### Semester I

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<th>Sl. No.</th>
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**Practical**

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**Total**

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**Total**

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* 3 Weeks of Industrial Training during earlier semester vacations

### SEMESTER IV

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

### ELECTIVES FOR M.E. PRINTING AND PACKAGING TECHNOLOGY

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

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

TEXT BOOKS
3. Dr.B.Kumar and Dr.S.Natarajan and Dr.M.Govindarajan, “Fundamentals of Packaging”, Published by PHI Learning Pvt Ltd, Jan. 2009

REFERENCES
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
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

UNIT III GRAPHIC DESIGN

UNIT IV STRUCTURAL DESIGN
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
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

REFERENCES
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

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
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
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

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
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
Polyethylene – Linear and Branch Polymers (HDPE, LLDPE, LDPE, EVA, EAA, Ionomers, Polypropylene – Homo and copolymer (Oriented and Biaxially Oriented), Polystyrene, Polyvinyl chloride (PVC), Poly Vinyldiene 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.
UNIT III FLEXIBLE PACKAGING
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

UNIT V MATERIALS TESTING AND STANDARDS
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

REFERENCES

MA8161 STATISTICAL METHODS FOR ENGINEERS

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)

UNIT II TESTING OF HYPOTHESIS (9+3)
Tests based on Normal, t, χ² and F distributions for testing of means, variance and proportions - Analysis of r × 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)

L:45 +T: 15 TOTAL: 60 PERIODS

TEXT BOOKS:

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
### PG8201 PACKAGE PRINTING PROCESS

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**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**

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**

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**

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

**UNIT IV  PREPRESS WORKFLOW**

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**

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

**REFERENCES**


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### PG8202 PACKAGING LAWS AND REGULATION

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**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

---

*Attested*

**DIRECTOR**

Centre For Academic Courses
Anna University, Chennai-600 025
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

REFERENCES
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.
UNIT II  PAPERBOARD AND FLEXIBLE PACKAGING MACHINE

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 - VFSS, HFFS, Rotary; Thermoform, Shrink/stretch wrapping and bundling, Types of Filling Machines, Wrapping Machines.

UNIT III  RIGID PACKAGING MACHINERY

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

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

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

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
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
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
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
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
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

REFERENCES

PG8211 PACKAGE TESTING LABORATORY

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

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

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
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**

**UNIT I FOOD PACKAGING**
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 attitude, functional foods; Sensors - Electronic nose, Electronic tongue.

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

**UNIT III COSTING**

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

**REFERENCES**
PG8002 ANTI-COUNTERFEITING AND PRODUCT PROTECTION  

UNIT I  SECURITY INKS & SUBSTRATES  9

UNIT II  NUMBERING AND BAR CODING  9

UNIT III  HOLOGRAMS  9

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
3. Pharmaceutical Anti-counterfeiting by Davision Mark, copyright @ John willey sons

PG8003 AUTOMOTIVE AND INDUSTRIAL PACKAGING  

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
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
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.

TEXT BOOK

TOTAL : 45 PERIODS

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
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
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
Consumer and Industrial Buyer Behavior, Models, Behavioral Applications in Branding, Case Studies

UNIT IV BRAND MANAGEMENT PLANNING
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
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
### UNIT V CASE STUDIES / MINI PROJECT

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.

**REFERENCES**


### PG8006 ERGONOMICS IN PACKAGING

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**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

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

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

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

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

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

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
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

UNIT III PACKAGING OF SNACKS FOOD
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
Classification of Beverages – Packaging Requirements of Alcoholic and Non-Alcoholic Beverages – Product Characteristic and Packaging Requirements.

