SAVITRIBAI PHULE PUNE UNIVERSITY

FACULTY OF ENGINEERING

SYLLABUS STRUCTURE FOR T.E. (PRINTING TECHNOLOGY)

(2019 COURSE)

WITH EFFECT FROM YEAR 2021 - 22

Printing Technology Third Year (2019 Course)

With Effect From: 2021-22

SEMESTER – I													
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**			**Examination Scheme**					**Total Marks**	**Credits**	
						Paper		**TW**	**PR**	**OR**			
			Th.	**Pr.**	**Tut.**	**In Sem**	**End Sem**					**TH/ TW**	**PR/ OR**
1.	308281	Print Statistics	03	02	--	30	70	25	--	--	125	3	1
2.	308282	Offset Printing Techniques	03	02	--	30	70	25	25	--	150	3	1
3.	308283	Color Science and Measurement	03	02	--	30	70	--	25	--	125	3	1
4.	308284	Ink Technology	03	02	--	30	70	--	25	--	125	3	1
5.	308285	Advanced Print Layout Design	--	02	--	--	--	--	25	--	25	--	1
6.	308286	Elective - I	03	--	--	30	70	--	--	--	100	3	--
7.	308287	Seminar	01	--	--	--	--	50	--	--	50	1	--
8.	308288	Audit Course	--	--	--	--	--	--	--	--	--	--	--
Total			**16**	**10**	--	**150**	**350**	**100**	**100**	--	**700**	**16**	**5**
Total Credits												**21**	

SEMESTER – II													
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**			**Examination Scheme**					**Total Marks**	**Credits**	
						Paper		**TW**	**PR**	**OR**			
			Th.	**Pr.**	**Tut.**	**In Sem**	**End Sem**					**TH/ TW**	**PR/ OR**
1.	308289	Flexo Printing Techniques	03	02	--	30	70	25	25	--	150	3	1
2.	308290	Color Management	03	02	--	30	70	25	25	--	150	3	1
3.	308291	Design of Experiments	03	02	--	30	70	25	25	--	150	3	1
4.	308292	Advanced Package Layout Design	--	02	--	--	--	25	--	--	25	--	1
5.	308293	Elective - II	03	02	--	30	70	--	25	--	125	3	1
6.	308294	Internship**	--	--	--	--	--	100**	--	--	100	--	4
7.	308295	Audit Course	--	--	--	--	--	--	--	--	--	--	--
Total			**12**	**10**	--	**120**	**280**	**200**	**100**	--	**700**	**12**	**9**
Total Credits												**21**	

**** The detailed guidelines for Internship are mentioned in the syllabus.**

(308281) Print Statistics

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

Pre-requisites: Engineering mathematics, Management Information System and Cost Estimation

Course Objectives:

The objectives of the course are:

1. Attain basic and technical knowledge of the term print quality.
2. Understand various tools available for process improvement.
3. Understand the use of control charts for the process monitoring
4. Understand various types of process variations.
5. Understand the various types of data distributions.
6. Learn six sigma basics for process improvement.

Course Outcomes:

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

1. Understand the basic technical knowledge of the Quality in printing.
2. Understand the importance & methods of data collection
3. Understand the various parameters and methods of data analysis
4. Know various techniques of graphical representation of data analysis
5. Know various techniques of graphical representation of data analysis
6. Learn the six sigma quality & process capability.

Unit 1: Quality, Process, Control and Process Variability [6 hours]

Basic concepts, TQM, Processes and SPC System, Basic tools, Information about process, Process mapping and flowcharting, process analysis, Variation, types and causes of variation

Unit 2: Data collection and data distribution [6 hours]

Approach, Sampling, sampling distribution and unbiasedness, determining the sample size, collection of data, bar charts, Normal distribution, Binomial and multinomial distribution, Poisson distribution, Geometric distribution, Exponential distribution, Uniform distribution, areas under normal curve

Unit 3: Exploratory data analysis **[6 hours]**

Histogram , Scatter diagram, amount of variability of data set, Box and whisker plot, Empirical quantiles, quartiles and the IQR, The central limit theorem, standardizing averages, application of central limit theorem, Measures of accuracy or centering, The centre of a data set, the amount of variability of a data set, Measures or precision or spread.

Unit 4: Process analysis, control and Improvement **[6 hours]**

Run charts, Control charts for variables such as X bar-R chart, X bar-S chart, X-MR, Zone chart; Process problem solving, Pareto analysis, cause and effect analysis, use of control charts for managing out of control processes.

Unit 5: Basic Statistical Models **[6 hours]**

Random samples and statistical models, distribution features and sample statistics, estimating true distribution, simple linear regression and correlation model, correlation coefficient,
Introduction to multiple linear regression.

Unit 6: Six Sigma Process Quality **[6 hours]**

Process Capability Analysis, SPC and management system, Defining six sigma, benefits, and problem solving process (DMAIC), six sigma and role of design of experiments, Break through management

Guidelines for Student's Lab Journal

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

Guidelines for Laboratory Conduction

1. Use electronic pocket calculator for the practical
2. Use graph paper for drawing charts and graphs.
3. Write the experiment in the journal and get it checked within a week.

Term Work

Term Work shall consist of following ten experiments:

1. Analysis of spectral data by histogram
2. Analysis of Data using Pareto Chart for Prioritization
3. Analysis of Print Density by X bar- R chart
4. Analysis of Print Density by X bar- S chart
5. Analysis of Color Difference by X-MR chart
6. Evaluation of printing variables by zone chart
7. Analysis of different print variables by interactive plot
8. Capability analysis of a print process
9. Analysis of data using box plot
10. Root cause analysis using cause and effect diagram for the given problem
11. Process mapping / Process flowcharting for the given process

Text Books:

[T1] Smith G. M., Statistical Process Control and Quality Improvement, 5th Edition, Pearson Education

[T2] Modi S. M., Statistical Process Control and Related Quality Tools, D. L. Shah Trust

Reference Books:

[R1] John S. Oakland, (2003), Statistical Process Control, 5th Edition, Butterworth-Heinemann

[R2] Thomas Pyzdek, (2003), The Six Sigma Handbook: A complete guide for Green Belts, Black Belts and Managers at all levels, McGraw-Hill Companies, Inc.

