing.**

Course Outcomes: This course will be helpful for the students: -

1. To gain knowledge about various converting process
2. Applications and working of various converting process in packaging industry.

Text & Reference Books:

1. Packaging Machinery Handbook: The complete guide to automated packaging machinery including packaging line design Nov 17, 2012 by Henry CPP, John RLetter Press Printing Part 1, 2, By C.S. Misra
2. Introduction to Packaging Machinery, Packaging Machinery Manufacturers Institute. By Davis, C.G.,
3. Encyclopedia of Packaging Technology, John Wiley & Sons Inc. Publication, 2009 By Kit L Yam,The Wiley
4. The Packaging User's Handbook, Blackie Academic & Professional, 4th Reprint, 1996 By : F A Paine

QUALITY CONTROL AND WASTE MANAGEMENT

General Course Information	
Course Code: BTPK-703-L Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives

1. To give the students comprehensive knowledge of various quality control techniques used in packaging industry.

2. To understand various waste management strategies in packaging industry.

Unit-I

Definition of Quality, Quality control, its meaning, objective, and functions, Quality Cost, economic consideration, Quality Assurance, Comparative study of quality control and quality assurance, Benefits of Quality Control in Printing Industry, TQM, Quality Circles

Unit-II

Solid, Liquid and Gaseous **wastes** in printing and packaging organizations, Environmental impact of printing and packaging industry, SWOT Analysis, wastage reduction in printing and packaging industries. **Green protocol and green printing concepts**-

Unit-III

Establishing Quality control programme in different departments of Printing organization. Introduction to ISO:9000 and ISO:14000 series. **Environment Management system,** QMS and EMS, Paper and paper board testing instruments for testing printability, print quality and end-user requirements. **ISO standards for Graphic technology- ISO 12647- Process Control for halftone colour separation, Proof and production prints, ISO 16760:2014 – Prepress data exchange. ISO 16762 & 16763 for Post press, ISO 284b for Printing ink ISO/TC 130 for digital printing and ISO/TC 122 for packaging**

Unit-IV

Various tests on packages**,** Ink testing instruments for testing optical and working properties and end-use requirements Process control instruments, Quality Control Strip, Press sheet control devices used for production of multi-colour printing jobs Basic principles of these instruments and devices how they function and what they measure, minimum instrumentation necessary to produce a product consistent with the appropriate quality level.

Course Outcomes

1. Students will be able to understand quality principles in a deeper level.
2. Students will be able to reduce wastage in the organizations.

Recommended Books:

1. W.H. Banks, Inks, Plates and Print Quality, Pergamon Press
2. Quality Control for quality printing, Graphic Arts, Technical Foundations
3. Waste management practices by John Pichtel

PACKAGING OF INDUSTRIAL AND HAZARDOUS GOODS

General Course Information	
Course Code: PW-4, BTPK – 704- L **Course Credit: 3.0** **Contact Hours**: 3/week, **(L-T-P:3-0-0)** **Mode:** Lectures and Tutorials **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Objectives:

1. Study the classification, characteristics & sensitivities of various industrial products.
2. Understand package design &development approach based on the type of industrial product.
3. Study the classification and properties of wood, including the defects.
4. Study the different wood based packaging forms and other bulk carriers.
5. Understand the product protection principles.

Outcomes: At the end of the course, learners should be able to;

1. Effectively choose packaging materials based on characteristics of industrial products.
2. Describe the various properties & defects of wood packaging material
3. Analyze the various hazards & environmental issues related to Packaging and select a specific protection method for the product.
4. Choose various bulk carriers for industrial packaging based on the type of product.

UNIT-I

Introduction & Classification: Introduction to industrial products packaging, difference between consumer and industrial packaging needs. The packaging Considerations and package design approach, protective requirements and distribution – hazards, their sensitivity influencing packaging design and development criteria Industrial Products Classification – Product Group Wise, Its Nature, Classification & Requirements; Heavy, Medium and Light Engineering Goods; Electronic Products; Auto Components/ Spares, Chemicals and others.

UNIT-II

Wood as Packaging Material: Classification of wood – Groups, softwood & hardwood, plywood Properties of wood – Density, Moisture Content Defects found in wood – Knots, Cross Grain, Cupping, checking and others. Introduction to Wood seasoning & Preservation
Wood Packaging Forms Wooden Boxes & Crates – Difference & Types. Introduction to Wooden Pallets, Palletized Boxes& Box Pallets and their various components; Wooden Dunnages.

