

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2013
M.E. PRINTING AND PACKAGING TECHNOLOGY (FULL TIME)
I TO IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PG8101	Fundamentals of Packaging	3	0	0	3
2.	PG8102	Package Design and Development	3	0	2	4
3.	PG8103	Paper and Board Packaging	3	0	0	3
4.	PG8104	Plastics Packaging	3	0	0	3
5.	MA8161	Statistical Methods for Engineers	3	1	0	4
6.		Elective I	3	0	0	3
PRACTICAL						
7.	PG8111	Technical Seminar	0	0	2	1
TOTAL			18	1	4	21

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PG8201	Package Printing Process	3	0	0	3
2.	PG8202	Packaging Laws and Regulation	3	0	0	3
3.	PG8203	Packaging Machinery	3	0	0	3
4.	PG8204	Packaging Performance and Testing	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
PRACTICAL						
7.	PG8211	Package Testing Laboratory	0	0	4	2
TOTAL			18	0	4	20

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.		Elective IV	3	0	0	3
2.		Elective V	3	0	0	3
3.		Elective VI	3	0	0	3
PRACTICAL						
4.	PG8311	Industrial Training*	0	0	0	2
5.	PG8312	Project work Phase I	0	0	12	6
TOTAL			9	0	12	17

* 3 Weeks of Industrial Training during earlier semester vacations

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	PG8411	Project Work Phase II	0	0	24	12
TOTAL			0	0	24	12

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 70

ELECTIVES FOR M.E. PRINTING AND PACKAGING TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PG8001	Advancements in Packaging	3	0	0	3
2.	PG8002	Anti-counterfeiting and Product Protection	3	0	0	3
3.	PG8003	Automotive and Industrial Packaging	3	0	0	3
4.	PG8004	Brand Management	3	0	0	3
5.	PG8005	Computer Applications in Packaging	3	0	0	3
6.	PG8006	Ergonomics in Packaging	3	0	0	3
7.	PG8007	Food Packaging	3	0	0	3
8.	PG8008	Glass, Wood and Metal Packaging	3	0	0	3
9.	PG8009	Healthcare Packaging	3	0	0	3
10.	PG8010	Offset Printing Technology	3	0	0	3
11.	PG8011	Package Attributes – Shelf Life	3	0	0	3
12.	PG8012	Packaging and Environment	3	0	0	3
13.	PG8013	Packaging Economics	3	0	0	3
14.	PG8014	Packaging Logistics and Supply Chain Management	3	0	0	3
15.	PG8015	Printing Inks and Coatings	3	0	0	3
16.	PG8016	Robotics in Packaging	3	0	0	3

Attested

Sobhan
DIRECTOR

AIM

- To provide an overview of packaging needs, types, technologies

OBJECTIVES

- To introduce the need and importance of packaging
- To impart knowledge about types of packaging, packaging materials, machineries

UNIT I OVERVIEW OF PACKAGING**7**

Packaging – Overview, scope, Market scenario, Packaging Education, Definition, Need, Packaging Functions, Types, Standards, Package Development, Package specifications, Package Distribution, Pre-shipment testing, Quality control, Laws and Regulations, Environmental issues, WPO, APF

UNIT II PACKAGING MATERIALS AND PROCESSES**9**

Packaging materials, Container types, Conversion Processes, Specialty Packaging, Packaging Line, Machinery selection, Selection of packaging material and type, Economics

UNIT III FMCG PACKAGING**12**

Requirements for FMCG packaging: Cosmetics, Textile, Footwear, Toiletries, Household, Glassware, Consumer electronics, Hardware packaging, Electrostatic Discharge Protective Packaging, Graphic requirements- color selection, color perception; Laminates

UNIT IV BULK PACKAGING**10**

Bulk packaging requirements, types; FIBC, Industrial packaging - Steel containers, Fibre Drums, Plastic Drums, Corrugated boxes, Crates - Wooden crates, Steel crates, Sacks, Export packaging, Hazardous materials packaging

UNIT V PACKAGE FINISHING**7**

Lamination, Hot foil stamping, Die-cutting, Varnishing, Coatings, Labels – types, substrates, adhesives; Closures, Sealing methods; Security in packaging - Need, Materials, Techniques

TOTAL :45 PERIODS**TEXT BOOKS**

1. Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of packaging professionals, Naperville, Illinois, USA, 2002.
2. Joseph F. Hanlon, Robert J. Kelsey, and Hallie Forcinio, "Handbook of Package Engineering", Third Edition, CRC press, 1998
3. Dr.B.Kumar and Dr.S.Natarajan and Dr.M.Govindarajan, "Fundamentals of Packaging", Published by PHI Learning Pvt Ltd, Jan. 2009

REFERENCES

1. Aaron L. Brody and Kenneth S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 1997

AIM

- To give an overview of package development process and package designing

OBJECTIVES

- To provide information on basic concepts in package designing, design considerations and design workflow.
- To learn about the package design and performance simulation software's

UNIT I INTRODUCTION**9**

Packaging and Modern Merchandising, Marketing Requirements, Brand Management, Product Lifecycle, Planning for change, Design considerations – structural development, packaging coordination, graphics, packaging line engineering, cost of development; Economic considerations: package cost vs. product cost, Environmental Considerations, Life cycle Assessment, Legal issues, Recent trends

UNIT II PACKAGE DEVELOPMENT**9**

Managing the Packaging Function, Project Scope, Consumer Research, Behavioral Measures, Eye Tracking and the features of a package, Optimizing Package Design, Package Design Process, Specifications, Benchmarks, Package Designer's Checklist, Package Design Evaluation – ocular tests, questionnaires.

UNIT III GRAPHIC DESIGN**9**

Demographics and Psychographics, The Retail Environment, Fundamental Messages, Equity and Brand Names, Typography, Color, Illustration, Graphic Design Basics, Package Design and Marketing Studies, Package Aesthetics, Decoration Aspects, Layout and Feature Selection.

UNIT IV STRUCTURAL DESIGN**9**

Predicting package performance, Role of Structure, Structural Design – folding cartons, cans, glass containers, plastic containers, bags and pouches; Die-making, Drawing, Moulds, Prototypes, Samples, etc., Package Optimization

UNIT V CLOSURES**9**

Function, Types, Selection considerations, Container and closure dimensioning, Metal closures, Closure Seals, Plastic closures, Injection moulds and closure design, tamper evident closures, child resistant closures. Special closures and functions, Case study and Mini Project for package design

TOTAL: 75 PERIODS**TEXT BOOKS**

- Marianne R. Klimchuk and Sandra A. Krasovec, "Packaging Design: Successful Product Branding from Concept to Shelf", Wiley, 2006,
- Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of packaging professionals, Naperville, Illinois, USA, 2002

REFERENCES

- Aaron L. Brody and Kenneth S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 1997
- Giles Calver, "What is Packaging Design?: Essential design handbook", Rotovision, 2004
- Steven DuPuis, John Silva, "Package Design Workbook: The Art and Science of Successful Packaging", Rockport Publishers, 2008

PACKAGE DESIGN LABORATORY

LIST OF EXERCISES

- Create Graphics Design for Folding cartons
- Create Graphics Design for Glass containers
- Create Graphics Design for Plastic containers
- Create Graphics Design for Bags & Pouches
- Create Graphics Design for Tin cans
- Create Closure Designs
- Create Dieline layouts for folding cartons and their multiple ups
- Create 3D Modelling and Package Performance Simulation for folding cartons
- Create 3D Modelling and Package Performance Simulation for Glass containers
- Create 3D Modelling and Package Performance Simulation for Plastic containers
- Create 3D Modelling and Package Performance Simulation for Bags & Pouches
- Create 3D Modelling and Package Performance Simulation for Tin cans

Total Laboratory Hours: 30

Lecture:45 + Laboratory: 30 TOTAL: 75 PERIODS

PG8103

PAPER AND BOARD PACKAGING

L T P C
3 0 0 3

AIM

- To impart knowledge on paperboard packaging materials and their processing technologies

OBJECTIVES

- To explain the properties of paper and paperboard and their effect in package performance
- To explain in detail about the various types of paper and paperboard packages and their manufacturing processes

UNIT I MANUFACTURING & APPEARANCE PROPERTIES 10

Sources, Paper and Paperboard Manufacturing process, Paper and board Coating, Appearance properties—Brightness, Whiteness, Colour, Surface smoothness, surface structure, gloss, opacity, printability and varnishability, Surface strength, Ink and varnish absorption and drying, Surface pH, Surface tension, Rub resistance.