[R3] Walpole R., Myers R. H., Myers S. L., Ye K., Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education

[R4] Dekking F.M., Kraaikamp C., LopuhaaH.P., MeesterL.E., A Modern Introduction to Probability and Statistics, Springer

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

(308282) Offset Printing Techniques

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	03	In Sem: 30 Marks
Practicals: 2 Hrs/ Week	01	End Sem: 70 Marks
		Term Work: 25 Marks
		Practical: 25 Marks

Pre-requisites: Introduction to Printing Processes, Print Production Techniques

Course Objectives:

The objectives of the Course are:

1. Learn offset principles, cylinder configurations, packing requirements and other specifications of print shop
2. Learn Computer to Plate techniques
3. Understand Ink roller train & reason of oscillator rollers
4. Understand working of dampening systems and importance of dampening chemistry
5. Understand operation of feeder and delivery
6. Understand printability responses and green printing initiatives

Course Outcomes:

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

1. Identify web configurations and describe reel handling methods
2. Examine and categorize different inks and dampening systems used for web offset and newspaper production
3. Compare different dryers used and solve troubleshooting of ink drying
4. Examine factors affecting web tension
5. Utilize and analyze print attributes TVI, grey balance etc.
6. Solve troubleshooting of print results of web offset and utilize green initiatives in printing press

Unit I: Cylinder geometry and Sheetfed and Web Configuration configurations [6 hours]

Introduction to Offset Printing used for commercial and packaging, Sheet fed and Webfed Process Flow diagram, construction of printing units, 5 and 7 o'clock cylinder geometry, packing requirements for plate and blanket cylinders, blanket types and blanket structure, automatic plate

changing for sheetfed and webfed, Configurations of Web presses such as blanket to blanket, Y, stack, H type configurations. Workflow (material movement) of commercial workshop. Workflow of Packaging workshop. (e.g., WIP for packaging plants is more) Pantone colors and their behaviors on offset presses What should be the machine configuration as per job (4 col/6 col + Coater/7 + Coater/Coater at the beginning and at the end of press/ Double coater only at the end) Spectrophotometers and their functions in line with press.

Unit II: CTP technologies [6 hours]

Surface preparation for Offset, layout preparation, CTP –thermal and violet, CTCP and other technologies, thermal plate and plate processing and developing, Quality comparison of Thermal/CTCP. (Project) Integration of Pre-Press with Press and Post Press (Smart Printshop) Variable Software for commercial/packaging segment Study of Laser Technology used in the CTP

Unit III: Sheet transfer in sheetfed and paper handling webfed offset presses [6 hours]

Feeders – study of all parts of feeders, mechanisms of sheet transfer- double diameter and triple diameter impression cylinders and transfer drums, shaft less feeders, suction belts sheet guiding, grippers, mechanism in delivery system, Sheet Infeed System Paper logistics, reel stands, reel handling, reel to web processing, splice preparation, clamp truck transport, and automatic splicers. Plates used for web presses, metal backed low gap blanket technology, packing calculation in web offset, Drive concepts in web offset machine, mechanical shaft, shaft less drives in printing units, solid and skeleton transfer cylinders

Unit IV: Inking and dampening systems in Sheetfed and Web Offset Process [8 hours]

Study of different inking systems, principle of ink transfer in inking system – hydrodynamic thrust and ink splitting, different metering systems of ink duct, roller materials for conventional and hybrid UV Offset machines, UV sheetfed for packaging printing, integrated color measurement, inking unit temperature control, Construction of Dampening System, Developments and modifications in dampening system construction, Dampening Roller materials, fountain solutions & their characteristics, continuous flow dampening in sheetfed presses, Role of different constituents used in fountain solutions, Effective use of IPA and IPA substitutes in fountain solution.

Unit V: Transfer drums Delivery unit, Dryers, Chillers and Folders [6 Hours]

Dryers & chill rolls, regeneration thermal oxidizers used on heat set presses, temperature settings of dryers and chillers as per ink coverage and substrate used, Ink behavior in coldest and heat set presses, IR dryer and UV dryer in web offset, Folders used for commercial publication, newspaper industry, continuous stationery, folding techniques, folder maintenance on web offset.

Unit VI: Web Handling, Auto-registration control and Auxiliary Equipment [6 Hours]

Effect of transport velocity and surrounding air on web transport, web instability problems in the press such as wrinkling and fluttering, Web tension control, load cells, web handling, factors affecting tension- press related tension and paper related tension, modulus of elasticity of paper, web tension profile and shrinkage profile after dryers, Registration control- auto registration control used on web presses, closed loop systems for register control, Auxiliary equipment used on web offset- remoisturizer unit, anti-static devices, temperature-controlled oscillators, Angle bars, turner bars

Guidelines for Laboratory Conduction

1. Clean all tools, machine parts every time before starting of practical.
2. Check for the electrical connections before start up and end of the practical.
3. Wear apron while performing the practical in screen lab.
4. Direct contact with chemicals should be avoided.
5. Do not inhale the chemicals and cleaning agents used for cleaning.
6. Store the chemicals in 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 record of the following experiments presented in the form of journals.

1. To mount plate on plate cylinder and prepare standard operating procedure for the same
2. To mount blanket on blanket cylinder and prepare standard operating procedure for the same.
3. CTP plate calibration (plate linearization) for press profiling
4. Setting of ink duct and tracing ink path on the inking unit
5. Setting of dampening system
6. To set and operate feeder (stream feeder)
7. To print multi-color job (first 2 colors of 4 colors)
8. To print multi-color job (next 2 colors of 4 colors)
9. To measure quality checks consumables for web offset substrate, inks, fount etc.
10. To carry out print analysis of a newspaper printed job and commercial heat set printed job

Text Books:

[T1] Printing Industries of America Staff, Daniel G. Wilson (2003), Web Offset Press Operating, 5th Edition, GATFPress, USA

[T2] C. S. Mishra (1991), Technology of Offset Printing, 1st Edition, Anupam Prakashan, India

[T3] Lloyd DeJidas, Thomas Destree (2005), Sheetfed Offset Press Operating, 3rd Edition, GATFPress, USA

Reference Books:

[R1] W. R. Durrant (1977), Web control, North Wood publication 1st Edition,

[R2] H. Kipphan, (2001), Handbook of Print Media, 1st Edition, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg, Germany.

[R3] Tim Claypole, Nigel Wells (2012), Best Practice Tool Box, Web Offset Champion Group, Welsh Centre for Printing and Coating, Swansea University

[R4] Wan Ifra Newsprint and News inks Guide (1993), Word Association of Newspapers and News Publishers

[R5] John MacPhee (1998), Fundamentals of Lithographic Printing, 2nd Edition, GATFPress, USA

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

(308283) Color Science and Measurement

Teaching Scheme	Credits	Examination Scheme
Lectures: 3 Hrs/ Week	03	In Sem: 30 Marks
Practicals: 2 Hrs/ Week	01	End Sem: 70 Marks
		Practical: 25 Marks

Pre-requisites: Print Production Techniques

Course Objectives:

The objectives of the Course are:

1. To understand human vision perception.
2. To identify effect of illuminant and standard observer for the perception of color.
3. Application of various color systems for color measurement.
4. To perform visual and instrumental color assessment.
5. Application of MATLAB software for color assessment.
6. Application of Kubelka Munk theory for color matching.

