SAVITRIBAI PHULE PUNE UNIVERSITY

FACULTY OF ENGINEERING

SYLLABUS FOR
B.E. (PRINTING TECHNOLOGY)

(2019 COURSE)

WITH EFFECT FROM THE YEAR 2022 - 23

Printing Technology Final Year (2019 Course)
With Effect From 2022-23

SEMESTER – I														
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**			**Examination Scheme**					**Total Marks**	**Credits**		
						Paper								
			Th.	**Pr.**	**Tut.**	**In Sem**	**End Sem**	**TW**	**PR**	**OR**		**TH/ TW**	**PR/ OR**	**TUT**
1.	408281	Elective - III	3	02	--	30	70	--	25	--	125	3	1	--
2.	408282	Elective - IV	3	02	--	30	70	--	25	--	125	3	1	--
3.	408283	Gravure Printing Techniques	3	02	--	30	70	25	--	50	175	3	1	--
4.	408284	Digital Printing Techniques	3	02	--	30	70	25	50	--	175	3	1	--
5.	408285	Package Testing	--	--	02	--	--	50	--	--	50	--	--	2
6.	408286	Project Stage - I	--	02	--	--	--	50	--	--	50	--	2	--
7.	408287	Audit Course	--	--	--	--	--	--	--	--	--	--	--	--
Total			**12**	**10**	**02**	**120**	**280**	**150**	**100**	**50**	**700**	**12**	**6**	**2**
Total Credits												**20**		

SEMESTER – II														
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**			**Examination Scheme**					**Total Marks**	**Credits**		
						Paper								
			Th.	**Pr.**	**Tut.**	**In Sem**	**End Sem**	**TW**	**PR**	**OR**		**TH/ TW**	**PR/ OR**	**TUT**
1.	408288	Elective - V	03	--	--	30	70	--	--	--	100	3	--	--
2.	408289	Elective - VI	03	--	--	30	70	--	--	--	100	3	--	--
3.	408290	Operations Management in Printing and Packaging	03	02	--	30	70	25	50	--	175	3	1	--
4.	408291	Adhesives and Coatings in Packaging	03	02	--	30	70	25	50	--	175	3	1	--
5.	408292	Project Stage - II	--	06	--	--	--	100	--	50	150	--	6	--
6.	408293	Audit Course	--	--	--	--	--	--	--	--	--	--	--	--
Total			**12**	**10**	**--**	**120**	**280**	**150**	**100**	**50**	**700**	**12**	**8**	**--**
Total Credits												**20**		

Electives for the Course:

Subject Code	Elective - III	Subject Code	Elective - IV
408281 A	Paper Board and Corrugation Package Technology	408282 A	Multimedia Advertising
408281 B	Polymer Science	408282 B	Process Optimization and Total Quality Management in Printing
408281 C	Open Elective	408282 C	Open Elective

Subject Code	Elective - V	Subject Code	Elective - VI
408288 A	Food and Pharmaceutical Packaging	408289 A	Sustainable Packaging
408288 B	Printed Electronics	408289 B	Management Information Systems and Data Science
408288 C	Open Elective	408289 C	Open Elective

List of Audit Courses (Semester I):

Course Code	Audit Course Title
408287-I	Digital and Social Media Marketing
408287-II	Food Technology
408287-III	MOOC

List of Audit Courses (Semester II):

Course Code	Audit Course Title
408293-I	Leadership and Personality Development
408293-II	Engineering Economics

PROGRAMME OUTCOMES (PRINTING TECHNOLOGY)

1. The graduate shall be able to apply the engineering knowledge that includes fundamental physics, chemistry, and mathematics for problem-solving in printing engineering.
2. The graduate shall be able to identify and formulate research problems in the field of printing and packaging by reviewing literature and solving it using basic principles of mathematics, statistics, and sciences.
3. The graduate shall be able to solve challenges related to health, environment, and safety in the printing and packaging field realizing their responsibility to society.
4. The graduate shall be able to investigate problems in the field of printing and materials by implementing research methods such as the design of experiments and analytical tools to interpret the data.
5. The graduate shall try to develop solutions to solve complex problems in the field of ink, substrate, printing, and packaging processes.
6. The graduate shall be able to evaluate and solve issues related to the quality of any printed product conforming to industry requirements and standards both national and international.
7. The graduate shall demonstrate knowledge in the areas of designing and prepress areas for the purpose of error-free solutions during printing.
8. The graduate shall effectively carry out calibration, operation, and maintenance of machines and equipment used in the printing and packaging industry.
9. The graduate shall understand the working of mechanical, electrical, and electronic components used in various printing and packaging machines and equipment.
10. The graduate shall demonstrate managerial skills, individual skills, and team spirit in operations carried out in the printing, packaging, and converting industry.
11. The graduate shall be able to evaluate critically the implications of wrong practices that cause serious environmental problems and develop products that lead to greater sustainability.
12. The graduate shall follow ethics in his/her professional and research field and thus remain committed to the responsibilities of an engineer.

(408281 A) Elective III: Paper Board and Corrugation Package Technology

Teaching Scheme	Credits	Examination Scheme
Theory: 3 Hours/Week	04	In Sem: 30 Marks
Practical: 2 Hours/ Week		End Sem: 70 Marks
		Practical: 25 Marks

Pre-requisites: Material Science

Course Objectives:

The objectives of the Course are:

1. Understand various types of paper and paper board used in packaging
2. Apply Packaging Formulations, Structural data to Design Packages
3. Explain different forms of Paper-Based Packaging
4. Create various Paper Board Packages
5. Explain the importance of Corrugation in Packaging
6. Analyze various tests for packaging applications

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Explain the manufacturing process for paper and paperboard
2. Apply Packaging formulae and Design packages
3. Identify various types of labels, bags, and multi-wall sacks based on their application
4. Construct folding cartons based on the specification for a given application
5. Correlate the properties of the corrugated package based on functions and applications
6. Evaluate the packages based on the Test for varying applications

Unit 1: Paper and Paper Board **[6 hours]**

Raw Materials, Paper and Paper Board Manufacture, Packaging Papers and Paper Boards, Technical requirements of paper and paperboard for packaging such as Appearance properties and Performance properties, Specifications and Quality Standards, Conversion Factors

Unit 2: Package Design: Strength & Aesthetics **[6 hours]**

Package design considerations, Package specification condition considerations, types of design: structural, graphics, Factors influencing design, fundamentals of package layout, Primary, Secondary & Tertiary Packages

Unit 3: Paper-Based Packaging **[6 hours]**

Types of Labels such as Self-adhesive labels, Glue-applied labels, In-mold labels, shrink sleeves, stretch sleeves, Wrap-around, Nature, and function of labels, Selection factors for labels, Types of paper used for paper bags, Bag manufacture, multi-wall paper sacks

Unit 4: Paper Board Packaging **[6 hours]**

Rigid boxes, Materials used for rigid boxes, Manufacturing of folding cartons, Conversion operations on cartons, design specifications for cartons, Punching, Rotary Die Cutting, Common Problems and Solutions, Printing Process consideration, estimating the cost of cartons, liquid-filled cartons, composite cans, fiber tubes

Unit 5: Corrugated Packaging **[6 hours]**

Corrugated Board Materials, Liner, Medium, Adhesive, Corrugated Board Grades, Specifications, Flute configurations, Correlation between ECT and BCT, functions of corrugated fiberboard, Box stability, Containment and Protection, Boxboard packing line considerations, Packaging for food contact, recyclability, applications of solid fiberboard packaging, paperboard based liquid packaging

Unit 6: Package Testing **[6 hours]**

Package Testing standards; BS, IS, TAPPI. GSM, Drop Test, Inclined impact, Horizontal impact, Vibration testing, Stacking, and Compression test, Bursting strength, Peel Adhesion, Edge Crush, Ring Crush, etc. Package Strength Certification Process, Shear Resistance, Adhesive Coat Weight, Water absorption capacity test, Caustic soda resistance test, Paper-weight test, Bending stiffness test

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the Department, and the Principal.

4. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with the date.
5. Put one blank page in between two experiments and mention the experiment number, date, and title of the experiment in a separate line.

Guidelines for Laboratory Conduction

1. Check for the electrical connections before the start-up and end of the practical.
2. Apron is compulsory while conducting practicals on the printing machine.
3. Write the experiment in the journal and get it checked within a week.

Term Work

Term Work shall consist of the following ten experiments:

1. Understanding the nomenclature of a folded carton preparing reverse tuck end carton
2. Preparing Basic Line work of Standard Dimensions
3. Preparing Carton design with Die Line
4. Preparing Mockup of Package and Test
5. Moisture level effect analysis of corrugated cartons
6. Estimating Carton strength with Bursting Strengths Tests
7. Estimating Strength of Corrugated Carton with Ring Crush Analysis
8. Estimating Carton Strength with Bursting Strengths Tests
9. Estimating Strength of Corrugated Carton with Crush Analysis
10. Calculation of Paper, Costing of Carton

Text Books:

[T1] Diana T., Selke S. E. M., Kamdem D. P., & Shires D., (2015). Cartons, Crates and Corrugated Board, DEStech Publications, Inc., 2nd Edition

[T2] S. Natarajan. M. Govindarajan, and B. Kumar (2009), Fundamental of Packaging Technology, PHI, New Delhi.

[T3] Diana Twede, Susan E.M. Selke Cartons, (2005) Crates, and Corrugated Board: Handbook of Paper and Wood Packaging Technology

Reference Books:

[R1] Kirwan M. J. (2005). Paper and Paperboard Packaging Technology**,** Blackwell Publishing

[R2] Walter Soroka, (2009), Fundamentals of Packaging Technology, Institute of packaging professionals, Fourth Edition.

[R3] Bill Stewart, (2004), Packaging Design Strategies, Pira International Ltd, 2nd Ed.

[R4] Walter Stern, (1981), Handbook of Package Design Research", Wiley Interscience.

Unit	Text Books	Reference Books
Unit 1	T1, T2	R1
Unit 2	T1, T2	R1, R2, R3
Unit 3	T1, T2	R2
Unit 4	T1, T3	R2
Unit 5	T2, T3	R2, R3, R4
Unit 6	T2, T3	R2, R3, R4

(408281 B) Elective III: Polymer Science

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	04	In Sem: 30 Marks
Practical: 2 Hrs.		End Sem: 70 Marks
		Practical: 25 Marks

Pre-requisites: Material Science in Printing and Packaging

Course Objectives:

The objectives of the Course are:

1. Understand the basic concepts of Plastics.
2. Know various types of Polymers used in Packaging.
3. Recognize different types of polymers based on their tests.
4. List different types of Additives and Compounds used for polymer manufacture.
5. Explain the modifications in Polymeric films.
6. Explain the mass transfer in Packaging films.

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Categorize polymers based on their structure, molecular weight, and morphology.
2. Know the basic requirements of packaging and different polymers used in packaging along with their applications.
3. Assess various polymers based on their tests and properties.
4. Explain various additives and compounds used in Polymer formation.
5. Explain Mechanical, Chemical, and Surface Modifications in Polymeric films.
6. Explain various types of interactions and permeability in polymeric films.