UNIT II PERFORMANCE PROPERTIES 10

Basis Weight, Thickness, Moisture Content, Ash content, Dirt content, Tensile strength, Stretch or elongation, Tear Strength, Burst strength, Stiffness, Compression strength, Crush strength, Folding endurance test, pick resistance, Creasability and foldability, Ply bond strength, Flatness and dimensional stability, Porosity, Water absorbency, Gluability/Sealing, Taint and odour neutrality,

UNIT III PAPER AND PAPERBOARD - TYPES 7

Paper - Tissues, Greaseproof, Glassine, Vegetable Parchment, Label paper, Bag papers, sack craft, Impregnated Papers, Laminating papers; Paperboard – LWC board, HWC board, Folding box board, white lined chipboard, solid bleached board, solid unbleached board, Liquid packaging board, Container boards, Specialty boards.

UNIT IV CONVERSION PROCESS**11**

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.

UNIT V CORRUGATED BOARD**7**

Corrugated Board construction - Flutes/Single, Double, Triple Wall, Board grades, Manufacture, Adhesive Bond, Specifications, Testing methods – Burst test, Flat Crush, Edge Crush, CMT, Ring crush, Compression Test, McKee Formula/BCT. Box Layout, Types, Manufacture/Scoring Allowances, Optimization, Economy. Inserts/Partitions, Stack Height, Pallet Patterns, Banding/Strapping/Taping/labelling/wrapping, Corrugated Board Pallets, Corrugated Board Cushions and Honey comb.

TOTAL : 45 PERIODS**REFERENCES**

1. L. Brody, K. S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 2nd Edition, Wiley, New York, USA, 1995
2. Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of Packaging professionals, Naperville, Illinois, USA, 2002.
3. Joseph F. Hanlon, Robert J. Kelsey, and Hallie Forcinio, "Handbook of Package Engineering", Third Edition, CRC press, 1998
4. Hand book on Modern Packaging Industries by National institute of industrial research & Asian Pacific Business press.1978.

PG8104**PLASTICS PACKAGING****L T P C
3 0 0 3****AIM**

- To impart knowledge on polymeric packaging materials and their processing technologies.

OBJECTIVE

- To explain the properties of a polymer material based on the structure and chemistry of the material
- To select the suitable polymer material and technology for manufacturing of a particular type of packaging

UNIT I INTRODUCTION TO POLYMERS**7**

Basic concepts, Role of Plastics in Packaging, Polymer structure and properties, Polymerization techniques and types, Molecular Weight and Molecular Weight distribution, Polymer Morphology, Polymer properties – Mechanical, Thermal, Optical, Electrical, Barrier and Surface adhesion properties.

UNIT II MAJOR PLASTICS IN PACKAGING**12**

Polyethylene – Linear and Branch Polymers (HDPE, LLDPE, LDPE, EVA, EAA, Ionomers, Polypropylene – Homo and copolymer (Oriented and Biaxially Oriented), Polystyrene, Polyvinyl chloride (PVC), Poly Vinylidene Chloride (PVDC), Polystyrene (PS), Polyvinyl Alcohol (PVOH) and Ethylene Vinyl Alcohol (EVOH), Nylon, Polyester – Polyethylene Terephthalate (PET), Polyethylene Naphthalate (PEN) – Polycarbonate (PC), Fluoropolymers, Styrene-Butadiene Copolymers, Acrylonitrile Copolymers, Thermoplastic Elastomers : Cellophane and Cellulosic Plastics, Polymer Blends : Thermosets – Acrylics, Phenolics, Alkyds, Epoxies and Urethanes.

*Attested**Sobhan*
DIRECTORCentre For Academic Courses
Anna University, Chennai-600 025.

UNIT III FLEXIBLE PACKAGING 8

Material Selection, additives and compounding processing – Sheet and Film, Extrusion and Extruders – Cast film, Blown Films, Stretch and Shrink wrap, Film and Sheet Co-extrusion, Co-extruders film, Laminated film, metallized film, Intelligent / Smart films, oriented polystyrene film, microwavable films, Edible and soluble films, Packaging types – Bags, Pouches, Collapsible tubes, Bag-in-box, Flexible cans, sacks and case study.

UNIT IV RIGID PACKAGING 9

Material selection, additives and compounding, Injection molding-closures, Rotational Molding, Compression molding, Blow molding-Extrusion, Injection, Stretch, and Aseptic Blow molding – Plastic bottles, tubes, Plastic pallets, Drums, Barrels, Jerry cans and shipping containers, Plastic Foams – Poly olefin foams, Poly urethane, Poly styrene and bio-based foams, Thermoforming – types-Drape, Vacuum and pressure forming and case study.

UNIT V MATERIALS TESTING AND STANDARDS 9

Thickness, Strength Properties – Tensile, Puncture, Tear, Burst, Impact and Flexural, Surface Properties – Surface energy, friction, abrasion and dart impact, Optical Properties – Haze and Gloss, Colour, Clarity, Barrier Properties, National and International Standards for testing.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Selke, S. E. M., Culter, J. D. and Hernandez, R. J., "Plastics Packaging: Properties, Processing, Applications and Regulations", Second Edition, Hanser Gardner Publications, Inc., USA, 2004.

REFERENCES

1. Aaron L. Brody and Kenneth S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 2nd Edition, Wiley, 1997
2. Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of packaging professionals, 2002
3. A.S. Athayle, "Handbook of packaging plastics", Multi Tech publishing co, First edition, 1999.
4. Gordon L. Robertson, "Food Packaging Principles and Practice", Second Edition, CRC Press, 2006.
5. Richard Coles and Mark Kirwan, "Food and Beverage Packaging Technology", Second Edition, A John Wiley & Sons, Ltd., Publication 2011.
6. Dr.S.K.Nayak, "Fundamental of Plastic Testing" by Springer Publication, 2010.



MA8161

STATISTICAL METHODS FOR ENGINEERS

**L T P C
3 1 0 4**

OBJECTIVE:

- This course aims at providing the necessary basic concepts of a few statistical methods and to apply them to various engineering problems.

OUTCOME:

- It helps the students to have a clear perception of the power of statistical ideas and tools would be able to demonstrate the application of the statistical techniques to problems drawn from industry, management and other engineering fields.

UNIT I ESTIMATION THEORY (9+3)
Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency - Maximum likelihood Estimation - Method of Moments.

UNIT II TESTING OF HYPOTHESIS (9+3)
Tests based on Normal, t , χ^2 and F distributions for testing of means, variance and proportions - Analysis of $r \times c$ tables – Goodness of fit .

UNIT III CORRELATION AND REGRESSION (9+3)
Multiple and Partial Correlation - Method of Least Squares- Plane of Regression – Properties of Residuals - Coefficient of Multiple Correlation - Coefficient of Partial Correlation – Multiple Correlation with total and partial correlations - Regression and Partial correlations in terms of lower order coefficients

UNIT IV DESIGN OF EXPERIMENTS (9+3)
Analysis of variance - One-way and two-way classifications - Completely randomized design - Randomized block design - Latin square design.

UNIT V MULTIVARIATE ANALYSIS (9+3)
Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components: Population principal components – Principal components from standardized variables.