Course Outcomes:

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

1. To understand human vision perception.
2. Evaluate the effect of illuminant and standard observer on the color coordinates.
3. Calculate the color coordinates for various color systems.
4. To identify the parameter and perform the visual and instrumental color assessment.
5. To apply the MATLAB color tools for color measurement.
6. To understand the role and application of Kubelka Munk theory for color matching.

Unit I: Understanding color and color science [6 hours]

Fundamentals of color science, electromagnetic spectrum, additive and subtractive color theory, light source and standard illuminant, spectral power distribution, color temperature, reflectance and transmission properties of objects including substrates and colorants, viewing condition.

Unit II: Human Vision Mechanism [6 hours]

Basics of human vision and color perception, trichromatic and opponent color mechanism, color vision deficiency of various types, color blindness test methods, concept of CIE standard observer,

color matching experiment, human eye adaptation to various lighting conditions, psychophysical aspects of color.

Unit III: Color Systems **[6 hours]**

Color system notations and various color models, color systems based on uniform color perception, Munsell Color system, Natural Color System, OSA uniform color Scales, perceptual attributes of color, additive and subtractive color systems, CIE color systems, CIELab, CIExyY, CIELuv, CIELch, concept of standard observer 1931 and 1964, standard illuminant, color constancy and color appearance models CIECAM02

Unit IV: Color Measuring Instruments **[6 hours]**

Fundamental principles of color measurement systems, color charts, color reference catalogues, Color measuring instruments, structure and variations of densitometers, tri-stimulus colorimeters, spectrophotometers, spectroradiometers, The measurement condition used (M0, M1, M2, M3) illuminating light, viewing geometry, purpose and use of each instrument, gloss meters

Unit V: Color Tolerance and Color Difference Equations **[6 hours]**

Visual color evaluation, standardized illuminating and viewing conditions, instrumental colour assessment, concept of color deviation and equations CIE 1976, CIE 1994, CIE 2000, CMC 1:1, CMC 2:1, acceptability vs perceptibility issue, color tolerances, color processing s/w MATLAB

Unit VI: Colorants and substrates **[6 hours]**

Dyes verses Pigment, Classification of colorants, The color index international, special colorants-Fluorescents and Flakes, Metamerism : Cause of metamerism, Metamerism Types, Metamerism Index, Spectral match, Metameric match, Types of metamerism, Color inconstancy; Understanding Kubelka Munk Theory, Role and Application of KM theory for color matching, Producing colors: Color mixing laws, Visual based color matching, Instrumental based color matching.

Guidelines for Laboratory Conduction

1. Students should write the journal in own handwriting with either black or blue pen.
2. Handwriting and Figures must be neat and clean.
3. Journal must contain certificate indicating name of the institute, student, department,
4. Subject, Number of Experiments completed, Signatures of staff, HOD, Principal.
5. Index must contain serial number, title of the experiment, page number and the signature of staff along with date.

6. Put one blank page in between two experiments and mention experiment number, date and title of the experiment in separate line.

Guidelines for Laboratory Conduction

1. Check for the electrical connections before starting up and end of the practical.
2. Do the calibration of equipment before the sample measurement.
3. Shut down the computer system after the end of practical.
4. Do the logbook entry before leaving the lab.
5. Write the experiment in the journal and get it checked within a week.

Term Work:

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

1. Calculate Hue error and gray error for coated and uncoated substrate.
2. Study the effect of Printing Sequence on two color and three color Trapping.
3. Find out the Gray balance for given substrate.
4. Calculate CIE tri-stimulus values X, Y, Z for given patches using Excel.
5. Study the effect of different Illuminants on CIE color Co-ordinates.
6. Perform the visual color assessment for measuring color difference.
7. Perform the Instrumental color assessment for calculating color difference.
8. Set an Instrumental color tolerance from Instrumental and Visual data.
9. Introduction to color processing software: MATLAB.
10. Study an application of MATLAB for color measurement.

Text Books:

[T1] Roy S. Berns (2000), Billmeyer and Saltzman's Principles of Color Technology, 3rd Edition, John Wiley & Sons, New York.

[T2] Phil Green, (1999), Understanding Digital Color, Second Edition, GATF Press.

[T3] John A. C. Yule, Gray G. Field, (2001), Principles of Color Reproduction, 2nd Revised Edition, GATF Press

Reference Books:

[R1] Gray G. Field, (1998), Color & its Reproduction, GATF Foundation, Pittsburgh.

[R2] Hunt, R. W. G. and Pointer, M. R. (2011) Measuring colour (4th edition). John Wiley & Sons.

[R3} Green, P. J. and MacDonald, L. W. (2002) (eds) Colour engineering. John Wiley & Sons.

[R4] R.W.G Hunt, (2004), The Reproduction of Color, ISBN: 978-0-470-02425-6, Sixth Edition, John Wiley & sons

[R5] Roy S. Berns, (2019), Billmeyer and Saltzman's Principles of Color Technology, John Wiley & sons, A Wiley Inter Science Publication.

Unit	Text Books	Reference Books
Unit I	T1, T2	R1, R3
Unit II	T1, T2	R2
Unit III	T2	R1, R2
Unit IV	T1	R1, R2
Unit V	T1	R2, R3
Unit VI	T1, T2	R2, R3

(308284) Ink Technology

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

Prerequisites: Engineering Sciences I and II, Material Science

Course Objectives:

1. To analyze pigments properties, importance of additives, Solvent and resin in printing ink and their effect on printability.
2. To differentiate types of printing inks for different printing process and for various printing application.
3. To analyze rheology of printing inks and their effect on printability.
4. To understand different methods of ink drying
5. To formulate printing inks for various printing process.
6. To evaluate quality of inks for the processes based on standards for food and non-food applications.

Course Outcomes:

1. To evaluate effect of pigments properties, additives, solvent and resin on printability
2. To differentiate printing inks based on printing process and their end use application.
3. To analyze parameters affecting ink Rheology and effect of ink rheology onprintability.
4. To Understand ink drying mechanism and different methods of ink drying
5. To prepare formulation of inks for various application.
6. To test the quality control parameters for ink and their raw material.