Unit 1: Basic Concepts of Plastics **[6 hours]**

Monomer, Polymer, Constitutional Unit, Homopolymer, Copolymer, Polymer Nomenclature, Interatomic Forces, Intermolecular and Intramolecular Forces, Categorization of Plastics, Polymer Structure, Molecular Architecture, Copolymer Structure, Chain Polymerization, Addition Polymers, Molecular Weight and Molecular Weight Distribution, Polymer Morphology

Unit 2: Plastics in Packaging **[6 hours]**

Basic requirements of Packaging, Raw materials for Packaging such as Cellophane, Polyethylene, Polypropylene, PET A, PET G, Aluminum Foil, PVC, PS, Bio-based plastics, Thermosets, Polymer Blends, Food grade plastics, Recycling of plastics, Applications

Unit 3: Polymer Properties and Tests **[6 hours]**

Thermal Properties – Melting Temperature, Glass Transition Temperature, Thermal Transitions, Heat Capacity, Heat of Fusion, Thermal Conductivity, Thermal Expansion Coefficient, Dimensional Stability, Mechanical Properties – Tensile Strength, Tear Strength, Impact and Bursting Strength, etc., Barrier Properties – OTR, WVTR, Diffusion Coefficient, Solubility Coefficient, Permeability Coefficient, Bond Strength, Blocking, Friction, Heat Sealing, Optical Properties – Gloss, Haze, Transparency, and Opacity, Electrical Properties, Adhesion Test, Chemical Resistance Test – Solvents and Chemicals, Migration Test, Polymer Identification test,

Unit 4: Additives and Compounding **[6 hours]**

Introduction, Compounding, Antioxidants, Heat Stabilizers, UV Stabilizers, Additives for Surface Modifications, Colorants – Dyes, Organic and Inorganic Pigments, Antifogging Agents, Nucleating Agents, Plasticizers, Antistatic Agents, Oxygen Scavengers, Desiccants, and Fragrance Enhancers, Fillers and Reinforcements, Antimicrobials or Biocides, etc. Factors affecting Additive Solubility

Unit 5: Modifications in Polymeric Films **[6 hours]**

Introduction, Mechanical Modifications – Orientation, Crystallization, Cross-linking, Chemical Modifications – Chlorination, Fluorination, Bromination, Sulfonation, Chemical Etching, Grafting, Surface Modifications – Plasma Treatment, Corona Treatment, Characterization

Unit 6: Mass Transfer in Polymeric Packaging **[6 hours]**

Introduction, Physical and Chemical Basis for Interaction, Types of Interactions – Permeation, Migration, Sorption, Thermodynamic Equilibrium, Diffusion, Factors affecting Permeability, Determination and Application of Permeability, Shelf-Life Estimation

Term Work:

The students shall complete the following activities as a part of Term-Work:

1. Identification of various Polymer Substrates by Chemical Test Method
2. Identification of various Polymer Substrates by Tearing and Burning Test Method
3. Determination of CoF for BOPP film

4. Determination of CoF for PET film
5. Evaluation of Gloss and Haze on Varying Polymer Substrates
6. Calculation of Surface Energy of Polyethylene substrate
7. Calculation of Surface Energy of Polypropylene substrate
8. Assessment of Polyethylene substrate by Tensile Strength Test
9. Assessment of Peak Load, Break Load, and Young's Modulus of Varying Polymer Substrates
10. Correlation of Load to Elongation of Varying Polymer Substrates

Text Books:

[T1] A. S. Athayle, (1992), Plastics in Packaging, Tata McGraw-Hill Publication.

[T2] A. S. Athayle, (1992), Plastics in Flexible Packaging, Multi-Tech Publishing.

[T3] Elsayed M. Abdul-Bary, (2003), Handbook of Plastic Films, Rapra Technology Limited, UK

Reference Books:

[R1] Aaron L. Brody, Kenneth S. Marsh, (1997), Encyclopedia of Packaging Technology, 2nd Edition A Wiley-Interscience Publication.

[R2] Susan E. M. Selke and John D. Culter, (2016), Plastics Packaging – Properties, Processing, Applications and Regulations, 3rd Edition, Hanser Publications, Munich

[R3] Charles A. Harper and Edward M. Petrie, (2003), Plastic Materials and Processes – A Concise Encyclopedia, A John-Wiley and Sons, New Jersey

Unit	Text Books	Reference Books
Unit 1	T1	R1
Unit 2	T1, T2, T3	R1
Unit 3	T3	R1
Unit 4	-	R2. R3
Unit 5	-	R2, R3
Unit 6	-	R2, R3

(408282 A) Elective IV: Multimedia Advertising

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	04	In Sem: 30 Marks
Practicals: 2 Hrs/ Week		End Sem: 70 Marks
		Practical: 25 Marks

Pre-requisites: Introduction to Printing Processes, Digital Printing Technology

Course Objectives:

The objectives of the Course are:

1. Describe the basic concepts and principles in mass communication technology and the significance of different marketing tools
2. To understand types of advertising, their applications, attributes
3. Understand the significance of market research, media research, and campaign planning
4. To understand branding and brand equity
5. To get an insight into integrated media campaigning.
6. To develop a complete understanding of the promotion of a product, service, or idea and use the concept of theme building and USP

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Develop, create concepts and design different types of themes
2. Understand Marketing mix, Types of advertisement and applications, and basics of Research
3. Understand the market and audience surveys, the basics of research carried out in media selection
4. Learn the concept of product launch, types of media, product positioning
5. Understand the basics of campaign planning, creativity, branding, and select type of campaign
6. Understand different aspects of construction and creativity, advertisement agency structure, multimedia concepts, a 2D advertisement with animation s/w

Unit 1: Introduction **[6 hours]**

What is an idea, how to develop an idea, the core idea, the research process, Finalize the core concept, Mood Board, Styling, Referencing, look and feel, Presentation, Pitching, Developing an idea into a narrative form, Advertising as a tool of communication Role of Advertising in the

marketing mix, Types of Advertising, Product Advertising, Service Advertising, Institutional Advertising, Public Relations Advertising, Public Service Advertising, Financial Advertising

Unit 2: Market and Advertising **[6 hours]**

Research – Types / Scope of research, Market Research – Market surveys – Audience surveys Market segmentation Targeting, Advertising Research, Advertising evaluation, ADGMAR approach, Types of Advertising evaluation

Unit 3: Media & Product **[6 hours]**

Types of media, Media Vehicles, Functions, Audience surveys, TRP, NRS, ABC, Product research meaning & scope, Analyzing & Testing of products, Important of product research, Limits, Product Positioning

Unit 4: Campaign Planning and Brand Building **[6 hours]**

Three phases of the campaign, Campaign planning – this identification, why to advertise in terms of campaign, Creativity & psychology in advertising, Introduction – What is Brand, Brand communication Purpose for advertising Brands, Necessity of Brands, Brand building Process – Role of an advertising agency in building brands – The Brand Story, Brand Equity - Personality, Positioning

Unit 5: Construction of Advertisement **[6 hours]**

Introduction to – Text – Typography - Fonts – Style – Layout, Color theory, Styling – Layout Tables - Graphics – Illustration – Image manipulation - Restoration – infographics – Print media – Online media – Outdoor media - TVC. Visualization, copywriting, Headlines, slogan, Types of copy, Requisites of an effective layout, Advertising agency structure, Responsibilities of personnel, Advertising Budget, methods of budgeting, and Budgeting process.

Unit 6: Latest trends in Advertising and Multimedia Advertising **[6 hours]**

Digital advertising, Using mobile, QR codes, Co-branding strategy, Content marketing (development and distribution of relevant, useful content—blogs, newsletters, white papers, social media posts, emails, videos, etc.), File formats, Non-linear programs, Collaboration of different media such as video skills, audio & animation, Animated advertising case study, AR (Augmented reality)/VR (Virtual Reality), Case study

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. All the diagrams, workflows, and figures must be drawn on a blank sheet and should be neatly labeled
4. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the department, and the Principal.
5. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with a date.

Guidelines for Laboratory Conduction

1. Check for the Computer, printer, scanner, and LAN connectivity before the start of the practical.
2. Check and note down the setup details of hardware and software as per the format given
3. Follow the format given for the procedure and note down all the observations as per the format given.
4. Check the status of the printer while taking a printout, it should be in “ready” status only.
5. Write the experiment in the journal and get it checked within a week.

Term Work:

Note: Term-work shall consist of the record of the following experiments presented in the form of journals.

1. Campaign planning for selected product/ service/ idea
2. Design a full-page newspaper advertisement
3. Design a full-page magazine advertisement
4. Design an outdoor advertisement for hoarding
5. Design an outdoor advertisement for banner
6. Design a Facebook image advertisement of 1:1 ratio (1080×1080 pixels), and write the copy for the ad's caption
7. Do comprehensive research on trending topics related to a product for content marketing.
8. Write a blog of 500 words related to your product/service to be posted on the brand's website
9. Design multimedia advertisement in Flash for cable TV (running strip)
10. Design multimedia advertisements in Flash for internet viewing (Ads on websites)

Text Books:

[T1] Chunawalla, Sethia, (2015), Foundations of advertising theory & practice, Eighth Edition, Himalaya Publications

[T2] Batra, Myers, Aaker, (1996) Advertising Management, 9th Edition, Prentice Hall

Reference Books:

[R1] Richerd E. Meyer, (2009) Handbook of Multimedia, second edition, Cambridge Publications

Unit	Text Books	Reference Books
Unit 1	T1, T2	R1
Unit 2	T1, T2	R1
Unit 3	T1, T2	R1
Unit 4	T1, T2	R1
Unit 5	T1, T2	R1
Unit 6	T2	R1

(408282 B) Elective IV: Process Optimization and Total Quality Management in Printing

Teaching Scheme	Credits	Examination Scheme
Theory: 3 Hours/Week	04	In Sem: 30 Marks
Practical: 2 Hours/ Week		End Sem: 70 Marks
		Practical: 25 Marks

Pre-requisites: Flexo Printing Techniques, Gravure Printing Techniques, Offset Printing Techniques, Screen Printing, Digital Printing Techniques, Print Statistics, Color Science and Measurement, Color Management, Design of Experiments

Course Objectives:

The objectives of the Course are:

1. To understand the fundamentals of process standardization
2. To explain the concepts of total quality management in Printing
3. To evaluate the print with different quality management techniques
4. To implement the pre-press and print process control techniques
5. To verify the print process standardization
6. To improve and optimize the print processes

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Identify the Problem and the Parameters Critical to Process and Quality in Printing
2. Apply the tools for the assessment of quality in Printing
3. Build Process Map and correlate between pre-press and press control for achieving the desired standard
4. Assess the Printing Quality with Quality Management Tools
5. Standardize the print process with different calibration techniques
6. Develop statistical regression models and optimize with a desirability approach

Unit 1: Fundamentals of Process Standardization [6 hours]

Basic definitions of Process, Types of Process, Quality, and their relationship. Defining Variation, Process Improvement, Benefits of Process Improvement, Tools for Process Improvements such as Charter, SIPOC, Process Mapping, Prioritization Matrix, RPN, FMEA, Why-Why Analysis, Pareto,

SPC Tools for Printing application, Problem Definition, SMART Objectives, Need for Standardization/Optimization. Critical to Process and Critical to Quality, Voice of Customer, Process Maps/ Flowcharts, Value Stream Map