L:45 +T: 15 TOTAL: 60 PERIODS

TEXT BOOKS:

1. R. A. Johnson and C. B. Gupta, "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
2. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", Pearson Education, Asia, 6th Edition, 2007.
3. Gupta, S.C. and Kapoor, V.K. "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, Eleventh Edition, 2002.
4. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 5th Edition, Thomson and Duxbury, Singapore, 2002.
5. Murray, R. Spiegel and Larry J. Stephens, "Schaum's Outline, -Statistics", Third Edition, Tata McGraw-Hill, 2000.
6. J.E. Freund, "Mathematical Statistics", 5th Edition, Prentice Hall of India, 2001.

PROGRESS THROUGH KNOWLEDGE

PG8111

TECHNICAL SEMINAR

L T P C
0 0 2 1

This course is introduced to enrich the communication, writing and presentation skills of the student on technical and other relevant topics. In this course, a student has to present technical papers on recent advances in packaging technology which will be evaluated by staff.

TOTAL : 30 PERIODS

AIM

- To impart the fundamentals of printing and digital printing process.

OBJECTIVES

- To provide information about various activities in the prepress & Press and their sequence
- To understand the different digital printing process, workflow and its applications
- To provide an overview about the finishing processes

UNIT I FUNDAMENTALS OF PRINT PRODUCTION PROCESS 8

Print production workflow – typography, graphic design, page layout, prepress, printing, post press/finishing; Materials – substrates, ink; Drying methods; Recent trends.

UNIT II IMPACT PRINTING TECHNOLOGIES 10

Relief process – letterpress, flexography; Planographic process – lithography, offset; Gravure process and Screen printing process; Pad printing; Printing presses – types.

UNIT III NON-IMPACT PRINTING TECHNOLOGIES 9

Characteristics of non-impact printing; inkjet printing – types; electrophotography, magnetography, ionography, thermography, electrography and hybrid printing system, digital printing.

UNIT IV PREPRESS WORKFLOW 10

Colour theory; Halftone process – dot shape, screening- FM, AM and Hybrid, Screen ruling; Conventional prepress – typesetting, film reproduction, page makeup, image carrier preparation, proofing; Digital prepress – scanner, image acquisition, imposition, RIP, CTF, CTP; colour management and digital Proofing

UNIT V FINISHING PROCESS 8

Print Finishing - cutting, folding, gathering, securing; Lamination – types; varnishing – types; die-cutting; embossing; foiling; production sequence for various print products – case study.

TOTAL : 45 PERIODS**REFERENCES**

1. Helmut Kipphan, "Handbook of Print Media", Springer Publications, 2004
2. J. Michael Adams, Penny Ann Dolin, "Printing Technology", Delmar Publishers, 2002.
3. Kaj Johansson, Peter Lundberg, Robert Ruberg, " A Guide to Graphic Print Production", Wiley, 2002
4. John Drew, Sarah Meyer, "Color Management for Packaging: A Comprehensive Guide for Graphic Designers", RotoVision, 2008

AIM:

- To have a knowledge about the various International and National laws and regulations with respect to packaging.

OBJECTIVES:

- To understand the various rules and regulations with respect to packaging in India
- To comprehend the International laws with relation to various forms of Packaging

UNIT I	INDIAN REGULATORY SYSTEM	11
Introduction, The Standards of weights and Measures Act (SWMA), Standard Units, Laws, Regulations and Ministries involved, Essential Commodities Act, Agricultural Produce (Grading and Marketing) Act, Prevention of Food Adulteration Act, Codex Standard Act, Export (Quality Control and Inspection) Act, Bureau of Indian Standards		
UNIT II	DECLARATIONS ON PACKAGED COMMODITIES	10
Declarations for Interstate Trade and Commerce, Standard Packages, Maximum Permissible Error, Label Declarations, Standard Quantity specifications for various products, Symbols and Units used		
UNIT III	INTERNATIONAL LAWS AND VIOLATION OF LAW	6
Uniform Weights and Measures Law, Uniform Packaging and Labeling Regulation (UPLR), Uniform Unit Pricing Regulation (UPR), Details of Violations, offences, Penalties under various sections, EU-REACH Regulations in packaging.		
UNIT IV	PACKAGING STORAGE REQUIREMENTS	6
Various storage requirements of Products, Specifications of Raw Materials used, is Specifications with respect to packaging and Packaging Materials		
UNIT V	PACKAGING REQUIREMENTS AND PFA	12
Packaging requirements under PFA, Declaration and Labeling, Specification of Display panels, Statutory Requirements on Packages, PFA Enforcement methods, Fruit Products Order (FPO) Meat Food Products Order (MFPO) Agricultural Grading and Marking Rules (AGMARK), Edible Oil Packaging (Regulatory) Order.		

TOTAL: 45 PERIODS

REFERENCES

1. G C P Range Rao," Modern Food Packaging, Packaging Laws and Regulations", CFTRI Mysore , IIP Publications, 2005
2. The Standards of Weights and Measures act, (1976) & Standards of Weights and Measures (Packaged Commodities) Rules (1977), Rule Book, Govt. Of India.
3. BIS Rule Book, Govt. Of India.

PG8203

PACKAGING MACHINERY

L T P C
3 0 0 3

AIM

- To understand about the different types of packaging machineries and to contribute to the productivity of packaging operations involved in various markets

OBJECTIVES

- Identify unit operations that comprise common packaging lines
- Specify operating requirements of individual packaging machines in order to allow groups of packaging machines to function as a coherent system.
- Understand the relationships between products, packages, machines, and personnel.

UNIT I INTRODUCTION

9

Types of packaging machinery, Packaging line layout and design principles, Impact of end-use markets on machine needs and specifications - biotech/pharmacy/medical devices/ food / drinks/ chemicals, Machine and line components & controls - PLC, HMI, Servo motors, Smart machines, SCADA systems, Displays, Sensors.

Attested
Sobhan
DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

UNIT II PAPERBOARD AND FLEXIBLE PACKAGING MACHINE 9

Paperboard Packing Machinery – Cutting & Creasing, Embossing, Hot foil stamping, Folding & gluing machines, Cartoners, Case formers, Tray formers, Case/tray packer,; Flexible packaging machines – Extrusion moulding, Blown film machine, Bag former, Form-Fill-Seal - VFFS, HFFS, Rotary; Thermoform, Shrink/stretch wrapping and bundling, Types of Filling Machines, Wrapping Machines.

UNIT III RIGID PACKAGING MACHINERY 9

Injection moulding machine, Orienter, Liquid fillers: Volumetric, Level or cosmetic fill, Aerosol, Carbonated; Dry fillers: Augur, Volumetric, Weight, Tablet fillers; Cappers, Tube filling, Can former, Labeling Machines – Stick on, Shrink sleeves, Capping - Induction Sealing

UNIT IV PACKAGING LINE 9

Conveyors, accumulators and unscramblers, Container cleaning - Air blast, Ionized air blast, Water rinse, Wash and rinse, Aggressive wash and rinse; Sterilization, Coding and marking, Scales and check weighing, Robots, Placers/dispensers Techniques for measuring line capacity and efficiency, On line – end of line systems, shrink and stretch wrapping, cartoning, Case erector, case packing.

UNIT V DISTRIBUTION PACKAGING 9

Distribution Packaging: Product identification & verification – Barcodes, RFID Vision/inspection, Metal detectors and x-ray inspectors, Case Packaging Machinery, Palletisation - Palletizing and depalletizing, Containerisation Packaging.

TOTAL : 45 PERIODS

TEXT BOOK

1. Davis, C.G., "Introduction to Packaging Machinery", Packaging Machinery Manufacturers Institute, 1997

REFERENCES

1. A. L. Brody, K. S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 2nd Edition, Wiley, New York, USA, 1995
2. Luciano, R., "How to Write Packaging Machinery Specifications", Institute of Packaging Professionals, Herndon, VA. 1995.
3. Zepf, P.J., "Improving Packaging Line Performance", Institute of Packaging Professionals, Herndon, VA, 1996.