Unit 1: Introduction to Printing Inks and Ink ingredients [6 hours]

Difference between Paints and Inks; Dyes & Pigments; Elements of inks: Types of Pigments: Organic pigment, Inorganic pigment, Extenders, Chemistry and Technology, Pigment properties; Additives: Wetting and dispersing agents, Viscosity controller, Dryers, Flow and leveling agents, Anti-foam, Adhesion promoter, UV Stabilizers, Plasticizers, Waxes, Surfactants, Antioxidants etc; Solvents used for ink manufacturing, Solvent classification, characteristics, uses and application; Resins : Chemistry and Technology of Natural resins, Synthetic resins and their application.

Unit 2: Different types of Printing Inks **[6 hours]**

Classification of Inks based on Printing Processes such as Lithography, Letterpress, Gravure, Flexographic, Screen, inkjet, Photostat copier, their merits and demerits. Specialty Inks such as Metallic inks; security and special effect printing inks, Thermo graphic, Scented, Fluorescent Inks, reverse lamination and surface application.

Unit 3: Rheology of Printing Inks **[6 hours]**

Basic understanding of Rheology, Shear Flow, Shear Rate, Shear Stress, Newtonian fluids, non-Newtonian fluids , Shear Thinning Liquids, Shear Thickening Liquids, Thixotropy of Ink, Visco-Elasticity, loss modulus and elastic modulus , Behavior of Inks on machines; Storage stability of Inks, Factors that have effect on Rheological Behavior of Printing Ink, Influence of Ink Rheology on Printing Quality, Study of Viscometer and rheometer.

Unit 4: Setting and Drying of Printing Inks **[6 hours]**

Setting of printing ink; Methods of Ink Drying: Radiation curable systems, Infra-red Curing, Ultra-Violet Curing, Micro-Wave and Radio-Frequency Drying, Electron-Beam Curing, Radiation Curable Equipments and Future trends.

Unit 5: Formulation and Manufacturing of Printing Inks **[6 hours]**

Formulation of Inks based on Printing Process and for various substrates. Factors to be considered while formulating printing inks, Base ink system, Extenders, Heavy ink systems, Standard ink system, Manufacturing techniques for various printing process inks, Preparation of varnishes, Ink Pigment Dispersion Process: Wetting of the Pigment Particles, Breakdown of the Pigment Particles, Stabilization of the Dispersion; The influence of various process parameters on the pigment dispersion. Mixing and milling equipments: Three roll mill, Bead mill, Attritor mill, Grinding Media, Handling, transportation and storage of ink.

Unit 6: Testing and Quality Control of Inks **[6 hours]**

Testing of raw materials: pigments, resins: FTIR, Ink component analysis by GC head space, HPLC, GC-MS, ICP-OES; Ink Tests and Measurement: Ink proofing, Tests for color, shade & strength, viscosity, solids content, ink compatibility, ink adhesion test, COF, Rub resistance, Gloss, Mottle, Wet and Dry Abrasion resistance, Testing methods for printing smoothness, ink receptivity, picking and run ability, Quality control for Paste and Liquid inks. Environmental laws for print industry, VOC & its significance in printing inks, Hazardous waste. Environmental effects and control mechanism, Trouble shooting in various printing processes, BIS & Brand owner and others

standard for Printing Ink for Food Packaging and others Packaging

Guidelines for Student's Lab Journal

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

Guidelines for Laboratory Conduction

1. Check for the electrical connections before start up and end of the practical's.
2. Write the experiment in the journal and get it checked within a week.
3. Apron is compulsory while conducting practical's in ink testing laboratory.
4. Metal objects are not allowed while handling the milling machine.
5. Do not inhale the solvents used for inks.
6. Store the solvents in a cool dark place

Term Work

Term Work shall consist of following ten experiments:

1. Calculate the Density of liquid and Paste Ink.
2. Calculate the water pick up capacity of offset paste ink.
3. Analyze the effect of emulsification on flow of offset paste ink.
4. Evaluation of relation between viscosity and printability of gravure inks.
5. Understand an Ink Dispersion process.
6. Analyze the effect of dispersion on Transparency of Ink.
7. Analyze the effect of Ink Ingredient on gloss of inks.
8. Evaluation of relation between Ink film thickness and print quality for Flexo inks.
9. To identify the solvents through their odor.
10. Measure the solid content of liquid inks and effect of solid content on printability property.

Text Books:

[T1] R. H. Leach & R. J. Pierce, the Printing Ink Manual, Fifth Addition (2007), Published by Springer

[T2] Apps E. A, Printing Ink Technology, First Edition (1958), Leonard Hill (Books) Ltd. Efen Street, London

[T3] Chris H. Williams, Printing Ink Technology, Third Edition (2001), Pira International

[T4] Dr. Nelson R. Eldered, What Printer Should Know About Ink, Third Edition, (2001), Published by GATF Press, Pittsburgh,

Reference Books:

[R1] Laden P. O, 'Chemistry & Technology of Water based Inks', 1st Edition (1997),
Published by Blackie Academic & Professional

[R2] Ronald E. Todd, Leatherhead, Second Edition (1996), Printing Inks, Pira International

Unit	Text Books	Reference Books
Unit 1	T1, T2	R1, R2
Unit 2	T1, T2, T3	R1, R2
Unit 3	T3, T4	R1, R2
Unit 4	T1, T2, T3	R2
Unit 5	T2, T3	R1, R2
Unit 6	T1, T2, T3, T4	R2

(308285) Advanced Print Layout Design

Teaching Scheme	Credits	Examination Scheme
Practical: 02 Hrs. / week	01	Practical: 25 Marks

Prerequisites: Print & Package Layout Design, Print Production techniques

Course Objectives:

1. Understand basics of layout planning.
2. Understand layout planning for conventional sheetfed and webfed presses.
3. Understand layout planning for digital segment.
4. Understand imposition for bound and unbound jobs.
5. Understand ganging of different size jobs – labels, cartons and boxes.
6. Understand layout planning for large format printing segment.