Unit 2: Total Quality Management Concepts **[6 hours]**

Introduction, Defining Quality, Quality Control, Quality Assessment, QC Vs. QA, Benefits of Quality, Elements of Total Quality Management, Cost of Quality, Evolution of TQM, Benefits of TQM, PDCA Cycle, 7 QC Tools, Quality Function Deployment, Introduction of TQM Concepts in Print Production Industry, Standards such as ISO 9000, ISO 14000, Need for ISO Standards

Unit 3: Quality Management in Printing **[6 hours]**

Management Practices in Printing such as 5S, Visual Management, Standard Operating Procedures in Printing and Packaging Industry, Calibration of Measuring Instruments used in Printing, Repeatability, and Reproducibility of the Printing Instruments, Quality Control Targets, Preventive Maintenance for Printing, Implementation of Kanban and Kaizen Culture in Printing and Packaging, Implementation of TPM in Printing

Unit 4: Pre-press and Print Process Control **[6 hours]**

Process Maps for Printing Processes by defining CTP/ CTQ in Pre-press such as Color Management, Parameters in plate-making and engraving such as line screen, cell shapes/ angles, depth, resolution, etc., File format, Preflight check, prepress parameters standardization, printing form, proofs, Tone Reproduction Curves, CRPCs, Color Space Conformity, Process Control Elements, Press-run Measurements, SCTV, Standards for Pre-press and Press such as ISO 12646, ISO 12647-7, ISO/TS 10128, ISO 15076, ISO 20654, ISO 3664, ISO/PAS 15339

Unit 5: Print Process Standardization **[6 hours]**

Calibration Techniques for Implementation of ISO Standards such as G7® for Printing Processes, Standards, Specifications, and Tolerances for G7®, Specifications such as GRACoL, SWOP, FOGRA, Compliance such as Grayscale, Targeted and Color Space, Press Linearization, Output Curves, Gamma Curves, Variation in DQ, and DL, Press Verification, Spot Color Reproduction with Expanded Color Gamut for Printing Processes, Optimization, Fingerprinting, Characterization, and Verification Run, Gamut Analysis, Deviation and Variation Criteria, Certificate of Analysis, Standards such as ISO/PAS 15339, ISO 17972, ISO 13655, ISO 3664, ISO 19302

Unit 6: Print Process Optimization **[6 hours]**

Optimization of Printing Process with Linear Regression Model, General Linear Model, Polynomial Regression Model, Mixture Design Model, Response Surface Methodology Analysis, Second-Order Response Surface, Central Composite Design, Box-Behnken Design, Analysis of the Models, Surface Plot, Contour Plot, Interpretation of R^2, Checking the Adequacy of a Model for Printing Application, Desirability Approach for Printing

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the department, and the principal.
4. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with a date.
5. Put one blank page in between two experiments and mention the experiment number, date, and title of the experiment in a separate line.

Guidelines for Laboratory Conduction

1. Clean all tools, and machine parts every time before starting of practical.
2. Check for the electrical connections before start-up and end of the practical.
3. Wear an apron while performing the practical in the lab.
4. Do not inhale the chemicals and cleaning agents used for cleaning.
5. Write the experiment in the journal and get it checked within a week.

Term Work

Term Work shall consist of the following ten experiments:

1. Process Mapping of a Printing Process for the given CTQ
2. Evaluating the Repeatability and Reproducibility of Printing Measuring Instrument
3. Assessment of the Plate Linearization with Measured, Target, and Adjustment Curves
4. Process Control for Evaluation of Response in an Offset Press
5. Calibration with G7® Grayscale Compliance for Digital Printing Process
6. Calibration with G7® Targeted Compliance for Digital Printing Process
7. Calibration with G7® Grayscale and Targeted Compliance for Flexography Printing Process
8. Optimization of a Banded Anilox Roller and Plate Screening for a given response

9. Optimization of Gravure Press and Pre-press parameters for Multiple Responses with a Desirability Approach
10. Building a Process Improvement Design for Defect Minimization in a Printing Process

Text Books:

[T1] Enrique D. C., (2007), Process Optimization – A Statistical Approach, Springer Science+Business Media, LLC, NY, USA

[T2] Jens J. D., Kai K. & Kanji G. K., (2007), Fundamental of Total Quality Management, Taylor & Francis Group, USA

[T3] Sheth. G. (2013). Extended Color Gamut for Flexographic Printing. (Master's Theses)

[T4] Bogan. A. (2016). Extended Gamut Printing in Flexographic Packaging and the Impact of Brand Management. (Honors Theses).

[T5] Rodrigues M. I. and Iaemma A. F., (2015), Experimental Design and Process Optimization, CRC Press, Taylor & Francis Group, USA

[T6] Waste Minimization Manual Printing and Publishing Industry, Alberta Environment Protection

[T7] Sammy Shina, (2021), Industrial Design of Experiments, Springer Nature Switzerland AG

References:

[R1] Tristan Bourtos and Jennifer Cardela, (2016), The Basics of Process Improvement, CRC Press, Taylor & Francis Group, USA

[R2] Luthra S., Garg D., Agarwal A., & Mangla S. K., (2021), Total Quality Management, Principles, Methods and Applications, CRC Press, Taylor & Francis Group, USA

[R3] ISO 9000 Quality Systems Handbook, Taylor & Francis Group, USA

[R4] ISO 14000 Environmental Management Standards, John Wiley & Sons

[R5] ISO 12647 (all parts), Graphic technology - Process control for the manufacture of half-tone color separations, proof, and production prints

[R6] ISO/PAS 15339 (all parts), Graphic technology - Printing from digital data across multiple technologies

[R7] ISO/TS 10128, Graphic technology - Methods of adjustment of the color reproduction of a printing system to match a set of characterization data

[R8] ISO 2846 (all parts), Graphic technology - Color and transparency of printing ink sets for four-color printing

[R9] ISO 3664, Graphic technology and photography - Viewing conditions

[R10] ISO 12646, Graphic technology - Displays for color proofing - Characteristics and viewing conditions

[R11] ISO 13655, Graphic technology - Spectral measurement and colorimetric computation for graphic arts images

[R12] Guidelines for using print production standards V1.0 2019

[R13] Chung R., Wu C. and Sheng J. (2014). Gravure Press Calibration by G7® Simulation. TAGA Proceedings

[R14] Rong X. (2008, January). G7® Method for Indigo Press Calibration and Proofing. Society for Imaging Science and Technology, 603-606

[R15] Parsons J. (2017, February). The Value of G7® To Print Service Providers

[R16] GRACoL® and SWOP®, Guide to Print Production, 13, 14-28, Retrieved from https://services.Idealliance.org/ItemDetail?iProductCode=PRTGUIDE_13.0D&Category=DOWNLOAD&WebsiteKey=da18dc52-54ea-4f5c-9e16-c24969f7c24c.

[R17] Deshpande K., Green P. and Pointer M. (2014). Gamut Evaluation of an n-Colour Printing Process with the Minimum Number of Measurements. *Color Research and Application, vol. 40* (4), 408-415. DOI: 10.1002/col.21909.

[R18] Sharma A. and Seymour J. (2019). Evaluation of expanded gamut software solutions for spot color reproduction. *Color Research and Application, Vol. 45* (2), 1-10. DOI: 10.1002/col.22471.

[R19] Moses B. Kataka, Jean B. Byiringiro, and Peter N. Muchiri, (2018), Optimization of Printing Operations, IOSR Journal of Mechanical and Civil Engineering

[R20] Risk Reduction Engineering Laboratory, Guide to Waste Minimization in Commercial Printing Industry

Unit	Text Books	Reference Books
Unit 1	T1	R1
Unit 2	T2	R2, R3, R4
Unit 3	T3	R1, R2
Unit 4	T1	R5, R6, R7, R8, R9, R10, R11, R12
Unit 5	T3, T4	R13, R14, R15, R16, R17, R18
Unit 6	T5, T6, T7	R19, R20

(408283) Gravure Printing Techniques

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	04	In Sem: 30 Marks
Practicals: 2 Hrs/ Week		End Sem: 70 Marks
		Term Work: 25 Marks
		Oral: 50 Marks

Pre-requisites: Basic Printing Techniques, Material Science in Printing and Packaging, Ink Technology

Course Objectives:

The objectives of the Course are:

1. Distinguish different surface preparation methods for gravure.
2. Describe different image carriers for gravure.
3. Formulate the relationship between gravure process variables and printability.
4. Use of inking and drying systems on a gravure press.
5. Evaluate the effect of impression parameters on gravure print fidelity.
6. Describe web handling tools on a gravure press.

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Compare different gravure cylinder-making methods.
2. Analyze the effect of cell geometry on gravure printability.
3. Identify different press configurations, and inks for various gravure applications and evaluate the relationship between gravure process variables and printability.
4. Explain various types of inking systems, drying systems, and compute doctor blade assembly used on a gravure press.
5. Explain various pressurization methods and modern trends in the impression system.
6. Justify the importance of web handling and compute web transport roller and balancing of rollers on a gravure press.

Unit 1: Gravure Image Carrier **[6 hours]**

Basic Methods of Gravure Image Production, Chemical Etching, Electronic Engraving, and Direct and Indirect Laser Engraving, Processing Steps, Comparison between Etching and Engraving,

Making of an etched and engraved cylinder with reference to ink and substrate, Comparison between Electronic and Laser Engraving Process

Unit 2: Surface Preparation for Gravure **[6 hours]**

Cylinder bases, Functions of Copper, Chrome and Zinc, Variables in Plating, Process Steps from Press to Press, Base copper technique, Ballard Shell, Corrections in Copper and Chrome, Comparison between soft copper and hard copper, Measurement and Testing, the Surface finish of cylinder such as roughness measurement, consistency, and quality, Cylinder grading, Engraving requirements for different resin systems, and substrates, Gravure Proofing, Gravure Embossing.

Unit 3: Gravure Process **[6 hours]**

Introduction, Rotogravure Press Configurations, Unit construction, Press Sections Turret, infeed, outfeed, Sheet-fed Gravure, Ink Transfer in Sheetfed Gravure, Hybrid Process, Gravure Products and Applications, Types of Inks and Solvents used for Gravure, Compatibility of Resin with Solvents, Purpose of slow drying and fast-drying solvents, humidity factor. NTNK inks, Evaluation of solvent retention in the printed substrate, and laminate

Unit 4: Inking and Drying System for Gravure **[6 hours]**

Types of Inking system, Viscosity Control, Viscosity, and Gravure print quality, Doctor Blade and purpose, Doctor blade types, Doctor Blade assembly, Doctor blade loading, Need and Types of Dryers used on a gravure press, efficiency of dryers, Basic fundamentals of air inlet volume and velocity in a dryer, relationship of exhaust air volume with inlet air volume, LEL monitoring and recirculation of hot solvent laden air, Flammability of solvents, OSHA (Occupational Safety and Health Association) Standards, Incineration process (Regenerative thermal oxidation) or Solvent Recovery Plant 3T (Time, turbulence and temperature) concept for drying. Ink temperature stabilizer, Air heating mechanisms

Unit 5: Impression System **[6 hours]**

Functions of Impression system (impact of pneumatic pressure), types of elastomers used (relations with the characteristics of the substrate), making of an impression roller, types of impression system, factors governing pressure, impression loading, specifications for impression rollers, testing properties, Electrostatic Assist, need for ESA, Working of ESA, Benefits of ESA, Effect of ESA parameters on ink transfer, Impression shore hardness, and gravure print quality.