UNIT-III

Product Protection: Corrosion – Types and Preventive Methods, Introduction to Desiccants Cushioning – Concept, Fragility & Cushion Factor, Shock & Vibration. Open & Closed cell cushions and various cushioning Materials. Internal Fitments – Functions & Different Materials; Types of Internal Fitments - Corner supports, Pads, Liners/collars, Trays, Slotted Partitions and others. Concept of Reinforcement & Unitization
Bulk Carriers: Intermediate Bulk Containers (IBC) – Rigid & Flexible – Types, Materials of Constructions & Various designs. Corrugated Fibreboard Boxes, Paper Sacks, Jerry Cans,Fibre Drums and others.

UNIT-IV

Packaging of Chemicals: Cement, Fertilizers, Pesticides/ Insecticides, Petroleum products etc., Alternate bulk Packaging systems and their applications and benefits. Functions of chemical Packaging, Recent developments in chemical packaging.

Texts / References:

1. Friedman W.F. and J.J. Kipness, Industrial Products packaging, John Wiley & Sons

2. Klimchuck, Packaging Design & Engineering, Wiley

3. Joseph F.L. Robert S Keley, Handbook of Package Engineering, Technomic Publishing

4. F. A. Paine, Fundamentals of Packaging, Blackie A& P

5. Friedman W.F. and J.J. Kipness, Distribution Packaging, Robert E. Krieger Publishing Co

6. Wooden Containers/crates, Corrugated board/boxes, marking : Specification and Testing as per Indian Standards

PLASTIC AND POLYMER MANUFACTURING

General Course Information	
Course Code: PC 19 -BTPK 705 -L **Course Credit:** 3.0	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, **(L-T-P:3-0-0)** **Mode:** Lectures and Tutorials **Examination Duration: 3 Hours**	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objective: To give the students comprehensive knowledge of various types of plastics available in the industry, their applications and manufacturing for various types of packages.

UNIT-1

Types of plastic, thermosetting and thermoforming plastics – Thermo Setting polymers – Epoxicles, Melamine, Plastic Extrusion Process – Silicone, Urea formaldehyde, Polyester resin, Plastics Extrusion Process - **Dry extrusion and wet extrusion – Profile extrusion, Co-extrusion, extrusion coating, sheet film extrusion, below film extrusion, Coup aid extrusion and 3D printer Filament extrusion.**

Injection Molding, Blow molding, Co repression molding, Film Molding, Gas assist molding, Rotational molding, Structural form molding and thermoforming,

thermoforming in packaging,

UNIT-II

Application, advantages and disadvantage of - Low density Polyethylene, Linear Low density polyethylene, High Density Polyethylene, High Molecular High Density Polyethylene, **Plastic Moulding Processes,** extended polyethylene,

UNIT-III

Poly Propylene- **Types,** properties and applications in Packaging, **BOPP- Use and attributes of BOPP Films – Pros and Cons Recyclability of BOPP:**

Polystyrene- properties processing and Applications, Polystyrene and **Food Packaging and Safety information Expanded polystyrene**

UNIT-IV

Polyamides for packaging – properties, Uses – Nylon 6 and PA- 6, PA 6.6, Nylon II, Polyesters, Uses Properties, and application in packaging, Reusable Plastic bags Plastic woven Sacks, polycarbonate (PC)

Polyvinyl chloride (PVC), Uses, Application, Use of PVC in packaging, Environmental impact of polyvinyl chloride.

SUPPLY CHAIN AND LOGISTICS MANAGEMENT IN PACKAGING

General Course Information	
Course Code: BTPK – 706- L **Course Credit:** 3.0 **Contact Hours:** 3/week, **(L-T-P:3-0-0**) **Mode:** Lectures and Tutorials **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives

1. An in depth study of physical distribution system.
2. To introduce major building blocks, functions, business process, performance metrics and decision making in supply chain network.

Unit – I

Physical distribution: Participation in the physical distribution functions – The environment of physical distribution – Channel design strategies and structure – electing channel members – Setting distribution objectives and tasks – Target markets and channel design strategies.

Unit – II

Managing the marketing channel – Product, Pricing and Promotion issues in channel Management and Physical Distribution – Motivating channel members – Evaluating channel member performance – Vertical marketing systems – Retail co-operatives, Franchise systems and corporate marketing systems.