PG8204

PACKAGING PERFORMANCE AND TESTING

**L T P C
3 0 0 3**

AIM

- To provide knowledge on hazards in transport and storage environment and to suitably design a protective package

OBJECTIVES

To describe in detail

- On transportation hazards like shock, vibration, compression, etc.,
- On quantification of the extent of damage by using suitable testing methods
- On steps in developing a protective packaging

UNIT I HAZARDS**6**

Package Delivery System, Manual Handling, Warehouse handling equipments, Hazards - Transportation, Handling, Warehousing, Climatic, Others; Defining Package Distribution environment, Simulation of Distribution Environment, Integrity Tests, Simulation tests

UNIT II SHOCK & VIBRATION**14**

Shock - Spring/mass model of product on cushion, Shock transmission, Damage boundary curve, Typical shock damage, Measure of shock fragility, Accelerometers/shock indicators, Environmental data recorders; Handling statistics -drop heights, carriers; Shock pulse analysis, Drop testing machines - shock table, incline tester, cushion tester; Pallet marshalling, railcar coupling, horizontal impact tester; Transportation environment, Vibration damage - Natural frequency, Vibration magnification and resonance; Vibration measurement and testing - Transportation Recorders, Transportation surface profile, Random vibration testing, Replication/simulation.

UNIT III CUSHIONING SYSTEM AND PROTECTIVE PACKAGING**9**

Cushions - materials, manufacture, solid vs. loose fill, foam-in-place, Cushion properties - open vs. closed cell, relation to ideal spring, Corrugated as a cushioning material, Selection of cushioning material, Cushion design, Determining cushion thickness Steps in Design of protective packaging - Optimum Product/Package system, Prototype packages, Damage simulation; International standards for performance testing of shipping containers and units (ASTM, ISTA, ISO), Testing protocols.

UNIT IV COMPRESSION AND OTHER HAZARDS**7**

Compression - Package compression strength, Compression testing, Warehouse /transportation factors, Stack height calculations, Clamp truck damage; Climatic Effects - Temperature, Pressure, Humidity, Light, Dust, Rain; Temperatures inside trailers – heat transfer, Insulating packages; Biological Hazards – Microorganisms, insects, Rodents; Contamination by other goods – adjacent packs, radioactivity;

UNIT V SPECIAL TESTING METHODS**9**

Testing methodology- Oxygen Transmission, Water Vapour Transmission, Insulation, Leakage, Microbial Ranking, Burst strength, Tear strength, dart impact test, Vacuum testing, organoleptic evaluation, forklift test; Geometric stability of unitized loads - banding, stretch wrap.

TOTAL : 45 PERIODS**TEXT BOOK**

1. Brandenburg, Richard K., Lee, Julian June-Ling, "Fundamentals of packaging dynamics", 4th ed., L.A.B. Equipment, 2001

REFERENCES

1. Joseph F. Hanlon, Robert J. Kelsey, Hallie Forcinio, "Handbook of Packaging Engineering", 3rd edition, CRC Press, 1998
2. Sek M. and Kirkpatrick J. , "Corrugated Cushion Design Handbook", VUT, 2001
3. Russel, P G, and Daum, M P, "Product Protection Test Book", IoPP

PG8211**PACKAGE TESTING LABORATORY****L T P C
0 0 4 2****LIST OF EXPERIMENTS**

1. Determination of Tensile/compression strength of various packaging materials
2. Determination of Burst strength of various packaging materials
3. Determination of Crush strength of various packaging materials
4. Determination of Plybond strength of various packaging materials

5. Determination of Stiffness of various packaging materials
6. Determination of Scuff resistance of various packaging materials
7. Determination of Heat sealability of various packaging materials
8. Determination of gloss & haze of various packaging materials
9. Measure the color of a packaging material and compute color differences between different batches
10. Determination of permeability of various packaging materials
11. Determination of leaching of various packaging materials
12. Measure the surface pH of packaging materials
13. Determine the package performance by conducting Drop test
14. Determine the package performance by conducting Compression test
15. Determine the package performance by conducting Vibration test
16. Determine the package performance by conducting Impact test

TOTAL : 60 PERIODS

LABORATORY EQUIPMENT REQUIREMENTS

1. Universal Testing Machine
2. Burst tester
3. Ring Crush Tester
4. Plybond tester
5. Stiffness tester
6. Scuff tester
7. Heat Seal tester
8. Glossmeter
9. Hazemeter
10. Spectrophotometer
11. Permeability tester
12. Leak tester
13. pH meter
14. Drop tester
15. Compression tester
16. Vibration tester
17. Impact tester

PG8311

INDUSTRIAL TRAINING

L T P C
0 0 0 2

In order to expose 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 student will submit a 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.

PG8312

PROJECT WORK PHASE I

L T P C
0 0 12 6

Students have to do a research-based project in the department or in an industry and submit a report at the end of Phase I

PG8411

PROJECT WORK PHASE II

L T P C
0 0 24 12

Phase II of Project Work is a continuation of Phase I of Project. Students submit a report at the end of Phase II. There should be at least one paper presentation based on their project work.

PG8001

ADVANCEMENTS IN PACKAGING

L T P C
3 0 0 3

UNIT I FOOD PACKAGING

9

Active and Intelligent packaging, MAP – Recent trends, Application of nanomaterials and biopolymers in Food packaging; Portion Packaging; Packaging for Defense food, space food, high energy food for high altitude, functional foods; Sensors - Electronic nose, Electronic tongue.

UNIT II SUSTAINABLE PACKAGING

9

Sustainable Packaging - Materials, Design, Trends, Innovations; Energy efficiency; Logistic efficiency; Source Reduction – Lightweighting, Reuse of containers; Case study

UNIT III COSTING

9

Elements of Packaging cost, cost estimation of pack, Inventory Management – MRP, ERP, Profitability and cost reduction in supply chain management – Best Practices; Impact of FDI in Packaging industry, case study.

UNIT IV MACHINERY

9

Recent advancements in Packaging machinery, conveyors, Robotics in packaging, Advances in automation of Packaging industry, Industrial Ethernet and Machine to machine communication

UNIT V ENVIRONMENT

9

Waste – Types, source segregation, Disposal, Reduction, Waste Management; Carbon footprint; Package - Reduce, Reuse, Recycle; Environmental laws; Case study.

TOTAL : 45 PERIODS

REFERENCES

1. Gordon L. Robertson, "Food Packaging: Principles and Practice", Second edition, CRC Press, 2006.
2. Aaron L. Brody and Kenneth S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 2nd Edition, Wiley, 1997
3. Richard Coles and Mark Kirwan, "Food and Beverage Packaging Technology", Second Edition, A John Wiley & Sons, Ltd., Publication 2011.
4. W.S. Allen/P.N.Baker, "Handbook of plastic Recycling", Alkem Quality Edition, Alkem Publishing, 2009.
5. Susan E.M. Selke, "Packaging and the environment : alternatives, trends, and solutions", Technomic Publication, Revised Edition, 1994.