Unit 6: Web Handling **[6 hours]**

Turret Systems and Mechanism, Splicing Mechanism, Web Viewing System, Web Aligner, Mounting Techniques of Web Aligner System, Register and Tension Control, Web Transport Roller, Purpose of Idle Rollers, Requirements of Idler Rollers, Calculation of Roller Deflection, Roller Balancing, Electronic Line Shaft, Static Charges, and their effects, 3" and 6" air expandable shafts, chucks, Gravure Troubleshooting

Guidelines for Laboratory Conduction

1. Clean all machine parts every time before starting of practical.
2. Check for the electrical connections before start-up and end of the Practicals.
3. Wear an apron while performing the Practicals in the gravure lab.
4. Direct contact of metal objects with cylinders and plates should be avoided.
5. Do not inhale the solvents used for cleaning cylinders and diluting inks.
6. Cover and store the solvents in a cool dark place.
7. Write the experiment in the journal and get it checked within a week.

Term Work:

Note: Term-work shall consist of the record of the following experiments presented in the form of journals.

1. Study gravure machine principles
2. Print a single-color job with an etched/engraved cylinder on a given substrate
3. Calculate the volume of a varying gravure cell geometry
4. Correlate the volume of a varying gravure cell geometry to ink transfer
5. Evaluate the effect of ESA Voltage on print quality for a given substrate
6. Evaluate the effect of Air Gap distance on print quality for a given substrate
7. Evaluate the impact of rheological properties of ink during the gravure press run
8. Print a duo-tone with an engraved cylinder on a given substrate
9. Print a multi-color job with an engraved cylinder on a given substrate
10. Print a multi-color job with an engraved cylinder with varying variables on a given substrate

Text Books:

[T1] Barry A. Morris, (2017), Converting Process in The Science and Technology of Flexible Packaging, Elsevier

[T2] R. Mumby, (2012), Printing for Packaging in Packaging Technology, Elsevier

[T3] Zuzanna Żołek-Tryznowska, (2016), Rheology of Printing Inks in Printing of Polymers, Elsevier

[T4] P. Laden, (1997), Chemistry and Technology of Water-based Inks, Blackie Academic, London.

[T5] E. A. Apps, (1958), Printing Ink Technology, Leonard Hill Ltd.

Reference Books:

[R1] Gravure Process and Technology, (2003), Gravure Education Foundation and Gravure Association of America.

[R2] Harry B. Smith, (1994), Modern Gravure Technology, Pira International.

[R3] H. Kipphan, (2001), Handbook of Print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg.

[R4] Arif Ozcan & Rasim Zulfigaroglu, (2020), An investigation on the printability of different solvent-based inks by gravure printing onto various substrates, *Journal of Graphic Engineering and Design*, doi: 10.24867/JGED-2020-2-031

[R5] Simseker O., Batuhan Kurt & Emine Arman Kandirmaz, (2012), Effects of Different Solvents to Printability in Gravure Printing, *Asian Journal of Chemistry*, pp. 1-4

[R6] Ronald E. Todd, (1994), Printing Inks: Formulation Principles, Manufacture, and Quality Control, Pira International.

Unit	Text Books	Reference Books
Unit 1	T1	R1, R2, R3
Unit 2	T1, T2	R1, R2, R3
Unit 3	T1, T2	R1, R2, R3
Unit 4	T3, T4, T5	R4, R5, R6
Unit 5	T1, T2	R1, R2
Unit 6	T1, T2	R1, R2

(408284) Digital Printing Techniques

Teaching Scheme	Credits	Examination Scheme:
Lectures: 3 Hrs/week	04	In Sem: 30 Marks
Practicals: 2 Hrs/week		End Sem: 70 Marks
		Term Work: 25 Marks
		Practicals: 50 Marks

Pre-requisites: Introduction to Printing Processes, Print Production Techniques, Color Science and Measurement, Color Management and Standardization

Course Objectives:

The objectives of the Course are:

1. Create / Modify Digital Images as per output needs and utilize various file formats
2. Study and utilize digital imaging sensors
3. Capturing digital images and editing with a scanner and digital camera
4. Application of various methods of digital printing with technical aspects
5. Apply Variable Data Printing and Print on Demand efficiently
6. Work out costing of digital print jobs and compare them with conventional

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Analyze and evaluate file format for the required end purpose.
2. Create various types of PDF files/job options files for specific applications
3. Understand the components and principal of working with a digital camera
4. State and explain various types of Direct imaging methods used for digital printing
5. Understand, state, and comprehend different inkjet printing technologies and their applications
6. Describe POD and VDP technologies and their applications.

Unit 1: Pre-media – Pre-Press **[6 hours]**

File formats for storing different data types- classification, attributes, applications, Output file formats- PS, PDF, Compression of file-lossy and lossless file formats, Anti-aliasing and interpolation, Dithering, Different types of Raster Image Processor (RIP) used for Digital Printing, Raster image processing- the concept of output resolution, Screening techniques, Rational-Irrational screening, Font emulation, Font replacement, Imagesetter types, CTP types

Unit 2: Digital Workflow **[6 hours]**

Introduction to job flow and workflow, Comparison between conventional and digital workflow, Elements of workflow, Job ticket, Pre-flight checking, trapping, proofing, imposition, archiving, API, OPI servers, PDF, JDF, PJTF concept, PDF, and various file formats such as x1a, X/3, X/4 and it's importance in digital printing, Pre-flight, and Quality Control

Unit 3: Image Processing and Proofing **[6 hours]**

Introduction to Digital image processing, the concept of OCR, Fundamental steps in digital image processing, Function, Digital proofing, soft proof, hard proof, proofing technologies-Inkjet, electrophotography, Thermography, Nanotechnology

Unit 4: Digital Image Input Devices **[6 hours]**

Structure of Digital camera, Elements of SLR camera, the concept of resolution, Camera Raw – TIFF/JPEG Conversions, Various attributes such as dynamic range, white balance, black point, white point, Advances in the digital camera, WYSIWYG for the camera, display and printer using ICC based color management, Structure, and working of Scanners, Types of scanners, Concept of Input resolution, Bar code scanning concept, QR code scanning concept Advances in scanning technology

Unit 5: Computer to Press/Direct Images **[6 hours]**

Analog to Digital, File Types such as lossy and lossyless, Levels such as 8-bit/16-bit/32-bit, Direct Imaging-Principle, Features, Applications, once imageable masters- Principle, Types, Press Configurations, Re-imageable masters-Principle, Types, Press Configurations, Inkjet Presses-Continuous flow, drop on demand-Principle, types, Press configuration, ink types, ink properties, Ionography, Principle and Applications, Magnetography -Principle and Applications, Electrophotography- Principle and Applications

Unit 6: Applications and Advances **[6 hours]**

Concept of Variable data printing, Different file formats used in Variable data printing like PDF/VT, PPML, VPS, etc. Benefits, Applications, Working, Concept of Print on Demand, In-line post-press, and finishing operations, print solution through integration of pre-press, press, and post-press, Case Study

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. All the diagrams, workflows, and figures must be drawn on a blank sheet and should be neatly labeled
4. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the department, and the Principal.
5. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with the date.

Guidelines for Laboratory Conduction

1. Check for the Computer, printer, scanner, and LAN connectivity before the start of the practical.
2. Check and note down the setup details of hardware and software as per the format given
3. Follow the format given for the procedure and note down all the observations as per the format given.
4. Check the status of the printer while taking print out, it should be in “ready” status only.
5. Write the experiment in the journal and get it checked within a week.

Term Work:

Note: Term work shall consist of the following ten experiments

1. Edit raw images and convert images into different file formats with varying image resolutions.
2. Study and output a digital file in different PDF formats for various applications.
3. Scanning a document through OCR, prepare and output file for a service bureau.
4. Study and use of Digital Camera and Scanner.
5. RIP a digital file and output through Inkjet Proofer check for the Dot reproduction, Screen angle, and Screen ruling.
6. Design and output of Bar code and QR code
7. Calibration and Characterization (Profiling) of Electrostatic Printer
8. Simulate Electrostatic Printer and Inkjet Proofer
9. Outputting a job using the VDP technique and making a sample Transaction printing
10. Study various Workflow software.

Text Books:

[T1] Andrew Darlow, (2008), Inkjet printing Tips and Techniques, First Edition, Cengage Learning

[T2] Harald Johnson, (2004), Mastering Digital Printing, Second Edition, Cengage Learning PTR publishing

[T3] Robert C. Durbeck Folsheer (Ed.) (2012), Output hard copy devices, Second Edition, Academic Press Inc.

Reference Books:

[R1] H. Kipphan (2001), Handbook of Print media, Vetagbzlin, First Edition, Heidelberg publications

[R2] Richard M. Adams II & Frank D. Romano (1996), Computer to plate automating the print industry, second edition Gatf press

[R3] Michel L. Kleper, (2001), The Handbook of Digital Publishing (Volume1) PH, Second Edition, PTR publishing

Unit	Text Books	Reference Books
Unit 1	T2	R1, R2, R3
Unit 2	T1, T3	R1, R2
Unit 3	T2, T3	R1, R2
Unit 4	T1, T3	R1, R3
Unit 5	T2, T3	R1, R2, R3
Unit 6	T2, T3	R1, R2, R3

(408285) Package Testing

Teaching Scheme	Credits	Examination Scheme
Tutorial: 02 Hrs./week	02	Term Work: 50 Marks

Prerequisites: Introduction to Packaging Concepts, Materials in Printing and Packaging, Polymer Science

Course Objectives:

1. Evaluate the product resistance properties of a laminate
2. Estimate the Strength Tests for a laminate
3. Evaluate the end-use application test for a package
4. Gage the shelf-life of a package by chemical test
5. Assess the physical test on a package for transportation
6. Evaluate the environmental impact on a package

Course Outcomes:

At the end of this course, students will be able to:

1. Analyze the puncture, grease, and scuff resistance test for a package
2. Evaluate Peel, Bond, and Seal Strength for a package
3. Estimate CoF and Heat Shrinkage for a given package
4. Evaluate the Shelf-life of a package by Odor test
5. Correlate the impact of the Vibration and Drop test for package transportation
6. Gauge the impact of temperature and humidity on the dimensional stability of a package

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the department, and the Principal.
4. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with the date.
5. Put one blank page in between two experiments and mention the experiment number, date, and title of the experiment in a separate line.

Guidelines for Laboratory Conduction:

1. Check for the electrical connections before start-up and end of the practical.
2. Apron is compulsory while conducting Practicals on a printing machine.
3. Write the experiment in the journal and get it checked within a week.