Unit – III

Supply Chain: Building Blocks of Supply Chain Network – Performance Measures in Decisions in the Supply chain World – Models for Supply Chain Decision Making

Unit – IV

Supply Chain Inventory Management: Economic Order quantity Models – Recorder Point Models – Multichannel Inventory systems – Supply chain Facilities Layout – Capacity Planning – Inventory optimization – Dynamic Routing and Scheduling.

Relation to ERP: E-procurement – E-Logistics – Internet Auctions – E-markets – Electronic Business Process – Optimization Business Object in SCM.

Course Outcome: This course will help the students to gain the knowledge of efficient optimization and management of operation in Logistics Management and to impart knowledge and understanding on Supply Chain Management with the ability to apply them in the enterprise reality.

References

D.K. Agarwal, LOGISTICS & SUPPLY CHAIN MANAGEMENT, Macmillan India Pvt. Ltd. New Delhi, 2008

1. N. Chandrasekaran, SUPPLY CHAIN MANAGEMENT, Oxford University Press, 2010
2. Satish K. Kapoor &PurvaKansal, BASICA OF DISTRIBUTION MANAGEMENT - A LOGISTICAL APPROACH, Prentice – Hall India, 2003.
3. Sunil chopra, Meindl&Kalra, SUPPLY CHAIN MANAGEMENT, Pearson Education, India, 2009 Bowersox &Closs,
4. LOGISTICS MANAGEMENT, Tata McGraw Hill, New Delhi, 2008

CONVERTING PROCESS FOR PACKAGING LAB

General Course Information	
Course Code: BTPT 702-P **Course Credit:** 1.5	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week**, (L-T-P:0-0-3)** **Mode**: Lectures and Tutorials **Examination Duration: 3 Hours**	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

List of Experiment/Practical:

1. To Study about Flexible packaging manufacturing process
2. To Study about Strip Packaging
3. To Study Blister and Shrink, Packaging
4. To Study Strip Packaging Machinery
5. To Study Blow Moulding Machines
6. To Study about Corrugation Board and its manufacturing process

QUALITY CONTROL AND WASTE MANAGEMENT LAB

<table>
<tr><th colspan="2">General Course Information</th></tr>
<tr><td rowspan="2">Course Code: BTPK-703-P

Course Credit: 1.5

Contact Hours: 3/week, (L-T-P:0-0-3)

Mode: Practical & Lab Work

Examination Duration: 3 Hours</td><td>Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)</td></tr>
<tr><td>Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70) Internal practical evaluation is to be done by the course co-ordinator. The end semester practical examinations will be conducted jointly by external and internal examiners.</td></tr>
</table>

List of Experiments –

1. GSM, Caliper, Checking grain direction.
2. Tensile strength of paper, burst strength of paper.
3. Various Tests for packages, drop test, vibration tests, compression testing
4. Tearing testing of paper, brightness test of paper.
5. Gloss test, Ash Content Tester
6. Folding endurance, Standard Viewing of Print
7. Curl Testing
8. Identification of Solid, Liquid and Gaseous emissions in printing and packaging industry
9. Quality control for various packages
10. Measurement of viscosity of ink, tack measurement for ink

PACKAGING OF INDUSTRIAL AND HAZARDOUS GOODS LAB

General Course Information	
Course Code: BTPK – 705-P **Course Credit**: 1.5 **Contact Hours**: 3/week, **(L-T-P:0-0-3)** **Mode:** Lectures and Tutorials **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

OBJECTIVES: To develop awareness about the classification, characteristics & sensitivities of various industrial products and also understand package design &development approach based on the type of industrial and hazardous goods.

List of Experiments:

1. Study the classification, characteristics & sensitivities of various industrial products.
2. Understand package design &development approach based on the type of industrial product.
3. Study the classification and properties of wood, including the defects.
4. Study the different wood based packaging forms and other bulk carriers.
5. Understand the product protection principles.
6. VPI-paper/materials-Lab evaluation for effectiveness.
7. Quantity calculation of desiccant required effect of high humidity/temperature-on Industrial.
8. Product components-assessment of various coatings/wrappers.
9. Develop cushion curve for resilient cushions.
10. Assessment of compression set of selected cushioning materials.

OUTCOMES: At the end of the course, learners should be able to effectively choose packaging materials based on characteristics of industrial products and also analyze the various hazards & environmental issues related to Packaging and select a specific protection method for the product.