PG8002	ANTI-COUNTERFEITING AND PRODUCT PROTECTION	L T P C 3 0 0 3
UNIT I	SECURITY INKS & SUBSTRATES	9
Introduction, UV curing, photochromic inks, Monochromic Inks, Invisible Phosphorescent inks, Water resistant inks. Thermochromic inks, Solvent Sensitive inks, optically variable ink, Magnetic inks, Biometric ink, Fugitive ink, Secondary fluorescing ink, Watermarks, Security Fibres, Planchettes, Fluorescent Hilites, Iridescent coating, Security threads, Holographic foil, Coloured centre paper.		
UNIT II	NUMBERING AND BAR CODING	9
Numbering with MICR Ink on Rotary presses, Trouble Shooting, Modulus Systems, Weighted & Unweighted. Introduction, Principles of Bar Coding, Types of Coding, EAN 13 Code, Code 39 ACA etc., Typical Bar Code Machines & Print wheels, Scanners and their functions.		
UNIT III	HOLOGRAMS	9
Introduction, Manufacturing Process, Materials used of specifications, Holographic Recording & Master Origination, Finishing Process, Types of Holograms, Security holograms, clickograms, sterogram, Anigram and other optically variable devices.		
UNIT IV	SECURITY LABELS	9
Adhesives, Frangibility, security cuts and Perforations, Voiding, Alignment, Label reconciliation and storage conditions.		
UNIT V	TRACKING TECHNOLOGIES	9
Serial numbers, Linear bar code, Matrix codes, RFID (Radio frequency identification), GPS (Global positioning system), and other tracking technologies.		
		TOTAL: 45 PERIODS

REFERENCES

1. Leibinger, "Numbering Machines and Systems", Leibinger Numbering Systems, 2000.
2. William H. Erdei, "Bar Codes – Design, Printing and Quality Control", McGrawHill inc., 1998.
3. Pharmaceutical Anti-counterfeiting by Davision Mark, copyright @ John Willey sons

PG8003	AUTOMOTIVE AND INDUSTRIAL PACKAGING	L T P C 3 0 0 3
UNIT I	INTRODUCTION	9
Automotive industry and various departments, Automotive parts- electrical, mechanical, warehousing, sourcing, management practices- supply chain, Just in Time (JIT), scope of requirements.		
UNIT II	PACKAGING MATERIALS	9
Plastics- films, containers, pallets, straps, cushions; Paper board- cartons, corrugated boards, honeycomb, laminates; Wood- crates, boxes, pallets; Metal- crates, boxes.		
UNIT III	PACKAGING LINE & EQUIPMENTS	9
Conveyor system- carton folding, erection, filling, defect detection, pick and place robots; strapping machine types, wrapping machine types, fork lifts; Labeling and numbering; Label tracking and recognition system.		

UNIT IV HANDLING, STORAGE, PRESERVATION AND DELIVERY 9
Handling- pallets, packaging equipments, electronic equipment, fragile materials, hazardous materials; Storage- area designation, receipt and dispatch, stock condition assessment; Control- package, packaging, used packages; Preservation and segregation; Delivery system

UNIT V CORROSION PROTECTION & PACKAGE WASTE MANAGEMENT 9
Wax, Shellac, Varnish, Plastics, Paints, Corrosion inhibitors; Package recycling and reuse- Reduce, Recycling, Reuse (3R), Bio compatible packaging materials- dry grass, banana bark, natural fiber composites.

TOTAL : 45 PERIODS

TEXT BOOK

1. Walter F. Friedman, and Jerome J. Kipnas, "Industrial Packaging", Willey.
2. Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of Packaging professionals, Naperville, Illinois, USA, 2002.
3. Joseph F. Hanlon, Robert J. Kelsey, and Hallie Forcinio, "Handbook of Package Engineering", Third Edition, CRC press, 1998
4. Hans-Hermann Braess, Ulrich Seiffert "Handbook Of Automotive Engineering", Society of Automotive Engineers, 2005

PG8004

BRAND MANAGEMENT

L T P C
3 0 0 3

AIM

- To understand the role of buyer behavior and branding in packaging design and technology.

OBJECTIVES

- To explain the role and philosophy of Brand Management in the strategic marketing process and the resulting effects of the environment on Packaging decisions.
- To develop the attitudinal and conceptual basis necessary to apply a customer oriented approach for strategic marketing and business decisions and to help develop winning brands.

UNIT I CONCEPT OF BRAND MANAGEMENT 9
Introduction to the concept of Brand Management as an active working principle within the sales and marketing department, within the overall organization, Package as marketing tool, Case Studies.

UNIT II STRATEGIC PROCESS 9
The strategic process, environment and analysis, segmentation and positioning for building brands. Brand information systems and the application of brand Management using marketing principles, Case Studies

UNIT III BUYER BEHAVIOR 7
Consumer and Industrial Buyer Behavior, Models, Behavioral Applications in Branding, Case Studies

UNIT IV BRAND MANAGEMENT PLANNING 10
Application of analytical and logical marketing techniques required to solve Brand Management problems, and develop creative skills necessary to their success, Case studies Brand Affordability, Role of pricing in branding. Revenue – cost - profit relationships and their application to Brand Management. Revenue management and control, Case Studies

UNIT V BRAND LAUNCHING**10**

Brand Acceptance, Product innovation, development, management and control. Packaging and product design factors, product portfolio management , Brand Awareness promotional planning and control, rules of selling, advertising, PR and other specialist promotional tools, brand availability Physical distribution processes and channel decisions, Case Studies

TOTAL: 45 PERIODS**REFERENCES**

1. Kapferer - Jean Noel., Kogan, "Strategic Brand Management", Page Publishers, 2008
2. Kevin Lane Keller, „Strategic Brand Management“ , Pearson Education Ltd., 2008

PG8005**COMPUTER APPLICATIONS IN PACKAGING**

L	T	P	C
3	0	0	3

AIM

- To familiarize the computer aided modeling and various simulation application used in package design

OBJECTIVES

- Conceptualize and create product/package designs and/or soft proof designs.
- To apply the various design concepts and design tools and techniques while designing a package.
- To model a product using CAD software

UNIT I GRAPHIC DESIGN**8**

Graphics-Introduction, definition, types, creating and manipulating 2D vector graphics and bitmap graphics, Fonts as part of the graphic design, Computer graphics – applications – principles of interactive computer graphics – 2D, 3D transformations Visualization methods, techniques of interactive communication, and design applications -software packages, application in package design;

UNIT II COMPUTER AIDED DESIGNING**10**

CAD - Definition, methods, geometric modeling, Modeling of product metrics – Design for reliability ,manufacturability , assembly and disassembly Packaging structures, structural design factors, Design concepts for primary and Principle display panel, Packaging structural concept for different packaging materials.

UNIT III MODELING**9**

Surface Modeling techniques- Volume modeling- Geometry - comparison of representations - user interface for solid modeling, Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards, Assembly modeling - interferences of positions and orientation - tolerances analysis –

UNIT IV SIMULATION AND ANALYSIS**9**

Introduction to finite element analysis, Material parameters, Solid modeling tools and techniques; Mould Flow Analysis – Pressure, Thermal and Shrinkage analysis; Mechanical performance Analysis – drop, compression, vibration; Shelf life prediction software

Attested



UNIT V CASE STUDIES / MINI PROJECT**9**

Development of simulation models using the simulation language studied for package design, primary display panel, Principle display panel, Performance simulation, and shelf life simulation and process control.

TOTAL : 45 PERIODS**REFERENCES**

1. P.N.Rao, "Cad/Cam: Principles & Applications ", Tata McGraw Hill, 2010.
2. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994
3. Junuthula N. Reddy" An Introduction to the Finite Element Method" McGraw-Hill, 2006

PG8006**ERGONOMICS IN PACKAGING****L T P C
3 0 0 3****AIM**

- To understand, comprehend and apply the various human factors involved in packaging technology.

OBJECTIVES

- Various concepts on human factors through procedures of analysis
- Understanding of the processes of design as applied to the medium;
- Conceptualize and create product/package designs and/or interface designs based on sound human factors.

UNIT I ERGONOMICS**9**

Definition of human factors; Application of human factors data; Human activities: their nature and effects; Man-machine system and physical environment; Human performance and system reliability; Information input and processing

UNIT II HUMAN CONTROL SYSTEMS**10**

Visual displays: process of seeing, visual discrimination, quantitative and qualitative visual display; Alphanumeric and related displays, visual codes and symbols; Auditory, tactual and olfactory human mechanism; Applied anthropometry, physical space and arrangement

UNIT III INTRODUCTION TO DESIGN**10**

Visual Communication in Design - importance of scientific knowledge in design- Introduction to the Human Factors in Design - Physical human factors - Psychological or sociological human factors, Organizational human factors. Principles of Form and Function and the various Elements- Principles of Design and its relation to Human Factors , Principles of Package Design and its affect the visual stimulation of the audience. Case Studies

UNIT IV PACKAGE DESIGN**6**

Form, color, symbols, user specific criteria; Material, technology and recyclability; Packaging; Multiple utility oriented approach to product and package design Element of general design for the physically and mentally impaired.