Term Work:

Term Work shall consist of the record of the following experiments presented in the form of journals:

1. Evaluate Puncture Resistance of varying packaging materials
2. Measure the Grease and Scuff Resistance of varying packaging materials
3. Measure and Evaluate the Peel Strength/Bond Strength Test for a laminate
4. Perform Seal Strength Test for a package
5. Perform a CoF Test for a laminate
6. Assess the Heat Shrinkage for a given packaging application
7. Perform the Odor Test for a package
8. Perform Vibration Test on a package for a given product
9. Perform Drop Test on a package for a given product
10. Study of varying temperatures and relative humidity on a package

(408286) Project Stage I

Teaching Scheme	Credits	Examination Scheme
Practical: 2 Hrs/ Week	02	Term Work: 50 Marks

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Attain knowledge through the literature review and industry interaction related to the project.
2. Frame the problem statement with clear objectives, and state the hypothesis of the project.
3. Design and devise a methodology for a project
4. Plan the project schedules along with the estimated budget
5. Improve the report writing and individual skills
6. Fulfil the requirements of industry and society.

Project Phase - I is an integral part of the project. The project should be based on the knowledge acquired by the student during the coursework and should contribute to the needs of industry and society. The project aims to provide an opportunity of designing and build complete systems or subsystems in an area where the student likes to acquire specialized skills.

The student shall complete the part of the project that will consist of the Project Overview, Problem Statement, Objectives, Scope and Limitations, Literature Review, Methodology (DOE, Mathematical Model, etc.), Layout & Design of Setup, Practical Implications, Timeline, and Budget.

As a part of Project Stage - I, the student shall deliver a Project presentation with the above-mentioned contents.

The student shall submit the report of Project work in a standard format approved by the Guide/University.

(408287) Audit Course

In addition to the course of the credit, it is recommended that there should be an audit course (non-credit course). The student will be awarded a grade as AP on successful completion of the audit course. The student shall opt for one of the audit courses per semester. Such audit courses can help the student to get an awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. A list of audit courses offered in each semester is provided in the curriculum. Each student has to choose one audit course from the list per semester. Evaluation of an audit course will be done at the institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for an audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided the student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted for in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.
(Ref-http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of the following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands-on experience on a specific focused topic

Guidelines for Assessment (Any one or more of the following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

List of courses under Audit Course

Course Code	Audit Course Title
408287-I	Digital and Social Media Marketing
408287-II	Food Technology
408287-III	MOOC

Students can opt for an audit course from the list of Audit Courses of any branch of engineering.

(408287 - I) Audit Course: Digital and Social Media Marketing

Course Objectives:

The objectives of the Course are:

1. Understand the importance of digital marketing
2. Understand the social media and marketing

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Understand the fundamentals and importance of digital marketing and use the power of social media for business marketing
2. Analyze the effectiveness of digital marketing and social media over the traditional process

Course Contents

1. A Framework for Digital Marketing
2. Domain Names, Email, and Hosting
3. Yes, you need a website
4. The Three Components of a Modern Website: Mobile, Fast, and Accessible
5. Lock It Down: Digital Privacy, Data Security, and the Law
6. Social Media
7. Email Marketing
8. Online Advertising

Reference Books:

1. Avery Swartz, See You on the Internet: building your small business with Digital Marketing, ISBN 978-1-989603-08-6.
2. Social Media Marketing Workbook (2021): How to use social media for Business (2021 Social Media Marketing 1).

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	-	-	2	-	-
CO2	-	-	-	-	-	-	1	-	-	2	-	-

(408287 - II) Audit Course: Food Technology

Course Objectives:

The objectives of the Course are:

1. Understand the principles and technology of food products
2. Understand the principles of food engineering
3. Explain the packaging techniques used for food products with quality control

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Understand the methods of preservation and storage methods for food products
2. Understand various technologies used for processing food products
3. Correlate the packaging technique to the shelf life of products and fulfillment of standards for product safety

Course Contents

1. **Principles of Food Processing**

   Scope and importance of food processing. Principles and methods of food preservation storage of food such as milk, fruits, and vegetables, sources and composition of milk, processing, and toning of milk, homogenization, pasteurization, sterilization, storage, transportation, and distribution of milk, processing of milk products
2. **Principles of Food Engineering**

   Baking, roasting, and hot oil frying theory, equipment, and application effect on food materials for freeze-drying and freeze concentration.
3. **Food Packaging and Quality Assurance**

   Introduction, packaging operation, package functions, and design, protective packaging. shelf life of packaged foodstuff, methods to extend shelf-life. Materials for food packaging, Functions of quality control. Methods of quality, Assessment of food materials, Food regulations, food adulteration and food safety, grades and standards, ISO 9000 series, etc.

Reference Books:

1. Lewis, M.J. 1990. Physical Properties of Food and Food Processing Systems. Wood head, UK.
2. Charm S. E. Fundamentals of food Engineering, AVI, 1963.

3. Hall, Farral, Rippen, Encyclopedia of food Engineering, AVI 1970.
4. Mirajkar M, Menon- Food Science and Processing Technology Vol I & II New Delhi, Kanishka Publishers.
5. Fellows P., Ellis H, 1990, Food Processing Technology Principles and Practice New York
6. Held man, D.R. and Lund, D.B. Ed. 1992. Handbook of Food Engineering marcel Dekker, New York.
7. Rang Anna, S. 1986. Handbook of Analysis and Quality Control for Fruits and Vegetable Products. Tata McGraw Hill, New Delhi.
8. Painy, F.A. and Painy, H.Y. 1983. A Handbook of Food Packaging. Leonard Hill, Glasgow, UK.
9. Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Vegetable Science and Technology, Production, Composition, Storage and processing Marcel Dekker, New York.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	1	-	1	1	-	-	-	-	2	-
CO2	-	1	1	-	1	1	-	-	-	-	2	-
CO3	-	1	1	-	1	2	-	-	-	-	2	-

(408287-III) Massive Open Online Course (MOOC)

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Self-organize their participation to achieve their learning goals
2. Enhance knowledge in the respective area
3. Enrich personal skills.

(408288 A) Elective V: Food and Pharmaceutical Packaging

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hours/ Week	03	In Sem: 30 Marks
		End Sem: 70 Marks

Pre-requisites: Material Science in Printing and Packaging, Polymer Science

Course Objectives:

The objectives of the Course are:

1. Classification of Food and Packaging requirements.
2. Learn Types of Packaging and Materials for Pharmaceutical Packaging
3. Learn different types of Converting processes used for the products.
4. Understand Packaging Technique for Fast Moving Consumer Goods.
5. Acquire knowledge of various types of packaging techniques for food and pharmaceutical applications.
6. Attain knowledge of Legislative and Safety Aspects of Food and Pharmaceutical Packaging.

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Explain the food packaging requirements, deterioration factors, hazards, processing techniques, and steps to increase the shelf life of a package for food application.
2. Classify different types of materials and processing for Pharmaceutical Packaging
3. Explain extrusion, lamination, and varnishing techniques and compare the properties of layers used in packaging.
4. Classify the techniques used in Flexible and Rigid Packaging for FMCG products.
5. Describe flexible and rigid packaging techniques for food and pharmaceutical applications.
6. Explain the Quality Control, Safety Norms and Guidelines to be followed for Food and Pharmaceutical Packaging.

Unit 1: Food Packaging **[6 hours]**

Introduction, Functions of Packaging, Classification of Foods, Packaging Requirements for Food Stuff, Materials for Food Packaging, Bio-Plastics, Package Environments, Functions-to-Environment Grid, Packaging Design and Strategy, 4P's of Marketing for FMCG products, Packaging Characteristics in Multiple Retail Logistics and Distribution, Food Deterioration Factors,

Effects of Food Spoilage, Types of Hazards, Food Preservative Methods, Food Processing Techniques, Factors Influencing Shelf Life of a Packaged Product

Unit 2: Pharmaceutical Packaging **[6 hours]**

Introduction, Functions of Packaging, Types of Packaging – Primary, Secondary and Tertiary, Materials for Pharmaceutical Packaging, Criteria for Selection of Materials for Pharmaceutical Packaging, Sterilization and Pasteurization Procedures for Pharmaceutical Packaging, Warehousing, Handling and Distribution, Future Trends

Unit 3: Converting Processes **[6 hours]**

Extrusion and Co-extrusion technology, Advantages, Limitations, Polymer compatibility for co-extrusion process, applications of co-extrusion, Extrusion Blow Molding, Injection Stretch Blow Molding, Injection Molding, Thermoforming, Compression Molding, Coating techniques, lamination techniques such as Dry, Wet, Hot-melt, Thermal, and Extrusion, Metallization, Varnishing.

Unit 4: Packaging for Fast Moving Consumer Goods Sector **[6 hours]**

Filling System - Vertical Form Fill Seal Machine (VFFS), Horizontal Form Fill Seal Machine (HFFS), Tubular Form Fill Seal Machine (TFFS), Type of Fillers – Auger Filler, Rotary Filler, Multi-Head Weigh Filler; Sealing System – Vertical Sealing and Cross Sealing, Bottle Filling System (Food – Bottle, Caps, Tubes; Personal Care – Acrylic jars, Glass, PET Bottles, PP Bottles, PP Cap, LDPE Cap) and Cap Sealing System (Induction Sealing, Conduction Sealing), Capping, WADS.

Unit 5: Packaging Techniques for Food and Pharmaceuticals **[6 hours]**

Blister-Pack, Strip and Sachet Packaging, Bag-in-Box, Retort Packaging, Requirements for Retort, Aseptic Technology, Aseptic packaging for food products in PET Bottles, Lami-tubes, Processing, and Advantages, shrink wrapping, Process, stretch wrapping, Palletizing, Process, Flexible Pouches, Pouching machines, Active Packaging, Modified Atmospheric Packaging.

Unit 6: Legislative and Safety Aspects for Food and Pharmaceuticals **[6 hours]**

Quality Assurance Aspects of Packaging, Quality Specifications, Factors affecting Product Quality and Shelf Life – Chemical and Bio-chemical processes, Micro-biological processes, Physical and Physico-chemical processes, Migration from Packaging to Foods, Regularity Aspects of Pharmaceutical Packaging – Child Resistant Packaging, Need for Regulations for Pharmaceutical

Materials, FDA Guidelines, Qualification and Quality Control of Pharmaceutical Packaging Components – Suitability, Compatibility, Safety, Performance, Stability, Color Coding for Pharmaceuticals, Quality Specifications by World Health Organization (WHO)

Text Books:

[T1] S. Natarajan. M. Govindarajan, and B. Kumar, (2009), Fundamentals of Packaging Technology, PHI, New Delhi.

[T2] Walter Soroka, (2009), Fundamentals of Packaging Technology, Fourth Edition, Institute of Packaging Professionals.

[T3] Aaron L. Brody, Kenneth S. Marsh, (1997), Encyclopedia of Packaging Technology, 2nd Edition, A Wiley-Interscience Publication.

[T4] F. A. Paine and H. Y. Paine (19192), A Handbook of Packaging Technology, 2nd Edition, Springer Science+Business Media Dordrecht

[T5] Dr. Victoria Krauter (2019), Bio-plastics in Food Packaging, Science News

[T6] Gordon L. Robertson (2013), Food Packaging Principles and Practice, Taylor & Francis Group, LLC

[T7] Edward Bauer, (2009), Pharmaceutical Packaging Handbook, Informa Healthcare USA, Inc.