PLASTIC AND POLYMER MANUFACTURING LAB

General Course Information	
Course Code: BTPK 707 **Course Credit:** 1.5 **Contact Hours:**1(3hr)/week, **(L-T-P:0-0-3)** **Mode:** Practical **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.

Course Objective: To give the students comprehensive practical knowledge of various types of plastics available in the industry, their applications and manufacturing for various types of packages.

1. Study of some typical applications of polyester films in Packaging.
2. Study of Solubility test of Plastics.
3. Study of Melting Behavior of Plastics.
4. Study of Approximate Density of Plastics
5. Study of Ignition Test of plastics.
6. Study of Dry distillation test of Plastics.
7. Study of Chemical colour Identification Test of Plastics.
8. Study of Pyrolysis test of Plastics.
9. Study of Refractive Index of Plastics.

PROJECT WORK - I

General Course Information	
Course Code: BTPK 708 **Course Credit:** N.C. **Contact Hours:** (2hr)/week, **(L-T-P:0-2-0)** **Mode:** Practical **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two assessment each of 20 marks, Project Performance measured through percentage of attendance (4 marks) Assignments (4 marks) and project performance (2 marks), and end semester viva-voce examination by the external examiners of 70 marks.

The concept of major Project will be started by a group of maximum ten students under the guidance of project guide (Faculty member).

INDUSTRIAL TRAINING PRESENTATION- II

<table>
<tr><td colspan="2">General Course Information</td></tr>
<tr><td rowspan="2">Course Code: BTPK-709

Course Credit: - Non-Credit

Contact Hours: 2/week, (L-T-P:0-2-0)

Mode: Tutorials

Examination Duration: 3 Hours</td><td>Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)</td></tr>
<tr><td>For the end semester examination, the presentation will be made by the students and Viva-Voce examinations will be conducted by External Examiner (preferably from Industry).</td></tr>
</table>

For industrial exposure of the students to the latest technology and to make them understand the workflow in the industry, training in the Industry forms a compulsory and significant aspect. Students will be trained in industry for a period of 3 weeks during the earlier semester vacations. Their performance will be periodically assessed by the staff in charge from the department and a coordinator industry. After completion of the training period the students will submit a detailed report. There will be a viva-voce at the end of the training and grades will be awarded. The areas of training during these periods will be in different branches of printing and packaging.

GREEN PRINTING

General Course Information	
Course Code: PW-4, BTPK – 801-L Course Credit: 3.5 Contact Hours: 3/week, (L-T-P:3-1-0)	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

OBJECTIVES: Working in Printing press are required to deal with different consumable materials like bio-degradable, non-biodegradable and other volatile compounds which subsequently create pollution to environment. This subject will teach students to know about bio-degradable and non-biodegradable materials, use of biochemical based material and thus encouraging greener production with limiting pollution. Student should have prior knowledge of printing process, conventional materials required for each process and nature of hazards involved etc.

OUTCOMES: At the end of the course, the students should be able to:

- Introduce the novel concept of green printing process and to enable students to tackle environmental problems in their chosen area of application.
- It will impart the concepts of recycling, recycling techniques.
- Know the use of bio-degradable and non-biodegradable materials, reducing pollution, use of more eco-friendly and biochemical based materials etc. in printing.

UNIT-I

Overview, Biodegradable material, Necessity, Advantage, Printing wastes – characteristics, type, life cycle of waste, pre-press, press and post-press wastes, Material input and typical waste output in Printing Industry, List of chemical in Printing industry activities, Waste segregation, Petrochemical need in Printing industry. Toxic compound, Environmental issues in printing facilities- emission to air, waste water, VOC emission, Sources of VOC, Environmental effect of VOC, Steps to reduce VOC emission, Avoiding or minimizing VOC loss.

UNIT-II

Implementing secondary control, Biochemical based cleaning solvents Biochemical enhance worker safety. Waste reduction recycling and reuse. Pollution Prevention and Cleaner Production. Particulate matter- Reduction, removal, collection, Contribution by products, Waste material, Chemical hazards, Inhalation, hazardous material management hazards-prevention and control.
Environment Management System – accounting concepts, data collection, evaluation and process operations, ISO 14000 and Life – cycle concepts. **Eco Management and Audit system, Life Cycle Assessment**

UNIT III

Waste – Collection, sorting, cleaning – **Recycling** – Overview and growth – Characterization of waste streams – Processing facilities for recyclable materials. **Recycling Technique / Methods-** Recycling rate, material recovery facilities – Integrating recycling with landfills – Processing equipments. Recycling of Paper, Metals, Plastic and Glass. **Waste Management:** Sustainability and global conditions - Material and solid waste management - Energy management -chemical waste management and green chemistry - Climate change and air emissions management - Supply water and waste water management - Environmental business management.