UNIT V FOOD PACKAGING TECHNOLOGIES
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
TEXT BOOK

REFERENCES

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

UNIT II CAPS AND CLOSURES

UNIT III METALS IN PACKAGING
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
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
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

REFERENCES

PG8009  HEALTHCARE PACKAGING
A L T P
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

UNIT II  PACKAGE DEVELOPMENT REQUIREMENTS
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
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; Prefillable Inhalers
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
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

REFERENCES

PG8010 OFFSET PRINTING TECHNOLOGY

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

UNIT II PRINTING UNIT CONFIGURATION
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 III BLANKETS, ROLLERS
Blanket types, requirements, manufacture, performance attributes. Rollers, types, properties, behavior. Basic inking and dampening system configuration. Fountain solution requirements, composition, re-circulation system and dosing units, Ink/water balance.

UNIT IV PRINTING AND INLINE OPERATIONS
Make-ready operations, multi colour printing, automatic plate fixing, computer controls in printing, automatic blanket wash, roller wash systems. Spot varnishing, coating, numbering. Metal printing UV Dryers, Hot air and IR Drying systems. Print problem identification and quality control.

UNIT V QUALITY CONTROL
Standards, Print Control Targets, Test Forms, In-line print quality measurement, inspection and control.

REFERENCES

PG8011 PACKAGE ATTRIBUTES – SHELF LIFE

AIM
• To assimilate the various factors governing the shelf life of a package.

OBJECTIVES
• To understand the mechanics of shelf life with respect to packages.
• To comprehend the various relationship between the product and the package.

UNIT I SHELF LIFE AND KINETICS OF PRODUCT DETERIORATION
Introduction, factors influencing product quality, shelf life, types of deterioration – physical, chemical, microbiological; measuring shelf life, predicting shelf life – predictive models, software systems; sensory evaluation methods, accelerated shelf-life tests – initial rate approach, kinetic model approach, Design of shelf life experiments, Extending shelf life

UNIT II BASIC PRINCIPLES OF MASS TRANSFER
Basic concepts of mass transfer, Mechanism of permeation, Sorption, diffusion, Permeability, Factors affecting permeability, Migration Interactions - volumetric method, gravimetric method, differential method, determination of solubility; Gas chromatograph

UNIT III DIFFUSION OF GASES AND VAPOURS
UNIT IV PERMEABILITY
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
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

REFERENCES
4. Richard cules, Mark J. Kirwan, “Food and Beverage Packaging”, 2011

TOTAL : 45 PERIODS
UNIT III WASTE MINIMIZATION
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
Waste - Collection, Sorting, Cleaning; Recycling Rate; Recycling techniques/methods – Paper/Paperboard, Plastics, Metals, Glass.

UNIT V ENVIRONMENTAL POLICIES

REFERENCES

PG8013 PACKAGING ECONOMICS

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
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
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
Relationship of economic policy and societal issues, Understanding and managing packaging costs

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

TOTAL : 45 PERIODS
UNIT V  QUALITY MANAGEMENT  
Quality Management in Packaging, Defect Prevention Techniques, Various Statistical tools used in maintaining Quality, 6 Sigma, ISO, Total Productive Maintenance  

REFERENCES  

PG8014  PACKAGING LOGISTICS AND SUPPLY CHAIN MANAGEMENT  
UNIT I  SUPPLY CHAIN MANAGEMENT  
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  
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  
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  
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  
Food Supply Chain – commodity crop, fruit and vegetables, animal protein; Retail Supply chain; Automobile, Textile, FMCG Products  

REFERENCES  
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  

TOTAL: 45 PERIODS
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
Colorants, Binder, Oils, and Additives – types, preparation, property requirements-offset inks, flexo inks, gravure inks and specialty inks.

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

UNIT III FLEXO, GRAVURE AND SCREEN INKS
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
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
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
UNIT I  INTRODUCTION TO ROBOTICS

UNIT II  INDUSTRIAL ROBOTICS

UNIT III  ROBOT CONSTRUCTION
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
Motion control, force control, trajectory control, visual servoing, Microprocessor- definition, construction, programming.

UNIT V  ROBOTS IN PACKAGE LINE
Pick and place robots, mobile robotics and walking machines, tele robots, micro robot, nano robot Standards – industrial robotics standards.

REFERENCES:
1. Saha “Introduction To Robotics”, Tata Mc graw hill publications

TOTAL : 45 PERIODS