Course Outcomes:

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

1. Apply basic concept of Layout planning.
2. Apply basic concept of layout for conventional printing presses.
3. Apply basic concept of layout for digital printing segment.
4. Design imposition schemes for bound and unbound jobs.
5. Create a layout for different size jobs.
6. Apply basic concept of layout for large format printing

Guidelines for Student's Lab Journal

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

Guidelines for Laboratory Conduction:

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

Term Work:

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

1. Overview of layout planning
2. Design 4 page brochure layout in A4 size
3. Layout planning for bound jobs for sheetfed presses
4. Layout planning for digital webfed presses
5. Layout planning for commercial jobs.
6. Layout planning for digital printing presses – Business cards, post cards, Mail orders etc
7. Layout planning for large format printing segment
8. Layout planning for optimization of sheet - Ganging
9. Layout planning & ganging of die-cut labels job
10. Layout planning & ganging of die-cut carton & boxes

References:

[R1] The Chicago Manual of Style, 17th edition, University of Chicago Press, (2017)

[R2] Hints of Imposition, an illustrated Guide for Printer and Pressman by Tom Burton Williams, Hardpress Publishing (2012)

[R3] Handbook of Print Media by Helmut Kipphan, Springer (2001)

(308286 A) Elective - I: Cyber Security

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

Pre-requisites: Programming and Problem Solving, Printing Digital Electronics

Course Objectives:

The objectives of the Course are:

1. Understand the basic Cyber security.
2. Understand database, email and file security.
3. Understand various types of Virus attacks and Logic Bomb.
4. Understand Steganography in Digital images.
5. Understand Intellectual Property Rights.
6. Understand cyber laws and its importance.

Course Outcomes:

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

1. Analyze the need and importance of cyber security in Printing and Packaging industry.
2. Apply the principals of database, email and file security.
3. Identify different virus attacks and logic bombs.
4. Identify the digital image with Steganography.
5. Categorization of Intellectual Property Rights.
6. Apply cyber laws in Information technology world.

Unit I: Basics of Cyber Security **[6 hours]**

Information Security Definition and Concepts, Overview of Security Threats , Goals of Security, Limitations and Challenges in cyber security, Types of Security attacks, Network Security, Malicious Codes, Intrusion detection systems, Hacking Techniques, Password cracking , Insecure Network Connections ,Concept of Firewall and Security.

Unit II: Database & File Security **[6 hours]**

Introduction to database security, Various attacks on a database, How can database be setup in a secure way, Benefits of building a secure database for printing and packaging industry, Different

ways of database security, Attacks on the database, threats, Introduction to email and file security, Phishing attacks, Key loggers, Trojan, malware, how to keep email and files on email safe.

Unit III: Virus attack and Logic bomb **[6 hours]**

Introduction to ransom ware/virus and how it attacks PC, Mobile and other devices. Types of viruses, How Virus can damage corporate world, How to avoid getting breached with a virus attack. Introduction to Logic Bombs, Difference between a logic bomb and virus, Working of logic bombs, Triggering of logic bombs. Preventing and diffusing a logic bomb. Threat level.

Unit IV: Digital Images (Steganography) **[6 hours]**

What is Steganography, History of Data hiding, Steganographic security, Data hiding in raw images, BMP images, palette (GIF) images, and in JPEG images, Advantages and disadvantages of Steganography.

Unit V: Intellectual Property Rights **[6 hours]**

Basic Principles and Acquisition of Intellectual Property Rights: Philosophical Aspects of Intellectual Property Laws. Basic Principles of Patent Law, Patent Application procedure, Drafting of a Patent Specification, Understanding Copyright Law, Basic Principles of Trade Mark, Basic Principles of Design Rights, International Background of Intellectual Property Information Technology Related Intellectual Property Rights

Unit VI: Introduction to Cyber Laws **[6 hours]**

Introduction, Definition and origin, Cybercrime and Information security, Classification of Cybercrimes, The legal perspectives- Indian perspective, Global perspective, Categories of Cybercrime, Types of Attacks, a Social Engineering, Cyber stalking, Cloud Computing and Cybercrime.

Text Books:

[T1] William Stallings, Computer Security: Principles and Practices, Pearson 6th Ed, ISBN: 978-0-13-335469-0

[T2] Nina Godbole, Sunit Belapure , Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiely India Pvt.Ltd, ISBN- 978-81-265-2179-1

[T3] Bernard Menezes, Network Security and Cryptography, Cengage Learning, ISBN-978-81-315-1349-1

[T4] Dr. V.K. Pachghare, Cryptography and Information security, PHI, Second edition, ISBN-978-81-203-5082-3

Reference Books:

[R1] Caryn R. Leland Allworth Press (1995), A Professional's Guide to Licensing and Royalty Agreements

[R2] Nihad Hassan, Rami Hijazi, Apress. (2017), Digital Privacy and Security Using Windows: A Practical Guide

[R3] Nina Gobole (2008), Information Systems Security: Security Management, Metrics, Frameworks and Best Practices (With CD)

[R4] Stefan Katzenbeisser and Fabien Petitcolas (1999), Information Hiding, Techniques for Steganography and Digital Watermarking,"

Unit	**Text Books**	**Reference Books**
Unit I	T1,T2	R1, R2, R3
Unit II	T1	R2
Unit III	T1	R1, R2
Unit IV	T3, T4	R4
Unit V	T2, T3,	R1
Unit VI	T1, T2, T3, T4	R1

(308286 B) Elective - I: Wood, Glass and Metal Based Packaging

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

Pre-requisites: Material Science in Printing and Packaging and Introduction to Packaging Concepts

Course Objectives:

The objectives of the Course are:

1. Attain the basic technical knowledge of various materials used for wood packaging.
2. Know the considerations for wood-based packaging.
3. Identify the requirements for glass packaging.
4. Learn the method of testing on glass scientifically.
5. Justify the use of metals in packaging industry.
6. Understand metal drums and closures for packaging.

Course Outcomes:

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

1. Apply the knowledge on application of wood in packaging industry.
2. Understand the parameters to be considered for designing wooden crate.
3. Evaluate the parameters in glass packaging
4. Understand the various methods and instruments used for glass material analysis
5. Apply the knowledge to use metals as packaging materials
6. Understand the importance of metal drums and closures for packaging.

Unit I: Wood Based Packaging **[6 hours]**

Introduction, Design Factors, Quality and Classification of Timber, Effect of Moisture on Wood Properties, Physical and Mechanical Properties of Timber, Considerations of Wooden Container such as Form and Size of each component, Thickness of components, size, spacing of nails, number of planks in a shook, types of joints, style of container etc.