UNIT IV

Need for Green Supply Chain Management (GSCM): Green supply Chains – Need for Green Supply Chains – Implications of modern supply chain management – The supply chain strategy – Ingredients of green supply chain strategy. **Industrial Ecology:** Introduction - Material flows in chemical printing - Industrial parks - Assessing opportunities for waste exchanges and by product synergies - Lifecycle concepts - Product stewardship and green engineering - Regulatory, social and business environment for green printing - Metrics and analytical tools - Green supply chains - Present state of green printing.

TEXT BOOKS

1. David Allen T. and David R. Shonnard, "Green engineering", Prentice Hall NJ, 2002.
2. David Dornfeld," Green printing fundamental and applications" Prentice hall, 2002.
3. 'Sustainable Supply Chain Management' Balkan Cetinkaya and Richard Cuthbertson (2nd) – Springer 2011
4. Kipphan Helmut, "Hand Book of Print Media", Springer, Germany, 2001.
5. Jones Gary A, "Air Pollution engineering Guide for Graphic Arts Industry", GATF, 1993.

REFERENCES

1. Sammy Shinga G., "Green electronics design and printing", Prince Publications,2008.
2. James clark, "Green chemistry", Blackwell publishing, 2008.
3. Paulo Davim," Sustainable printing", Wiley publications 2010.
4. Frank Kreith, George Tchobanoglous, "Solid waste management", McGraw Hill, 2002.
5. Stevens S., "Green plastics", Princeton University press, 2002.
6. Robert Ayres U., "A Handbook of Industrial Ecology", Edward Elgar publishing, 2002.
7. Hsiao-fan wang and Surendra M.Gupta Green supply management Product life cycle approach McGraw Hill, 2011.

8. W.S. Allen/P.N.Baker, "Handbook of plastic Recycling", Alkem Quality Edition, Alkem Publishing,2009.
9. R.Mckinney, "Technology of paper Recycling", Blackie Academic and professional, 1997.
10. Herbert F.Lund, " McGraw-Hill Recycling Handbook", 2nd Edition, 2001
11. John Geis A and Paul Addy L, "Materials handling for the Printer", GATF Press, Pittsburgh, 1999

LATEST TRENDS IN PACKAGING TECHNOLOGY

General Course Information	
Course Code: BTPK – 802 L **Course Credit: 3.5** **Contact Hours:** 3/week, **(L-T-P:3-1-0)** **Mode:** Lectures and Tutorials **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Unit 1

Innovative & Intelligent Packaging- introduction, applications and limitations. Introduction to the applications of Additive manufacturing, Erasable printing technology, Desktop Label Printer & Barcode Label Printer in packaging technology. **Inkjet application in label and Carton Printing. Functional Packaging-Interactive Packaging**

Unit 2

New machines in Packaging, application, Possibilities of UV printers in Packaging working and limitations of Receipt/NCR Printer, Sheet-fed Digital Printing, Jetted Materials and Substrates, new trends in cushioning, latest materials of Packaging.

Unit 3

Customized packaging, Packaging on demand, Track and trace systems, Active packaging, Introduction to bulk packaging, Recent developments in Rigid Packaging and Flexible Packaging, Personalization and Customization in Packaging.

Unit 4

New rules and regulations related to packaging in India, Europe and America. New Measurement Trends for volatile and non Volatile compounds in Packaging Industry

BULK AND INDUSTRIAL PACKAGING

General Course Information	
Course Code: BTPK – 803 L **Course Credit: 3.5** **Contact Hours:** 3/week, **(L-T-P:3-1-0)** **Mode:** Lectures and Tutorials **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course outcome:

1. Knowledge about bulk packaging and its application
2. Knowledge about various bulk packaging systems used in market
3. Thorough knowledge about different kind of materials used in bulk packaging
4. How to select proper packaging for industrial product.

Unit- 1

Introduction to packaging, meaning of Bulk Packaging, bulk packaging consideration, Product needs, Product weights.

Difference between bulk packaging and retail, Application of bulk packaging, advantages and disadvantages

Unit-2

Bulk Packaging systems: Intermediate Bulk Containers (IBC) - Rigid IBC tanks, Flexible IBC Tanks, Designing, advantages, application, acquisition and disposal, safety, container costs, container types. Flexible Intermediate Bulk Containers (FIBC) - history, Electrostatic properties, Applications, uses of flood barrier, emptying FIBC.