Reference Books:

[R1] Richard Coles, Derek McDowell and Mark J. Kirwan (2003), Food Packaging Technology, Blackwell Publishing

[R2] Richard Coles, and Mark J. Kirwan (2011), Food and Beverage Packaging, Blackwell Publishing

[R3] World Health Organization Technical Report Series, No. 902, (2002), Guidelines on packaging for pharmaceutical products

[R4] Dipak K. Sarker, (2020), Packaging Technology and Engineering Pharmaceutical, Medical and Food Applications, John-Wiley & Sons

[R5] Cantor, K., (2006). Blown film extrusion-An introduction. 1st ed., Munich-Hanser.

[R6] Aaron L. Brody, Modified Atmosphere Food Packaging, PIRA Publication.

[R7] D A Dean, E. R. Evans and I. H. Hall (2000), Pharmaceutical Packaging Technology, Taylor & Francis

Unit	Text Books	Reference Books
Unit 1	T1, T2, T3, T5	R1, R2
Unit 2	T2, T3	R1, R2
Unit 3	T1, T2, T3, T4	R3, R4, R5
Unit 4	T4, T5, T6, T7	R7
Unit 5	T2, T3	R4, R5, R6
Unit 6	T6, T7	R3, R6, R7

(408288 B) Elective V: Printed Electronics

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	03	In Sem: 30 Marks
		End Sem: 70 Marks

Pre-requisites: Introduction to Print Processes, Printing Digital Electronics, Basic Communication Systems, and Electronic Instrumentation

Course Objectives:

The objectives of the Course are:

1. Understand the main difference between Graphic and Electronic Printing
2. Know-how about the basic electronics components.
3. Learn the materials used in Printed electronics fabrication.
4. Understand different printing methods used in printed electronics.
5. Know application areas of printed electronics.
6. Understand advancements and future trends in Printed Electronics.

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Understand the potential of printing in manufacturing electronics.
2. Classify different materials which are used in PE fabrication.
3. Analyze basic electronics knowledge required for Printed Electronics.
4. Explore various printing methods for manufacturing PE.
5. Explore different applications of PE.
6. Know the opportunities and advancements in printed electronics.

Unit 1: Introduction to Printed Electronics **[6 hours]**

Basic concepts of printed electronics, use of conventional printing methods in printing electronics, PE Technology and Its Benefits, Market for printed electronics

Unit 2: Materials in Printed Electronics **[6 hours]**

Materials properties/synthesis of printable semiconductors, Inorganic materials, Organic materials & Conductive polymers used in Printed Electronics, Substrates: Thin Glass R2R Coated and Non-coated PET, PEN, fabrics, Inks, chemicals used, Substrate treatments, Design and Integration in Applications, Ink and substrate interaction

Unit 3: Basic Electronic Components **[6 hours]**

Processing issues for organic and printable semiconductors, Passive components: Resistors, Capacitors, Inductors, Diodes, Interface components, Interface components: Switches, Plugs, Sockets, Panel controls, Active components: Transistors – Bipolar, Field effect Integrated circuits Optoelectronic components: LED, LCD Logic gates

Unit 4: Printing Processes and Printed Electronics **[6 hours]**

Subtractive manufacturing, Clean-room requirements, Sintering, Masking, Coating, etc., Impact Printing Processes: Offset, Screen, Gravure, Flexography, and Non-impact printing processes-Inkjet Printing for production of PE, scope, and limitations, Advantages of Additive Manufacturing

Unit 5: Printed Electronics Applications **[6 hours]**

Area of Applications, Method of application, and benefits. Smart sensors, Carbon nanomaterials-based FETs, and transparent, wearable electronic devices

Unit 6: Advances and Future Trends **[6 hours]**

Various advanced technologies used in printed electronics production, Future market, and future products of printed electronics, OLEDs, Variable Sensors, Solar Cells

Text Books:

[T1] H. Kipphan ,2001, Handbook of Print media, Vetagbzlin, Heidelberg

[T2] Katsuaki Suganuma, 2014, Introduction to Printed Electronics, Springer

Reference Books:

[R1] Andrew Darlow,2008, Inkjet printing Tips and Techniques, Cengage Learning

[R2] C. Durbeck Folsheer (Ed.) (1998), Output hard copy devices, Academic Press Inc.

[R3] Kleper, M. L. (2004). Printed electronics and the automatic identification of objects. Sewickley: Graphic Arts Technical Foundation.

[R4] Hast, J., Jansson, E., Suhonen, R., Hakola, L., Tuomikoski, M., Vilkman, M., & Kopola, H. (2017). Printed electronics solutions-based processes with flexible glass. Flexible Glass: Enabling Thin, Lightweight, and Flexible Electronics.

Unit	Text Books	Reference Books
Unit 1	T1, T2,	R3, R4
Unit 2	T2	-
Unit 3	T2	R4
Unit 4	T2	R1, R3, R4
Unit 5	T2	R3, R4
Unit 6	T2	R1, R2, R4

(408289 A) Elective VI: Sustainable Packaging

Teaching Scheme	Credits	Examination Scheme
Theory: 3 Hours/Week	03	In Sem: 30 Marks
		End Sem: 70 Marks

Pre-requisites: Introduction to Packaging Concepts, Polymer Science, Food and Pharmaceutical Packaging

Course Objectives:

The objectives of the Course are:

1. To understand packaging materials and types of recycling
2. To set the goals for sustainable packaging
3. To design appropriate packaging and alternative materials for sustainability
4. To understand the role of a circular economy for sustainability
5. To estimate the packaging life cycle
6. To understand the regulations and supply chain management for sustainability

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. To understand rigid and flexible packaging materials and recycling techniques
2. To define sustainable goals, develop products and strategies for sustainability
3. To evaluate different approaches to packaging for sustainability
4. To evaluate the impact of a circular economy on waste reduction
5. To calculate the carbon footprint for quantifying the packaging life cycle
6. To understand the brand positioning, marketing strategy, and environmental claims for sustainability

Unit 1: Packaging and Recycling **[6 hours]**

Defining Flexible Packaging, Flexible Packaging Categories, Selection Criteria of Flexible Packaging, Benefits of Flexible Plastic Packaging, Flexible Packaging versus Rigid Packaging, Limitations of Flexible Plastic Packaging, Issues with Multi-layer Plastic Packaging, Aluminum, Steel, Glass, Paper and Board, Metals, Recycling, Types of Recycling

Unit 2: Sustainable Packaging **[6 hours]**

Introduction, Sustainable Goals, Need for Sustainability, Sustainable Product Development, Strategy for Sustainability, Impacts of sustainability by industry, FMCG, E-commerce, Electronics, etc., Sustainability in food packaging.

Unit 3: Design Considerations and Material Alternatives **[6 hours]**

Introduction, Effective Packaging, Efficient Packaging, Designing for Safety, Impact of material selection, Bio-Based and Biodegradable Food Packaging materials, Renewable Packaging materials, Edible Food Packaging materials, Bio-Composites materials, recyclable materials, Challenges with alternate materials and processing, Compostable packaging.

Unit 4: Circular Economy **[6 hours]**

Key Concepts and Terminology, Linear Economy, Introduction, Need for Circular Economy, Benefits of Circular Economy, 3R's of Circular Economy, Negative Impacts of Plastics, Disposal, Waste Management, Plastics in Circular Economy, Industry 4.0, and Circular Economy

Unit 5: Life Cycle Assessment in Packaging **[6 hours]**

Introduction, Need for Life Cycle Assessment, Need for Life Cycle Assessment, Green Packaging, Functions of LCA, Types of Packaging for LCA, Phases, and Processes in LCA, Levels of LCA, Life Cycle Assessment Tools, Cradle-to-Grave, Issues related to Air Pollution, Landfills, and Marine Pollution, Life Cycle Assessment for Packaging Materials and Food Packaging, Green House Gas Emissions, Carbon Footprint Assessment, Carbon Credits, and Offsets, Future of LCA

Unit 6: Regulatory and Supply Chain **[6 hours]**

Supply Chain Management, Understanding of global regulatory landscapes for sustainable Packaging (EU, NA, India). Brand Positioning and Marketing Strategy, Consumer Education and understanding of standard signs and symbols, Ethical sourcing, Impacts of Efficiency of transportation, Impact of Package size on supply chain, Environmental Claims, ISO 14040, ISO 14044, ISO 14064, ISO 14065, ISO 14066.

Text Books:

[T1] Karli Verghese, Helen Lewis, Leanne Fitzpatrick, (2012), Packaging for Sustainability, Springer.

[T2] Wendy Jedlica, (2009), Packaging Sustainability, John Wiley and Sons

References:

[R1] Ricardo Barra, Sunday A. Leonard, (2018), Plastics and Circular Economy

[R2] Subramanian Senthil Kannan Muthu, (2021), Sustainable Packaging, Springer

[R3] McKinsey Center for Business and Environment, (2016), The circular economy: Moving from theory to practice

[R4] Jon Dettling and Olivier Jolliet, (2010), Life Cycle Assessment and Packaging, PaperCon 2010, TAPPI

[R5] Umberto Arena, Maria Laura Mastellone and Floriana Perugini, (2003), Life Cycle Assessment of a Plastic Packaging Recycling System, Plastic Packaging Recycling

[R6] Kun-Mo Lee and Atsushi Inaba, (2006), Life Cycle Assessment Best Practices of ISO 14040 Series

Unit	Text Books	Reference Books
Unit 1	T1,	R1
Unit 2	T1, T2	R2
Unit 3	T1, T2	R2
Unit 4	T2	R3
Unit 5	T1, T2	R4, R5
Unit 6	T1	R6

(408289 B) Elective VI: Management Information Systems and Data Science

Teaching Scheme	Credits	Examination Scheme
Theory: 3 Hours/Week	03	In Sem: 30 Marks End Sem: 70 Marks

Pre-requisites: Introduction to Printing processes

Course Objectives:

The objectives of the Course are:

1. Understand basics of Management and functions of management,
2. Understand the concept of competition, competitive environment, and elements of competitive environment and analyze the role of MIS in competition.
3. Explain the workflow of the Management Information Systems (MIS).
4. State the vital role of MIS in a digital firm and its applications.
5. Explain the concepts of Data Science for quality improvement
6. Compute the various concepts of costing & estimation, preparing the cost sheets and finding out the estimate of various materials.