Unit II: Consideration for Box Design **[6 hours]**

Types of Loads, Plywood Boxes - Battened Construction, Timber species suitable for manufacturing of packing cases, wooden box styles, Crates, Selection of crate, Size and Weight, Degree of Protection, Types of Bases, Handling of crates, difference between plywood and normal

wood, ISPM-15 Regulation and process, different types of wooden pallets and its construction. Wooden pallets types A, B, C, ISTA 3B testing for Wood pallets,

Unit III: Glass Packaging **[6 hours]**

Introduction, Types of Glass, Properties, Glass Manufacturing, Applications, Advantages, Standards, Glass Containers, Parameters in Glass Containers, Modern trends in Glass Packaging

Unit IV: Testing of Glass **[6 hours]**

Physical Testing: Annealing Test, Thermal Shock, Pressure Test, Density Test, Gauging,
Chemical Testing: USP Tests

Unit V: Metal Containers **[6 hours]**

Metal Containers: Manufacture of Aluminum Foil, Properties and Applications, Tin Plate Characteristics, Properties, Manufacture of Black Plate, Advantages and Disadvantages of Metal Based Packaging, Modern Trends in Metal Based Packaging, Tin canister packaging used in food industry. Metals box used in Industrial packaging in automotive sector as returnable packaging, Metal box used for Lithium-Ion packaging used in electronic goods and EV, Testing protocols for Hazmat packaging based on United nation (UN) protocol.

Unit VI: Drums and Closure **[6 hours]**

GI Drums, Oil Drums, Types of Drums, Manufacture of Drums, Quality Control, Closures, Types, Parts, Essential Functions, Recent Developments

Reference Books:

[R1] Diana Twede (Author), Susan E. M. Selke (Author), Donatien-Pascal Kamdem (Author), David Shires (2015), Cartons, Crates and Corrugated Board: Handbook of Paper and Wood Packaging Technology, DEStech Publications, Inc; Second edition

[R2] Walter Soroka and CPP (2009), Fundamentals of Packaging Technology, Institute of Packaging Professionals; second edition, Fourth Edition

[R3] Walter Soroka and CPP (2008), Illustrated Glossary of Packaging Terminology, Institute of Packaging Professionals; second edition

[R4] P. Grayhurst, Packaging Technology, British Glass, UK

Important URLs:

[1] https://ispm15.com/

[2] https://www.ippc.int/static/media/files/publication/en/2018/06/ISPM_15_2018_En_WoodPackaging_2018-05-16_PostCPM13_Rev_Annex1and2_gUhtMXs.pdf

[3] https://www.palletcentral.com/

[4] GMA Pallet Grades: How and Why Are Pallets Graded? - iGPS Logistics, LLC

Unit	Text Books	Reference Books
Unit I		1, 2, 3
Unit II		2, 3
Unit III		4
Unit IV		4
Unit V		1,3, 4
Unit VI		1,3,4

(308286 C) Elective-I: Engineering Ethics

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

Pre-requisites: NA

Course Objectives:

The objectives of the Course are:

1. Understand human values and basics of ethics in engineering.
2. Understand design of ethics for engineers as managers, leaders
3. Understand theories of ethics
4. Learn use of mesh and role of thread in screen printing.
5. Understand academic and research ethics
6. Understand formulation and solution of cases.

Course Outcomes:

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

1. Understand human values and describe ethics
2. Explain ethical theories and its uses
3. Apply ethics as a design for engineers to address issues
4. Analyse code of conduct and its sections
5. Understand components of academic and research ethics
6. Formulate and Evaluate the cases

Unit I: Introduction to Engineering Ethics and Human Values [6 hours]

Introduction to ethical reasoning and engineering ethics, its importance in engineering, how ethics is used in engineering, the relevance of ethics for engineers. Personal and professional ethics, Professional practice in engineering, central professional responsibilities of engineers Workplace rights and responsibilities**.** Human Values: Love, Peace, Truth, Right Conduct and Nonviolence. Features: Universal (Needs to be applicable to all human beings), Rational (Appeal to human reasoning), Natural and Verifiable, all encompassing- cover all levels (Individual, Family and Society), Leading to harmony

Unit II: Ethical Theories **[6 hours]**

Consequential and non consequential ethics. Utilitarian ethic theory, Golden mean theory, Duty based ethics theory, Rights based ethics theory. Formulation and uses of ethical theories

Unit III: Ethics as a Design **[6 hours]**

Ethics as a design doing justice to moral problems, Intellectual property rights and ethics , Trade related intellectual property rights, Rights in India, Environmental ethics and spirituality, Engineering as social experimentation, Engineers as managers, consultants and leaders, Responsibilities of engineers

Unit IV: Code of Conduct **[6 hours]**

Role of codes of conduct in engineering, Ethical conduct of engineers, Professional Code, Corporate code, Leadership styles and ethical conduct, Key sections for code of ethics. Five codes of ethics: Integrity, Objectivity, Professional competence, Confidentiality, Professional behavior. Difference between code of ethics and code of conduct.

Unit V: Academic Ethics and Research ethics **[6 hours]**

Plagiarism, credit to author, Courtesy, copyright, licensing, creative commons, referencing, acknowledgement, Technical paper writing, Research ethics, ethical hacking

Unit VI: Formulation and Solution of moral problem **[6 hours]**

Case studies, Real life situation handling in printing industry. Solutions sought for different cases using ethical theories and code of conduct.

Text Books:

[T1] M. Govindrajan, S. Natrajan., V. S. Senthilkumar, (2004), Engineering Ethics, ISBN-10 : 9788120325784, ISBN-13: 978-8120325784, Prentice Hall India Learning Private Limited

[T2] Mike W. Martin, Chapman College, (2017), Ethics in Engineering, ISBN-10 : 9789339204457ISBN-13: 978-9339204457, Fourth edition; McGraw Hill Education

[T3] R. Subramanian, (2017), Professional Ethics, ISBN-10: 0199475075 ISBN-13: 978-0199475070, Second edition; Oxford University Press

Reference Books:

[R1] Steven K. Starrett, Ph.D., P.E., D.WRE; Amy L. Lara, Ph.D.; and Carlos Bertha, Ph.D., (2017), Engineering Ethics Real world case studies, ISBN (print): 9780784414675ISBN (PDF): 9780784480359, ASCE Press

[R2] Harris, (2017), Engineering Ethics: Concepts and Cases, ISBN: 9788131517291, 8131517292, 4th edition, Cengage

Unit	Text Books	Reference Books
Unit I	T1, T2	R1
Unit II	T1, T2, T3	R1
Unit III	T1, T2,	R1, R2
Unit IV	T1, T2, T3	R1, R2
Unit V	T1, T2, T3	R1, R2
Unit VI	-	R1, R2

(308287) Seminar

Teaching Scheme	Credits	Examination Scheme
Practical: 1 Hour/Week	01	Term Work: 50 marks

The seminar report shall be based on material, mainly collected and analyzed from research work in the field of printing published in technical and research journals (national and international). The report shall be about 20 pages of A4 size, including figures. The seminar report shall include a certificate, synopsis and references.