UNIT V DEMOGRAPHICS AND PSYCHOGRAPHICS OF THE TARGET AUDIENCE**10**

Understanding target audience when designing, Demographics and psychographics of a target audience, Demographic survey/study for a specific package and analyze psychographics differences within the target market's demographic group. Package and Market Research Studies.

TOTAL : 45 PERIODS

REFERENCES

1. Michal J.Burke, "Applied Ergonomics Handbook", Lewis Publishers, 2007
2. Wesley E.Woodson, Peggy Tillman & Bary Tillman, "Human Factors Design Handbook", Wiley publishing co., 2006
3. Gavriel Salvendy, "Handbook of Human Factors & Ergonomics", Wiley publishing co., 2007
4. Nigel Thoobald, "Packaging closures & Sealing systems", CRC Publishers, 2006

PG8007

FOOD PACKAGING

L T P C
3 0 0 3

AIM

- To provide an overall knowledge about food packaging materials and technologies

OBJECTIVES

- To explain about the deteriorative reactions in food and factors stimulating it
- To describe about the various technologies used in packaging of food to extend its shelf life
- To discuss about the specific requirements of various types of food products

UNIT I INTRODUCTION

9

History of Food, Food types – Determinated factors of food, Shelf life – Package/Product interaction, Influence of light transmittance; Testing of food packages – Sensory evaluation textural properties, Leak tests, seal integrity tests, migration tests.

UNIT II PACKAGING OF FRESH FOOD PROCESSED PRODUCTS

12

Requirements, Materials, packaging techniques for : Processed flesh foods – Red meat, Cured cooked meats, poultry, sea food; Horticultural products – Fruits, vegetables, flowers; Dairy products – Liquid Milk, Fermented products, Butter and spreads, Cheese, Milk powders; Food grains – wheat, flour, rice, grams; Spices, Edible Oils, Vanaspathi, Ghee; Processed foods – Ready to eat food, jams, ketchup, pastes, pickles.

UNIT III PACKAGING OF SNACKS FOOD

7

Requirements, Materials, packaging techniques for : Cereals & Snack foods – Breakfast cereals, Pastas, Bakery products, Biscuits, Cookies, Crackers, Nuts, Pretzels, Popcorn, Rice-based snacks, Meat snacks, Fast foods, Fruit based snacks, Chips; Confectionery – Candies, chocolates.

UNIT IV PACKAGING OF BEVERAGES

5

Classification of Beverages – Packaging Requirements of Alcoholic and Non- Alcoholic Beverages – Product Characteristic and Packaging Requirements.

UNIT V FOOD PACKAGING TECHNOLOGIES

12

Aseptic Packaging – Principle, sterilization of food contact surfaces, Aseptic packaging systems; Microwave oven-able packaging – Principle, materials; Active Packaging – Sachets and pads, active packaging materials, self-heating & self-cooling packages, changing gas permeability properties, widgets; Intelligent Packaging – quality indicators, time-temperature indicators, gas concentration indicators, microwave doneness indicators; CAP, MAP – principles, gases used, methods, equipments, Vacuum, labeling for food packaging.

TOTAL: 45 PERIODS

Attested

Sobhan
DIRECTOR

Centre For Academic Courses
Anna University, Chennai-600 025.

TEXT BOOK

1. Gordon L. Robertson, "Food Packaging: Principles and Practice", Second edition, CRC Press, 2006.

REFERENCES

1. Richard Coles and Mark Kirwan, "Food and Beverage Packaging Technology", Second Edition, A John Wiley & Sons, Ltd., Publication 2011.
2. Aaron L. Brody, Hong Zhuang and Jung H. Han, "Modified Atmosphere Packaging for Fresh-Cut Fruits and Vegetables, A John Wiley & Sons, Ltd., Publication 2011.
3. Jung H. Han, "Innovations in Food Packaging", Food Science and Technology International, 2005.
4. Richard Coles, Derek McDowell, and Mark J. Kirwan, "Food Packaging Technology", Sheffield Packaging Technology, 2003.
5. Frank A. Paine and H.Y. Paine, "Handbook of Food Packaging", CGC Press, 1993.
6. De Vlioger, J. J., Green plastics for food packaging, In Novel Food Packaging Techniques, Ahvenainen, R., Ed., CRC Press, Boca Raton, FL, 2003, Chap.24.

PG8008

GLASS, WOOD AND METAL PACKAGING

L T P C
3 0 0 3

AIM

- To impart knowledge on glass metal wood packaging and the material used for closures.

OBJECTIVES

- To study the types of glass, wood and metal packages in detail.
- To enhance the knowledge of materials used for closures for various packaging systems.

UNIT I GLASS PACKAGING

11

Glass, Definition, Raw materials, Additives, Other types of glass, borosilicate, Lead, Leaching, Glassmaking, Furnace, Melter, Regenerator, Refiner, Container manufacture, Press and blow, Blow and blow, Centrifugal casting, Ribbon machine, Drawn ware, Annealing, Coating, Nomenclature, Strength/Performance, Brittle failure, Internal pressure, Impact, Top load, Hydrodynamic failure, Thermal shock, Stress concentration, Defects, Specifications, Labelling, Recycling methods.

UNIT II CAPS AND CLOSURES

7

Selection Considerations, Container and Closure Dimensioning, Types, Screw, lug, friction, roll-on, snap-on, Child-resistant, Torque, Application, Removal, Liners, Fitments, Dispensing closures, Special Closures and Functions, Testing methods for closures; Closure Seals, Seam – types, Applications.

UNIT III METALS IN PACKAGING

9

Materials - Steel, stainless, aluminium, tinplate - properties; Cans - Three-piece can, Two-piece cans (DI and DRD), Composite cans, Can stresses, Compression/ Buckling, Drums – Properties; Sheet – Properties, Metal foil packaging, Metal Strapping/ Banding.

UNIT IV PACKAGING METALS PROCESSING

10

Manufacturing process – Steel, Stainless, Tinplate containers, Aluminium - Collapsible Tubes, Metal drums and pails, Metal Tubes, Aerosols, Uses, Two and three phase systems, Valves and dip tubes, Principles of operation; Propellants - fluorocarbons, hydrocarbons, compressed gases; Special aerosols - piston type, co-dispensing; Pumps, Lacquer coatings and its types

UNIT V WOOD PACKAGING**8**

Wood Classification, Nominal Dimensioning, Board Footage, Moisture Content, Psychrometer, Shrinkage/Expansion, Anisotropy, Moisture Stresses, Mechanical Properties, Pallets – Wood, Pallet types – one way, two way pallet, design/performance, Wood design principles - Nails, types and holding capacity, Crates/Boxes/Bin Pallets, Wirebound Boxes, Plywood, Particleboard, Fiberboard, Regulations

TOTAL: 45 PERIODS**REFERENCES**

1. L. Brody, K. S. Marsh, "The Wiley Encyclopedia of Packaging Technology", 2nd Edition, Wiley, New York, USA, 1995
2. Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of Packaging professionals, Naperville, Illinois, USA, 2002.
3. Joseph F. Hanlon, Robert J. Kelsey, and Hallie Forcinio, "Handbook of Package Engineering", Third Edition, CRC press, 1998
4. Hand book on Modern Packaging Industries by National institute of industrial research & Asian Pacific Business press.1978.

PG8009**HEALTHCARE PACKAGING****L T P C
3 0 0 3****AIM**

- To provide an overall knowledge about pharmaceutical and medical packaging materials and technologies

OBJECTIVES

- To explain about special requirements of pharmaceutical and medical products
- To provide knowledge about licensing and legislative requirements
- To describe about the various types of packaging for pharmaceutical and medical products

UNIT I INTRODUCTION TO PHARMACEUTICAL PRODUCT**9**

Types of pharmaceutical products & packages, Ethical medicines, Proprietary medicines, other classifications, Drug delivery systems, Inhalation therapies, Product spoilage mechanisms, Selection of containers, Healthcare Package requirements: Solid preparations, Powders, Semi-solid preparations, aqueous oral preparations, aqueous non-oral preparations, Non-aqueous liquid preparations, Inhalers, Medical devices.