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Understand the basics of Management, Organization, and its types
2. Understand the basics of MIS and competition in the market
3. Describe the various requirements of MIS and workflow of MIS
4. State the role of MIS in a digital firm and its various applications
5. Assess the Life Cycle along with techniques and tools for Data Science
6. Compute the costing and estimation for the printing application

Unit 1: Basics of Management **[6 hours]**

Concept of Organization, Introduction to Management, Functions of Management, Management by Objectives, Types of organizations, Functional departments of organization, Competitive Environment, Elements of a competitive environment

Unit 2: Basics of MIS **[6 hours]**

Concept of Information and Data, Database management system, Data warehousing, and Data mining, Need, Purpose and objectives of MIS, Contemporary approach to MIS, Michael Porter's 5 forces model, Information as a strategic resource, Use of information for competitive advantage, Information security and Control, MIS as a tool of Knowledge management, MIS as an instrument for the organizational change

Unit 3: Requirements and Types of MIS **[6 hours]**

Decision Making, Types of Decisions, Decision-making models, systems analysis and design, Systems Development Life Cycle, Information security and control, Decision support system, Group decision support system, Executive information system, Executive support system, Expert systems, and Knowledge-based expert systems

Unit 4: MIS in a Digital Firm **[6 hours]**

Introduction to E-Business Enterprise: A digital firm, Organization of business in a digital firm, Real-time enterprise, Information security challenges in E-Enterprise, Applications of MIS to E-Business like Personnel, Financial, Production, Raw material, Marketing management, MIS applications in a service industry

Unit 5: Data Science **[6 hours]**

Definition, Objectives, Mathematical and scientific techniques, Tools and technology, Types of Data Analysis, Data science job roles, Data Science Life Cycle, Pre-requisites for Data Science, Principal Component Analysis, Exploratory Data Analysis, Data Processing, Machine Learning, ML model development process, Cloud Computing, Difference Between Business Intelligence and Data Science, Improving product quality with data analytics

Unit 6: Costing & Estimation **[6 hours]**

Elements of cost, Product cost, Process cost, Marginal cost, Standard cost, Direct Material, Direct Labor, Factory cost, Overheads, Administrative cost, Definition of Estimation, Elements of estimation, Standard costing as a tool for estimation, Estimation of the substrate, ink, and other raw materials used for the print production, Costing and Estimating of Packages, Wastage calculations, requirements, and strength calculations.

Text Books:

[T1] Jayant K. Oke, (2005), Management Information System, Fifth Edition, Nirali Prakashan,

[T2] Dr. P. C. Shejwalkar, Dr. Anjali Ghanekar, Prof. D. P. Bhivpathaki, (2005), Principles & Practices of Management, 14th edition, Everest Publishing House

[T3] Robert Schultheis, Mary Summer, (1999), Management Information System, Tata McGraw Hill Edition, Delhi

[T4] James A. O'Brien, (2002), 5th edition, Management Information Systems – E Business Enterprise, Tata McGraw Hill Edition

[T5] Dr. Vijay Pithadia, (2012), Introduction to Management, 1st edition, Biztantam

[T6] Probyto Data Science & Consulting Pvt. Ltd. (2020), Data Science for Business Professionals: A Practical Guide for Beginners, 1st Edition, BPB Publications, India

[T7] Estimating for Printers, (1983), 12th edition, British Printing Industries Federation

Reference Books:

[R1] Waman S. Jawadekar, (2009), Management Information Systems, Text and Cases, 4rth Edition,Tata McGraw Hill Education Private Limited, New Delhi.

[R2] Stephen P. Robbins, Organizational Behaviour, 16th Edition, Pearson Education

[R3] Michael P. Papazoglon, Pieter M. A. Ribbers, (2006), E-Business, Wiley India

[R4] Dr. Suresh Dalera, Dr. Mansoor Ali, 5th Edition, Industrial Engineering and Management System, Standard Publishers Distributers, Delhi

[R5] Alexis Lean, (2014), Enterprise Resource Planning, 3rd edition, McGraw Hill Education (India) Private Limited, New Delhi

[R6] P. K. Ruggles, Printing Estimating Principles and Practices

Unit	Text Books	Reference Books
Unit 1	T1, T2, T5	R1, R2
Unit 2	T3	R1
Unit 3	T3	R3
Unit 4	T4	R4, R5
Unit 5	T6	-
Unit 6	T7	R6

(408290) Operations Management in Printing and Packaging

Teaching Scheme	Credits	Examination Scheme
Theory: 3 Hours/Week	04	In Sem: 30 Marks
Practical: 2 Hours/ Week		End Sem: 70 Marks
		Term Work: 25 Marks
		Practical: 50 Marks

Pre-requisites: Introduction to Printing Processes, Gravure Printing Techniques, Flexography Printing Techniques, Offset Printing Techniques, Digital Printing Techniques, Management Information System & Cost Estimation

Course Objectives:

The objectives of the Course are to:

1. Explain the concepts of Production and Operations Management
2. Relate Production, Planning, and Control Systems for Printing and Packaging
3. Build a Project Plan for implementation of the Printing and Packaging Project
4. Explain the various network scheduling techniques for Project Management
5. Distinguish various Job Sequencing and Inventory Management practices used in Printing and Packaging Industry
6. Estimate Assignment and Transportation Models

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Apply the concepts of Production and Operations Management for Printing and Packaging applications.
2. Devise a Production Plan for Printing and Packaging applications.
3. Develop a Project Plan with PBS and WBS tools for Printing and Packaging applications.
4. Evaluate Printing and Packaging Project scheduling by Gantt Chart, GERT, PERT, and CPM.
5. Evaluate job sequencing, and scheduling and discuss Inventory Management techniques for Printing and Packaging applications.
6. Analyze optimum resources, utilization, and transportation costs by assignment model and transportation models.

Unit 1: Introduction to Production and Operations Management [6 hours]

Types of production, Classification of the production system, Scope of Production Management, Benefits of Production Management, Responsibility and Decisions of Production Manager,

Operations Management, Difference between Production and Operations Management, Operation Management Practices for a Printing Press, Impact of Operations Management in Packaging, Operations Management of a Packaging Plant

Unit 2: Production, Planning and Control **[6 hours]**

Functions of Production Planning and Production Control, Stages of Production Planning and Control, Challenges in Production Planning and Control, Factors Affecting Production Planning and Control, MRP Vs. ERP, JIT, Production Planning System, Making the Production Plan, Process Planning, Capacity Planning, Aggregate Capacity Planning, Calculation of Capacity and Measure of Productivity to meet the demand of the desired product, Production Scheduling, Role of Production Planning and Control for Printing and Packaging Industry

Unit 3: Project Planning **[6 hours]**

Introduction, Types of Project Management, Project Controlling and Project Control Systems, Project Life Cycle, Project Plan, Establishing Project Objectives for Printing and Packaging, Validating the Objectives, Project Specifications and Statement of Work for Printing and Packaging, Project Breakdown Structure, and Work Breakdown Structure for Printing and Packaging Project, Difference between PBS and WBS, Benefits of PBS and WBS, Roles and Responsibilities of the Team working in a Project, Project Failures and Success

Unit 4: Network Scheduling Techniques **[6 hours]**

Introduction, Scheduling Techniques such as Gantt Chart, GERT, PERT and CPM, Advantages of Network Scheduling Techniques, PERT Vs. CPM, PERT Calculations for Printing and Packaging Project, Estimating Risk for Printing and Packaging Project, Network Diagram and Critical Path Analysis for a Printing and Packaging Project, Types of Floats, Calculation of Slack time

Unit 5: Job Sequencing and Inventory Management **[6 hours]**

Introduction, Application, Assumptions, Types of Sequencing such as First Come First Served, Shortest Processing Time and Johnson's rule, Lateness and Tardiness Concepts, Defining Inventory, Different Types of Inventories, Need for Inventory Management, Inventory Planning, Factors affecting Inventory Operations, Inventory Management Techniques for Printing and Packaging Industry

Unit 6: Assignment and Transportation Models **[6 hours]**

Introduction, Application, Assumptions, Types of Sequencing such as First Come First Served, Shortest Processing Time and Johnson's rule, Assignment Model, Applications, Assumptions,

Mathematical representation, Hungarian method for the Assignment problem, Sensitivity analysis, Transportation Model, Applications, Assumptions, Matrix technology, formulation and solution of Transportation model by NWCM, LCM, VAM method and test of optimality by MODI method

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the department, and the Principal.
4. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with the date.
5. Put one blank page in between two experiments and mention the experiment number, date, and title of the experiment in a separate line.

Guidelines for Laboratory Conduction

1. Use Pencil for drawing network diagrams.
2. Always remember the assumptions of various OR models before solving them.
3. Write the experiment in the journal and get it checked within a week.

Term Work

Term Work shall consist of the following ten experiments:

1. Calculate Capacity and Measure of Productivity for the desired product specifications
2. Prepare a Project-Based Structure for a Converting Industry
3. Define a Printing or Packaging Project and prepare a WBS for the Project
4. Prepare a schedule for a Printing Project with Gantt Chart using a software
5. Construct a Network Diagram and perform a Critical Path Analysis for a given Packaging Project
6. Define a Packaging Project and evaluate by PERT Technique
7. Estimate the Risk involved in a Printing or Packaging Project
8. Sequencing and scheduling of ‘m’ jobs n machines and ‘n’ jobs n machines for a Printing Process
9. Assigning the job to a Printing machine by the Hungarian method
10. Allocation of printing jobs to several work stations by Transportation model

Text Books:

[T1] Ullas Chandra Das and Ajit Kumar Mishra (2019), Production and Operations Management, Excel Books Private Limited, New Delhi

[T2] J. K. Sharma, (2016), Operations Research: Theory and Practices, 6th Edition, Trinity, New Delhi

[T3] Stephan N. Chapman, (2006), The Fundamentals of Production Planning and Control, 1st Edition, Pearson Education

[T4] Project Management Institute, (2019), Practice Standard for Work Breakdown Structures, 3rd Edition

[T5] James P. Lewis, (2011), Project Planning, Scheduling & Control, 5th Edition, McGraw Hill Publication

[T6] P. Rama Murthy, (2007), Operations Research, 2nd edition, New Age International (P) Ltd Publishers

[T7] Ranjeet Chitale, (2005), Statistical & Quantitative Methods, 4th Edition, Nirali Prakashan, Pune

Reference Books:

[R1] José Ramón San Cristóbal Mateo, (2015), Management Science, Operations Research and Project Management, Henry Ling Limited, at the Dorset Press, Dorchester, DT1 1HD, UK

[R2] Harold Kerzner, (2017), Project Management A Systems Approach to Planning, Scheduling, and Controlling, 12th Edition, Wiley & Sons Publishing

[R3] Dr. Suresh Dalera, Dr. Mansoor Ali, (2005), Industrial Engineering and Management System, 5th Edition, Standard Publishers Distributors, Delhi

[R4] S. Kalavathy, (2013), Operations Research, 4th Edition, Vikas Publishing House Pvt. Ltd.

[R5] G. Srinivasan, (2010), Operations Research Principles and Applications, 2nd edition, PHI Learning Pvt. Ltd, Delhi

[R6] Prem Kumar Gupta, D. S. Hira, (2008), Operations Research, S. Chand & Company Ltd, New Delhi

Unit	Text Books	Reference Books
Unit 1	T1, T2	R1
Unit 2	T3	R1, R2
Unit 3	T4, T5	R1, R2, R3
Unit 4	T5	R2, R3
Unit 5	T3, T4, T5	R2, R3
Unit 6	T2, T5, T3	R4, R5, R6

(408291) Adhesives and Coatings in Packaging

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	04	In Sem: 30 Marks
Practicals: 2 Hrs/ Week		End Sem: 70 Marks
		Term Work: 25 Marks
		Practical: 50 Marks

Pre-requisites: Material Science in Printing and Packaging, Ink Technology

Course Objectives:

The objectives of the Course are:

1. Explain the role of adhesives in packaging
2. Determine the formulation and manufacturing of an adhesive for a given application
3. Categorize the adhesives based on their applications
4. Explain the importance of coating and its types used for rigid and flexible packaging
5. Classify the coating methods based on end-use packaging applications
6. Select the testing method of adhesives and coating for a given application

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Classify the types of adhesives used in packaging
2. Explain the formulation and manufacturing of adhesives
3. Label various types of adhesives based on end-use packaging applications
4. List the coating types used in packaging for absorbent and non-absorbent stocks
5. Elaborate on the methods of coating application for absorbent and non-absorbent stocks
6. Test and evaluate adhesives and coatings for various applications

Unit 1: Introduction to Adhesives **[6 hours]**

Adhesion and adhesion theory, Polymers used in Manufacture, Types of adhesives, Polymers and Elastomers, Water-based, Solvent-based, Hot melt, Solventless adhesives. Chemistry and Mechanical Properties of Adhesives, Uses of Adhesive Bonding in Modern Industry.