Woven sacks- Gunny sack, paper sack, plastic bags. Bulk Shrink Wrap- Introduction, Composition, Manufacturing, application, Stretch Wrapping- Introduction, manufacturing, functions, Application- Manual, Semi-Automatic wrappers and Automatic wrappers,

Unit- 3

Material used in bulk packaging- LDPE, LLDPE, HDPE, PP, PVC, Nylon, Polyester

Other materials like- Corrugated, Bags, Metals, Wood

Unit- 4

Bulk Packaging for Hazardous Materials, Industrial packaging types.

Selection of proper packaging for industrial product- Flexible industrial packaging paper and plastic, rigid industrial packaging wooden, metal and plastic.

Reference books:

1. Encyclopaedia of Packaging Technology by Kit L. Yam, The Wiley publication
2. Internet

PACKAGING MACHINERY MAINTENANCE

General Course Information	
Course Code: BTPK 804-L Course Credit: 4	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 4/week, (L-T-P:3-2-0) Mode: Lectures and Tutorials Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

PO: This subject will include thoroughly knowledge about maintenance of Packaging machines. This includes:

1. Keen knowledge about various drive and control systems used in Packaging machine
2. Thorough knowledge about erecting and testing
3. Thorough knowledge about maintenance procedure.

Unit - 1

Introduction to stretch wrapping machine and its maintenance, Drive and Control Systems: Transmission systems such as AC and DC motors, belt, chain, gear, cranks, connecting rods, Paul and ratchet mechanisms, Hydraulic, Pneumatic controls. **Online Maintenance.**

Unit- 2

Introduction to Strip packaging machine and its maintenance, Erecting and Testing: Equipment needed for erection - selection of location and environmental conditions - erection procedure for various prepress printing and finishing equipments and machinery - loading and transport of raw materials.

Unit- 3

Introduction to blister packaging and material used in blister packaging, and blister design. Introduction to form- fill – seal machine, type, filling operations and its maintenance. Cylinders, Bushes and Bearings: Cylinder construction - testing run out and taper - cylinder bearing supports - eccentric bushes - removal and fixing of bushes - changing of oil seals maintenance of bushes and bearings.

Unit- 4

Maintenance procedures: Need and importance of maintenance - Definition, types, **Corrective maintenance, Preventive maintenance, Predictive maintenance, Zero hour maintenance,(TBM) Model of maintenance, Corrective model, Conditional Model, Systematic model, Legal maintenance, Subcontracted maintenance.** Maintenance policies - Maintenance organization – Maintenance of pumps and compressor - Lubricants, their types and Characteristics, Lubricating methods - Central lubrication with return oil Manual lubricating Greases, oils, Greases, oils, grades - preventive maintenance, break down maintenance.

Recommended Books:-

1. Electrical Engg. By B.L. Thareja Part I & II
2. Theory of Machines By Khurmi & Gupta S.Chand Publisher New Delhi

3. Packaging Technology (volume 3)

PACKAGING MACHINERY MAINTENANCE LAB

<table>
<tr><th colspan="2">General Course Information</th></tr>
<tr><td>Course Code: BTPK 804-P

Course Credit: 1.5</td><td>Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70) Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.</td></tr>
<tr><td>Contact Hours: 3/week, (L-T-P:0-0-3)

Mode: Lectures and Tutorials

Examination Duration: 3 Hours</td><td>For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.</td></tr>
</table>

1. Study of AC and DC motor
2. Study of Transmission system
3. Study of stretch packaging machine
4. Study of blister packaging
5. Study of form-fill-seal machine
6. Maintenance of cylinders
7. Maintenance of gear system of packaging machine

PROJECT WORK - II

General Course Information	
Course Code: BTPK -805 **Course Credit:** 9 **Contact Hours:** (3hr)/week, **(L-T-P:0-9-9)** **Mode:** Practical **Examination Duration: 3 Hours**	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two assessment each of 20 marks, Project Performance measured through percentage of attendance (4 marks) Assignments (4 marks) and project performance (2 marks), and end semester viva-voce examination by the external examiners of 70 marks.

Project will be an innovative working model of machine/equipments used in Printing Industry with required modifications and will be demonstrated during examination with the help of project report by a group of maximum ten students under the guidance of project guide (Faculty member)