UNIT II PACKAGE DEVELOPMENT REQUIREMENTS**9**

Approved Materials & its Sterilization methods, Package structure, Labeling - Text and graphics requirements, Bar codes, RFID Features, Expanded Content Labels, Package Inserts; Legislative requirements for packaging of medical preparations, Statutory requirements, General manufacturing considerations, Packaging Specification. Licensing considerations - Sources of official guidance, FDA, Influence of pharmacopoeias, License application procedure; Stability tests on finished product, Medicinal formulation/packaging compatibility, Stresses from manufacturing process, Toxicological investigations, Environmental issues, Variations, Medical devices, Case studies

UNIT III PRIMARY PACKAGES**9**

Films and laminates- materials, properties, Pouches & Strip Packs, Blister Packaging - Materials, OTC Drug Packs, Ethical Drug Packs, Clinical Trial & Sample Drug Packs, Unit dose packaging, Plastic Containers – Standard containers, Dispensing Bottles, Cans, Jars; Prefillabel Inhalers -

*Attested**Sobhan*
DIRECTOR

Metered Dose, Dry Powder; Prefillable Syringes – Injectors, Cartridges; Tubes - Composite Tubes, Plastic Tubes, Metal Tubes; Parental Vials & Ampoules; Containers - Semi-Rigid Containers, Mini-Bags; Medical Packages – Disposable gloves, Syringes, needles, catheters, dressings, sutures, surgical devices; Glass Containers; Aerosol Containers.

UNIT IV SECONDARY CONTAINERS AND PHARMACEUTICAL MACHINERY 9

Secondary Containers - Paperboard Containers; Prescription Dispensing Containers - Plastic Vials, Blister Packs, Glass Vials, Others; Shipping Containers – Corrugated Boxes, Folding Cartons, Trays, etc; Pharmaceutical machinery – Filling & Sealing machines for injection, infusion and screw neck bottles; ampoules; prefilled syringes and cartridges, Machinery for blister Packaging, Packaging line engineering, Line efficiency.

UNIT V PHARMACEUTICAL CLOSURES & LABELS 9

Standard Pharmaceutical Closures - Plastic, Metal; Child-Resistant Dispensing Closures – Disc, Pump-Type, Turret, Plastic Dropper, Squeeze Tops; Parental Stoppers, Flip-Top Closures, Paper, Foil & Laminated Lids, Top seal, Induction seal, wads & wading systems, Other Pharmaceutical Closures; Labeling-Requirement, NDC number, label construction, Universal Product code, Global trade item number, GSI standards.

TOTAL : 45 PERIODS

REFERENCES

1. Max Sherman, "Medical Device Packaging Handbook", 2nd edition, CRC, 1998
2. H. Lockhart, Frank Albert Paine, "Packaging of Pharmaceuticals and Healthcare Products", Springer, 1996
3. Otto G. Piringer, A. L. Baner, "Plastic Packaging: Interactions with Food and Pharmaceuticals", 2nd edition, Wiley-VCH, 2008

PG8010

OFFSET PRINTING TECHNOLOGY

**L T P C
3 0 0 3**

AIM

- To impart a good understanding of Offset Printing Technology

OBJECTIVES

- To introduce the principles of offset lithographic printing.
- To create an awareness on different types of machines and materials.

UNIT I PRINCIPLES OF OFFSET AND FEEDING 10

Principles of lithography, wetting of a solid surface by a liquid, emulsification of ink and fountain solution, fluid behavior in a nip. Basic configuration of offset machine. Sheet feeding and controls: Types of feeders, sheet control, drives, suction head mechanism, double sheet and no sheet detectors, side lays and front lays. Non-stop feeders. Sheet insertion and transfer systems, working principle, relative merits. Principles of web feeding.

UNIT II PRINTING UNIT CONFIGURATION 12

Cylinders: Various configurations, design, requirements, plate and blanket clamping mechanisms, pressure setting, packing, print length variation, equal diameter, true rolling principles. Cylinder drives. Sheet transfer and reversal systems, perfecting, delivery grippers, settings, quick delivery mechanisms. Anti set-off spray device. Feeders, delivery and other system components for metal printing.

UNIT IV PERMEABILITY**9**

Introduction, importance of permeation – effect of time and temperature, effect of moisture, effect of oxygen, choice of materials; Rate of transmission – variables of the polymer, effect of permeating species, temperature and pressure, wall thickness; Measurement of permeability- WVTR, GTR; multilayer structures, application of permeability to material selection and shelf life estimation, Cycling conditions, Computer models, calculations, predictions

UNIT V OTHER INTERACTIONS**9**

Product fragrance and packaging material interactions, Migration of packaging material with product/solvents, Effect of irradiation of polymeric packaging materials in formation of volatile compounds, Flavour/Active ingredient absorption with packaging material

TOTAL : 45 PERIODS**REFERENCES**

1. M. Mathlouthi, "Food Packaging and Preservation", Springer 1 edition, 1994.
2. C.M.D. Man, Adrian A. Jones, "Shelf Life Evaluation of Foods" 2nd edition, Aspen Publishers, 2000.
3. Otto G. Piringler, A. L. Baner, "Plastic Packaging: Interactions with Food and Pharmaceuticals", 2 edition, Wiley-VCH, 2008
4. Richard cules, Mark J. Kirwan, "Food and Beverage Packaging", 2011

PG8012**PACKAGING AND ENVIRONMENT****L T P C
3 0 0 3****AIM**

- To create awareness about the effect of packages on environment
- To contribute towards optimization of packaging materials and aid in reuse and recycling of packages

OBJECTIVES

- To provide information about environmental pollution and how packaging contributes to it
- To teach methods to minimize the wastages by optimization and recycling
- To analyze about various international approaches in tackling environmental pollution

UNIT I INTRODUCTION**9**

Components of environment; Environmental pollutions, its measurements and management; Air pollution and its control; Water pollution and its control; Solid wastes; Microorganisms as components of the environment; microorganisms as indicators of environmental pollution; bioorganic pollution; microbial toxicants and pollutants their biodegradation; biodegradation of plastics, biofouling; bioremediation. Packaging – Concerns on Environmental Pollution

UNIT II STORAGE & DISPOSAL OF WASTE**9**

Types of waste generated; Non- degradable & biodegradable wastes, Solid waste storage and disposal methods- land-filling, burial, incineration, recycling; Biological treatment of food, medical, consumer goods, pharmaceutical, industrial wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal; environmental laws; pests & their control.

UNIT III WASTE MINIMIZATION 9
Life Cycle Analysis, Optimization of packaging materials, Sources - Reduce, Reuse and Recycling (3R's), 7R's of Packaging, Biodegradable materials, Case Studies.

UNIT IV RECYCLING 9
Waste - Collection, Sorting, Cleaning; Recycling Rate; Recycling techniques/methods – Paper/Paperboard, Plastics, Metals, Glass.

UNIT V ENVIRONMENTAL POLICIES 9
Environmental policies of India, Packaging Code of Practice, International Approach - Green Dot; EU Packaging Directive.

TOTAL : 45 PERIODS

REFERENCES

1. W.S. Allen/P.N.Baker, "Handbook of plastic Recycling", Alkem Quality Edition, Alkem Publishing, 2009.
2. Susan E.M. Selke, "Packaging and the environment : alternatives, trends, and solutions", Technomic Publication, Revised Edition, 1994.
3. John Scheirs, "Polymer Recycling", Wiley Series in Polymer Science, 1997.
4. Ann-Christine Albertsson, "Degradable Polymer, Recycling Plastic Waste Management", Taylor & Francis Group, 1995.
5. R.Mckinney, "Technology of paper Recycling", Blackie Academic and professional, 1997.
6. Herbert F.Lund, " McGraw-Hill Recycling Handbook", 2nd Edition, 2001.