Unit 2: Formulation of Adhesives **[6 hours]**

Raw materials, equipment, and manufacturing process of Water-based, Solvent-based, Hot melt process, Adhesives with specifications and parameters, Ecofriendly and Biodegradable approach to Solvent-based adhesives, waterborne lamination, Advantages/Disadvantages of Adhesives

Unit 3: Applications of Adhesives in Packaging **[6 hours]**

Lamination Grade adhesives, Self-Adhesive Tape, Cold Seal adhesives, Hot Seal adhesives, Hot-melt, Types of adhesives for general label and pressure-sensitive labels, Adhesives for Flexible Packaging, Adhesives used for food-grade packaging materials, Evaluation of adhesives used in food-grade applications in packaging industries, Paper-based packaging, and combination packaging applications, Adhesives used for tapes - Rubber-based, Acrylic-based, Silicone-based, Tapes with cloth, plastic and paper base

Unit 4: Fundamentals of Coating **[6 hours]**

Introduction, Types of Coatings, Theory of Adhesion, Coating Rheology, Sagging and Slumping, Leveling, Viscosity changes after coating application, Coating Calculations, Polymers in Coating, Coatings used for metals and flexible films such as gloss, anti-static, matt, glitter, reverse metallization coating, release/silicone, anti-seal, Selection criteria of water-based coatings for food-grade packaging Fundamentals of coating for Paper and Board, Effect of Coating Pigment on Color and Lightfastness, 100% Solids coatings, PE coatings, Wax coatings

Unit 5: Coating Techniques **[6 hours]**

Coating processes and types of equipment, Wire-wound Rod Coater, Slot Die Coating for Low Viscosity Fluids, Extrusion Coating, Porous Roll Coater, Rotary Screen Coating, Gravure Coater, Coating formulation, Spray Coating, Coating rheology, Drying process, Types of Drying, Evaluation of coated paper, Effect of coating on food packaging materials, Regulations for Coatings in Food Packaging,

Unit 6: Testing of Adhesives and Coatings **[6 hours]**

Adhesive standards BIS, ASTM, PSTC, FINAT, Testing methods for adhesives, Adhesion Test, Adhesion Strength to Metal, Breaking Strength and Elongation at Break, Durability, Stability, Tack by Rolling Ball, Adhesive Content, Quality Control, and Quality Assurance, Raw Material Testing, Process Testing, and Finish Product Testing, Coating Tests such as Coat Weight Test, Global, and Specific Migration Tests, Scratch Resistance, and Product Resistance tests

Guidelines for Student's Lab Journal

1. Students should write the journal in their own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. Journal must contain certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, the signature of staff, Head of the department, and the Principal.
4. Index must contain serial number, the title of the experiment, page number, and the signature of staff along with the date.
5. Put one blank page in between two experiments and mention the experiment number, date, and title of the experiment in a separate line.

Guidelines for Laboratory Conduction

1. Check for the electrical connections before start-up and end of the practical.
2. Apron is compulsory while conducting Practicals on a printing machine.
3. Write the experiment in the journal and get it checked within a week.

Term Work

Term Work shall consist of the following ten experiments:

1. Application of solvent-based/water-based adhesives on a plastic film and laminating to another film by nipping heat seal pouch laminator
2. Bond Strength Test of laminated plastic film with applied solvent-based/water-based adhesives after 24 hours
3. Bond Strength Test of laminated plastic film with applied solvent-based/water-based adhesives after 48 hours
4. Peel Adhesion Test of Pressure-Sensitive Adhesive Film
5. Shear Adhesion Test of Pressure-Sensitive Adhesive Film
6. Evaluation of Tack on a given film by Rolling Ball and Loop Tack Tester
7. Analysis of solvent-based coatings for Adhesion, and Scratch with varying GSM on a plastic film
8. Analysis of solvent-based coatings for Gloss with varying GSM on a plastic film
9. Analysis of water-based coatings for Adhesion, Scratch, and Gloss with different application techniques on a plastic film
10. Product Resistant Tests such as ARSR, and grease resistance for Coatings

Text Books:

[T1] Sina Ebnesajjad, (2015), Adhesives Technology Handbook, 3rd Edition, Elsevier

[T2] Istvan Benedek & Mikhail M. Feldstein, (2009), Handbook of Pressure-Sensitive Adhesives and Products, Taylor & Francis Group, UK

[T3] Arthur A. Tracton, (2007), Coatings Technology, Fundamentals, Testing and Processing Techniques, Taylor & Francis Group, UK

Reference Books:

[R1] Sina Ebnesajjad, (2015), Handbook of Adhesives and Surface Preparation, 4rth Edition, Elsevier

[R2] Alphonsus V. Pocius 3rd Edition, Adhesion and Adhesives Technology, Hanser Publications.

[R3] Martin J. Forrest, (2005), Coatings and Inks for Food Contact Materials, Rapra Review Reports, Vol. 16. No.6

Unit	Text Books	Reference Books
Unit 1	T1, T2	R1, R2
Unit 2	T1, T2	R1, R2
Unit 3	T1, T2	R1, R2
Unit 4	T3	R3
Unit 5	T3	R3
Unit 6	T2, T3	R2, R3

(408292) Project Stage II

Teaching Scheme	Credits	Examination Scheme
Practical: 6 Hrs/ Week	06	Term work: 100 Marks
		Oral: 50 Marks

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Plan the structured experiments
2. Analyze, interpret the data and validate the results
3. Work as a team and improve technical skills to achieve the desired goals of the project
4. Follow professional ethics and interact with subject experts from the industry for the project
5. Relate the practical utility of the project
6. Improve report writing skills

In Project Phase - II, the student shall complete the remaining part of the project which will consist of the fabrication of the setup required for the project, conducting experiments, analysing of data, drawing results, validation of results, and conclusions.

As a part of Project Stage - II, the student shall deliver a Project presentation that includes Problem Statement, Objectives, Scope, Limitations, Methodology (DOE, Mathematical Model, etc.), Layout & Design of Setup, Analysis, Result and Conclusion, Practical Implications, Timeline, and Budget.

The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned Guide/University.

(408293) Audit Course

In addition to the course of the credit, it is recommended that there should be an audit course (non-credit course). The student will be awarded a grade as AP on successful completion of the audit course. The student shall opt for one of the audit courses per semester. Such audit courses can help the student to get an awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. A list of audit courses offered in each semester is provided in the curriculum. Each student has to choose one audit course from the list per semester. Evaluation of an audit course will be done at the institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for an audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided the student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.
(Ref-http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of the following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands-on experience on a specific focused topic

Guidelines for Assessment (Any one or more of the following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

List of courses under Audit Course

Course Code	Audit Course Title
408293-I	Leadership and Personality Development
408293-II	Engineering Economics

Students can opt for an audit course from the list of Audit Courses of any branch of engineering.

(408293 - I) Audit Course: Leadership and Personality Development

Course Objectives:

The objectives of the Course are:

1. To understand the importance of communication
2. To create awareness about teamwork and people skills
3. To know thyself
4. To recognize current and possible future of new-age thinking

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Express effectively through communication and improve listening skills
2. Develop effective team leadership abilities.
3. Explore self-motivation and practice creative/new-age thinking.
4. Operate effectively in heterogeneous teams through the knowledge of teamwork, people skills, and leadership qualities.

Course Contents

1. Communication: Listening Skills, Communication - 7 C's, Vision and Charisma, Planning and Organizing - Complex Tasks and Ideas --> Actionable Tasks, Presentation Skills.
2. Teamwork and People Skills: Talent Picking skills, Strong networking and Employee engagement, Coaching and Mentoring the team, Influencing, Delegating and Empowering, Generous, open communicator, Patience and Clarity of Mind, Inspire and Motivate, Ensure Team Cohesion, Empathy, Trust and Reliability.
3. New-age Thinking: Strategic Thinking, Critical and Lateral Thinking, Problem Solving Skills, Flexibility, Change Management VUCA.
4. Self-Awareness: What is Self? Real, Ideal and Social Self, Concepts related to Self - Self Concept, Self-Presentation, Self-Regulation and Impression Management, Definition and Causes of Prejudice, Relationship between Prejudice, Discrimination and Exclusion, Application Attitudinal Change and Reducing Prejudices, Self Esteem and Self Awareness, SWOT JOHARI, Self Esteem Quiz, Introduce Your Partner, Self-Introduction - How to sell yourself?-appearance, voice modulation, verbal(simple language), Motivation and Optimism, Positive Emotions and Success

Reference Books:

1. Paulsone, (2006), The Leader's Guide to Lateral Thinking Skills Unlocking the Creativity and Innovation in You and Your Team
2. Ronald Bennett, Elaine Millam, Leadership for Engineers: the magic of mindset‥
3. Urmila Rai & S. M. Rai, Business Communication, Himalay Publication House
4. Baron R, Byrne D, Branscombe N, BharadwajG (2009), ‟Social Psychology, Indian adaptation‥ , Pearson, New Delhi

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	2	-	2
CO2	-	-	-	-	-	-	-	-	-	2	-	2
CO3	-	-	-	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	-	-	2	-	2

(408293 - II) Audit Course: Engineering Economics

Course Objectives:

The objectives of the Course are:

1. Understand engineering economics and money management
2. Understand financial project analysis
3. Estimate project cost and apply for business
4. Understand making financial decisions when acting as team member or manager in the engineering project

Course Outcomes:

Upon successful completion of the course the student will be able to:

1. Understand economics, the cost money and management in engineering
2. Analyze business economics and engineering assets evaluation
3. Evaluate project cost and its elements for business
4. Develop financial statements and make business decisions

Course Contents

1. **Understanding Money and its Management:** Engineering Economic Decisions, Time value of money, Money management, Equivalence calculations.
2. **Evaluating Business and Engineering Assets:** Present worth analysis, Annual equivalence Analysis, Rate of Return Analysis, Benefit Cost Analysis.
3. **Development Project Cash Flow:** Accounting of Income Taxes, Project cash flow Analysis, Handling Project Uncertainty.
4. **Special Topics in Engineering Economics:** Replacement decisions, financial statements.

Reference Books:

1. Chan S Park, (2019), Fundamentals of Engineering Economics, 4rth Edition, Pearson
2. James Riggs, (2004), Engineering Economics, Tata McGraw-Hill

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	-	-	-	-	-	2	2	3	1
CO2	1	1	1	-	-	-	-	-	2	2	3	1
CO3	1	1	1	-	-	-	-	-	2	2	3	1
CO4	1	1	1	-	-	-	-	-	2	2	3	1