The presentation is expected to be in front of audience which must include two internal examiners one of them being the guide. Both examiners shall be University approved teachers. The distribution of marks shall be equally divided between the report and the oral presentation.

(308288) Audit Course

In addition to credits course, it is recommended that there should be audit course (non-credit course). The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided 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 following but not limited to)

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

Guidelines for Assessment (Any one or more of 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
308288-I	Six Sigma
308288-II	Corporate Branding

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

(308288 - I) Audit Course: Introduction to Six Sigma

Prerequisites: None

Course Objectives:

- To learn Six Sigma set of tools and techniques
- To understand improving production processes and eliminate defects,
- To learn qualitative and quantitative tools

Course Outcomes:

On completion of the course the learners will be able to

CO1: Communicate using Six Sigma concepts

CO2: Use the concept of a sigma level to evaluate the capability of a process or organization.

CO3: Understand and apply the five-step DMAIC model as a framework to organize process improvement activity

Course Contents:

1. Six Sigma and Organizational Goals
    A. Value of Six Sigma
    B. Organizational Drivers and Metrics
    C. Organizational Goals and Six Sigma Projects
2. Fundamentals of Lean and Six Sigma and their Applications
3. DMAIC (Define, Measure, Analyze, Improve, Control) and a number of qualitative and quantitative tools

Reference Books:

1. Kubiak, T. M., & Benbow, D. W. (2016). The certified six sigma black belt handbook. Quality Press.
2. Pande, P. S., Neuman, R. P., & Cavanaugh, R. R. (2014). Six Sigma way: How to maximize the impact of your change and improvement efforts. McGraw-Hill Education.

CO-PO Mapping:

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

(308288 - II) Audit Course: Corporate Branding

Prerequisites: None

Course Objectives:

- To understand what a brand is and how they can build successful ones
- To learn positioning and its importance to successful
- To understand consumer perception

Course Outcomes:

On completion of the course the learners will be able to

CO1: Understand the importance of branding and their value creation for their organizations.

CO2: Demonstrate an understanding of how to design and build a brand-driven organization.

CO3: Identify and create an effective brand positioning strategy**.**

Course Contents:

1. What is a brand and what is brand management?
2. Tools for marketing and branding strategy
3. The importance of consumer perception and behavior in branding
4. Brand Equity
5. Understanding consumer perception is crucial to determine a branding strategy.

Reference Books:

1. Blackett, T. & Boad, B. (Eds.). (1999). Co-Branding: The Science of Alliance. London: Macmillan.
2. Duncan, T., & Moriarty, S. (1997). Driving Brand Value: Using Integrated Marketing to Manage Profitable Stakeholder Relationships. New York.

CO-PO Mapping:

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

(308289) Flexo Printing Techniques

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

Pre-requisites: Introduction to Printing Processes

Course Objectives:

The objectives of the course are:

1. Compare between various methods of Flexography plate-making.
2. Explain negative requirements, mounting and de-mounting techniques, storage and handling of flexo plate and compute distortion of negative for flexo plate production.
3. Evaluate the relationship between flexo plate variables and printability.
4. Explain the Digital flexo plate-making and analyze different types of dots on flexo plates.
5. Identify different press configurations, inks for various flexo applications, compare conventional and shaft-less technology and explain modern trends in flexography.
6. Correlate between fountain and anilox parameters to printability.

Course Outcomes:

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

1. Distinguish different surface preparation methods for flexography.
2. Describe various pre-press requirements for flexo.
3. Evaluate the effect of flexo plate variables on printability.
4. Describe Digital flexo plate-making and compare between digital and conventional dot.
5. Categorize various types of flexo presses and advancements in flexography.
6. Evaluate the effect of ink metering parameters on flexo printability.

Unit 1: Surface Preparation for Flexo **[6 hours]**

Flexo artwork, Design considerations, Types of Flexo Plates, Processing of Rubber and Photopolymer plates, Comparison between Rubber and Photopolymer Plates, Processing machines, Safety regulations.

Unit 2: Requirements of Photopolymer Plates **[6 hours]**

Layout considerations, Specifications of negative, Distortion, Storage and Handling of raw and used plates, Mounting plates on and off the press, Advancements in plate mounting, De-mounting of plates from the cylinder.

Unit 3: Conventional Flexo Plates **[6 hours]**

Purpose and Effects of Back-exposure, Main exposure, Wash-out, Drying, Post-exposure and Finishing, Types of Wash-out Solvents, Standardization of Conventional Flexo Plate, Environmental concerns.

Unit 4: Digital Flexo Plates **[6 hours]**

Characteristics of Digital Flexo Plates, Digital Workflow, Types of images, Imaging of CTP, Ablation technique, Digital Engraving, Types of lasers used, Types of dots generated on flexo plate, Solvent based and Solvent-less Flexo plates, Effect of varying dots on printability.

Unit 5: Flexography Process **[6 hours]**

Introduction, Types of Flexo Press - Stack, Inline and CI, Press Configurations, Sections of a Flexo Press, Flexo Products and application, Types of dryers-UV, EB, Hot Air and Solvent, Efficiency of dryer, Drying rates, Types of Tapes and its impact on Print Quality.

Unit 6: Ink Metering for Flexography **[6 hours]**

Fountain and Anilox Roller for Flexography, Purpose of Fountain and Anilox Roller, Fountain roller bases and specifications, Role of anilox in Flexo, Factors affecting anilox selection, Anilox roller construction, Anilox coverings-Chrome and Ceramic, Cell configurations, Anilox cleaning, Storage and Maintenance, Anilox Defects, Doctor Blades for Narrow and Wide-Web Flexo presses.

Guidelines for Student's Lab Journal

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

Guidelines for Laboratory Conduction

1. Check for the electrical connections before start up and end of the practicals.
2. Wear apron while performing the practicals in flexo lab.
3. Direct contact of metal objects with cylinders and plates should be avoided.
4. Do not inhale the solvents used for plate processing and inks.
5. Store the solvents in cool dark place.
6. Write the experiment in the journal and get it checked within a week.

Term Work

Term Work shall consist of following ten experiments:

1. Introduction to Flexo Machine principles and plate making machine.
2. Performing Wash-out Test on 2.84 mm photopolymer plate.
3. Performing Back-Exposure Test on 2.84 mm photopolymer plate.
4. Performing Main-Exposure, Post –Exposure and Light Finishing Test on 2.84 mm photopolymer plate.
5. Preparation of PP plate with a given negative.
6. Evaluation of Plate Dot Structure
7. Analysis of Anilox Roller at varying screen ruling
8. Cell Measurement of Anilox Roller
9. Evaluation of Anilox Cell Structures
10. Analysis of a Flexo printed Image.