PG8013 PACKAGING ECONOMICS L T P C
3 0 0 3

AIM

- To assimilate and apply the concepts of Economics in Packaging.

OBJECTIVES

- To understand the concepts of costing and estimation in packaging.
- To comprehend the needs for quality management and wastage control in packaging.

UNIT I INTRODUCTION 10
Cost Systems, Marginal costing and Profit Analysis, elements of packaging costs Cost Estimation of Packaging costs, Cost Classification, Factors influencing finished costs

UNIT II PACKAGING ECONOMICS 9
Basic economics, Appreciation of future trends and developments with the cost confines of packaging, Economic issues in packaging as they relate to policies of the firm and government.

UNIT III ECONOMIC POLICY AND SOCIETAL ISSUES 8
Relationship of economic policy and societal issues, Understanding and managing packaging costs

UNIT IV COST EFFECTIVE PACKAGING 9
Guidelines, Techniques in Preventing unnecessary costs in Supply Chain , Factors required for successful packaging from a cost perspective, Case study

UNIT V QUALITY MANAGEMENT**9**

Quality Management in Packaging, Defect Prevention Techniques, Various Statistical tools used in maintaining Quality, 6 Sigma, ISO, Total Productive Maintenance

TOTAL: 45 PERIODS**REFERENCES**

1. M. Bakker, "Wiley Encyclopedia of Packaging Technology", John Wiley & Sons Ltd., 2008
2. Jim Mc Dermott, Anne Emblem, "Packaging: The facts", Institute of Packaging, USA, 2006
3. Edmund A Leonard, "Introduction to Economics of Packaging", Morgan - Grampion Publishers, University of Wisconsin – Madison, 2007

PG8014 PACKAGING LOGISTICS AND SUPPLY CHAIN MANAGEMENT**L T P C
3 0 0 3****UNIT I SUPPLY CHAIN MANAGEMENT****9**

Logistics and Supply Chain Management, Global Supply Chain scenario and importance, Conventional Supply chains, Supply chain participants, Packaging and logistics - interaction, unit load, palletization, Export packaging

UNIT II TRANSPORTATION**9**

Different Modes of Transportation: Road, rail, water, air, Advantages & Disadvantages of individual modes, Piggyback, Birdyback; Multimodal Transportation, Domestic and international transportation systems, Factors to be considered for Mode & Carrier Selection, Modal characteristics & Classification, Total Transportation Cost, Factors influencing Transport Cost, Packaging requirements for various transport modes, Package Markings and labeling

UNIT III WAREHOUSING**9**

Definition - Warehouses, Distribution Centers; Warehousing, Need for Warehousing, Economic/Service benefits, Types - Their Advantages & Disadvantages, Warehousing Operations, Packaging Materials Procurement, Factors Affecting Warehousing Cost, Warehouse Layout/ design principles, Warehouse information and management systems, RFID applications, Software for logistics

UNIT IV MATERIALS HANDLING SYSTEM**9**

Materials Handling - Introduction, Methods; Equipments – containerization & cubic utilization, forklift, cranes, conveyors, trucks, AGV; Pallets – types, materials, stacking, storage; Package design requirements for materials handling system, Unitization – labeling, strapping, stretch wrapping.

UNIT V CASE STUDY**9**

Food Supply Chain – commodity crop, fruit and vegetables, animal protein; Retail Supply chain; Automobile, Textile, FMCG Products

TOTAL : 45 PERIODS**REFERENCES**

1. Mats Johnsson, Mats Johnsson (tekn. dr.), "Packaging Logistics: A Value Added Approach", Univ., 1998
2. Kerstin Gustafsson, Gunilla Jonson Kerstin, David Smith, Leigh Sparks, "Retailing Logistics and Fresh Food Packaging: Managing Change in the Supply Chain", Kogan Page, 2009
3. Madeleine Pullman, Zhaohui Wu, "Food Supply Chain Management: Economic, Social and Environmental Perspectives", Routledge, 2011
4. Daniel Hellstrom, "Integrating Packaging and Logistics: Improving Supply Chain Performance", VDM Verlag Dr. Muller Aktiengesellschaft & Co. , 2008

AIM

- To provide the knowledge on printing inks used for different package printing process and the coating methods used for packaging applications.

OBJECTIVES

- To explain about the properties of raw materials used for printing inks and for different printing process and testing methods.
- To give the importance of coatings for different materials used for packaging and over view about Specialty coatings.

UNIT I RAW MATERIALS**7**

Colorants , Binder, Oils, and Additives – types, preparation , property requirements-offset inks, flexo inks, gravure inks and specialty inks.

UNIT II OFFSET INKS**9**

Sheet fed inks- formulation, properties- viscosity, tack, color, drying characteristic, rub resistance, light fastness, finess of grind gauge, and testing; Offset inks for plastic, Two piece can decoration, Printing problems.

UNIT III FLEXO, GRAVURE AND SCREEN INKS**12**

Solvent based inks- Formulations- Material selection, properties, drying mechanisms; Water based inks – Formulations- Pigments & dyes, acrylic binders, low voc solvents & additives. Ink properties- viscosity, pH, surface tension, testing, and drying mechanisms; UV based inks- formulations, properties, testing, light source-Selection & drying mechanisms; Inks for plastic containers, Ink related printing problems.

UNIT IV COATINGS**10**

Coating Rheology; Coating calculations; Adhesion Testing; Processing Technique – Electrodeposition of Polymers, Sputtered thin film coatings, Reactive Plasma – Deposition and etching; Surface treatment of Plastics – Flame and Plasma treatment, corona; Embossing; Paper coatings- coating materials- methods-properties, Metals- treatment, methods, corrosion-protection and coating types; Metallization-Types and testing; Wood- varnishing types- matt & gloss finish and coatings.

UNIT V SPECIALTY COATINGS**7**

Peelabel medical coatings –Types; Adhesives-pressure sensitive adhesives, self-seal adhesives, Radiation curable coatings- Ultra violet and electron beam coatings, Hybrid coatings, Embossing, and special effects.

TOTAL: 45 PERIODS**REFERENCES**

- R.H.Leach," The printing Ink Manual," 5th edition, Chapman & Hall, London 2002
- Nelson R.Eldred," What the Printer should know about Inks,"3rd edition, GATF press, 2001
- Ronald E..Tood," Printing Inks – Formulations, Principles, Manufacture, and Quality control Testing," PIRA International1996
- D. Satas and Arthur A. Tracton," Coating Technology- Handbook,2nd Edition, Marcel Dekker, Inc,2001
- Lothar Gottschhing& Heikki Pakarinen,' Paper making science and Technology, FapetOY Publishing,2000

UNIT I INTRODUCTION TO ROBOTICS**10**

Preface, Robotic Manipulation, Workspace Analysis and Trajectory Planning, Differential Motion and Statics, Manipulator Dynamics, Robot Control, Robot Vision, Task Planning, Trigonometric Identities, Moments of Inertia, List of Symbols.

UNIT II INDUSTRIAL ROBOTICS**8**

Laws of robotics- Role of robots- emerging trends- manipulator functions and design- Direct Kinematics: The Arm Equation, Inverse Kinematics: Solving the Arm Equation,, teleoperations.

UNIT III ROBOT CONSTRUCTION**9**

Material used- metals- nickel, aluminium, stainless steel, titanium; Plastics- ABS, PP, PTFE. Pneumatic and Hydraulic systems, electric motor- stepper motor, actuator and sensor

UNIT IV CONTROL AND INTELLIGENCE**9**

Motion control, force control, trajectory control, visual servoing, Microprocessor- definition, construction, programming.

UNIT V ROBOTS IN PACKAGE LINE**9**

Pick and place robots, mobile robotics and walking machines, tele robots, micro robot, nano robot Standards – industrial robotics standards.

TOTAL : 45 PERIODS**REFERENCES:**

1. Saha "Introduction To Robotics", Tata Mc graw hill publications
2. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, "Robotics: Modelling, Planning and Control", Springer verlag 2010