Text Books:

[T1] D. C. Mulvihill, (1985), Flexography Primer, GATF and Foundation of FTA.

[T2] The Beginner Flexographer, (1993), Foundation of Flexographic Technical Association

[T3] Flexography Principles and Practices, (1997), 4rth edition, Foundation of FTA

[T4] P. Laden, (1996), Chemistry and Technology of Water based Inks, Blackie Academic and Professional.

Reference Books:

[R1] Flexography Principles and Practices, (1999), 5th edition, Foundation of FTA

[R2] Anthony White, (1992), High Quality Flexography, Pira International.

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

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

(308290) Color Management

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: 25 Marks

Pre-requisites: Color Basics

Course Objectives:

The objectives of the Course are:

1. To understand the need and concept of color management.
2. To create an input profile and its application.
3. To analyze the factors for calibrating monitor and develop monitor profile.
4. To analyze the variables for calibrating the printer and generate a printer profile.
5. Generate a test chart and create a device link.
6. To evaluate the condition for visual color assessment.

Course Outcomes:

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

1. To understand need and importance of color management in printing.
2. To create and apply Input Device profile.
3. To analyze the factors for calibrating monitor and develop monitor profile.
4. To identify the variables for calibrating the printer and generate a printer profile.
5. To create a test chart and develop a device link.
6. To set the condition for visual color assessment and perform the assessment.

Unit I: Basics of Printing **[6 hours]**

Need for color correction in printing and graphic arts. Conventional color correction systems, grey balance and tone reproduction. Concept of color management systems, close loop color management vs open architecture color management. Device dependent (conventional) color workflow vs device independent (modern) color workflow. International Color Consortium (ICC) architecture to create color profiles. Different types of profiles, color transformation, gamut mapping, color management module (CMM), profile making software. Lab vs RGB vs CMYK color profiles, color management in Windows vs Apple Macintosh.

Unit II: Color Management for Input Devices **[6 hours]**

What are input devices profiles, Role of Input Profile, Profile tags for Input Devices, Reference file for Input device, 4C's for Digital Camera, RGB Color Space profile, Processing of Raw camera files, Concept of Digital Negative- DNG, Making a Digital camera profile, 4C's for Scanner, Test Charts for Scanner, Making a scanner profile, Application of Input profiles.

Unit III: Color Management for Monitor **[6 hours]**

Concept of color monitor Profiling, color monitor basics, basic calibration of monitors considering ambient lighting, creating monitor profile, importance of video cards and Lookup tables, application of monitor profile, concept of Soft proofing, conditions required for soft proofing.

Unit IV: Color Management for Printers **[6 hours]**

Concept of Printer profile, Four C's for Printer, Test charts for Printer, Profile tags for Printer, Calibration process for Offset, Flexo and Gravure and digital printer, Variables for gravure, flexo, offset, digital printer for Calibration, Making a Printer profiles, Rendering indent: Perceptual rendering indent, Relative & Absolute colorimetric intent, Saturation intent, Colorful, Chroma Plus, Gamut mapping, Logo Classic, Application of Printer Profile.

Unit V: Device Link and Hard Proofing **[6 hours]**

Proof to Press color management, 4C's for Proofer, Proofer calibration, Proofer Profiling, Concept of Hard Proof, Hard proofing process, Spot color Printing and Proofing , Inkjet proofing with Expanded Gamut Inks, Need of Device Link profile, Color Conversion through Device link Profile, Advantages and Disadvantages of Device Link

Unit VI: Visual Color Evaluation **[6 hours]**

Concept of Visual Colour Evaluation, viewing conditions for evaluation, contrast setting on greyscale, grey balance setting, tone reproduction curves, visual evaluation for complex images. Role of halftones in colour reproduction. Profile verification and corrections.

Guidelines for Laboratory Conduction

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

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

Term Work:

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

1. Measure a scanner test chart and create a scanner profile.
2. Create a profile for Digital Camera.
3. Calibrate the monitor and create a monitor profile.
4. Generate and Measure a Printer test chart and develop an ICC printer profile.
5. Perform proofer calibration for a given media.
6. Develop a Soft proof and Hard proof.
7. Study the effect of Absolute and Relative colorimetric intent used for proofing.
8. Generate a test chart for spot color and create a profile for spot color.
9. Create CMYK-to-CMYK Device Link Profile.
10. Edit the printer profile to improve color reproduction.

Text Books:

[T1] R.W.G Hunt, (2004), The Reproduction of Color, ISBN: 978-0-470-02425-6, Sixth Edition, John Wiley & Sons

[T2} Green, P. J. and MacDonald, L. W. (2002) (eds) Colour engineering. John Wiley & Sons.

[T3] Fraser, B., Murphy, C. and Bunting, F. (2004) Real world color management Berkely, CA: Peachpit Press

[T4] E.P. Danger, (1987), The Color Handbook, Gower Publication, England.

[T5] Richard M. Adams, Abhay Sharma and Joseph J. Suffoletto, (2008), Color Management Handbook - A Practical Guide, 1st Edition, PIA/GATF Press, United States of America.

Reference Books:

[R1] Roy S. Berns, (2019), Billmeyer and Saltzman's Principles of Color Technology, Fourth Edition, John Wiley & sons, A Wiley Inter Science Publication

[R2] Abhay Sharma, (2018), Understanding Color Management, ISBN: 978-1-119-22363-4, 2nd Edition, John Wiley & sons, A Wiley Inter Science Publication

[R3] Sharma, G. (2002) Digital Color Imaging Handbook, Boca Raton, FL: CRC Press LLC

[R4] Adams, Richard M., Weisberg, Joshua B., Practical Guide to Color Management, GATF Press.

Unit	Text Books	Reference Books
Unit I	T1, T2	R1
Unit II	T1, T3	R2
Unit III	T3	R2
Unit IV	T3	R2
Unit V	T2, T3	R2, R3
Unit VI	T2, T3	R2, R3

(408291) Design of Experiments

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

Pre-requisites: Print Statistics

Course Objectives:

The objectives of the Course are:

1. Understand the basic principles of Experimental Design and Problem Definition
2. Analyze Types of Data - Discrete and Continuous, Sampling and sampling distribution.
3. Formulate Hypothesis and Errors
4. Estimate factors and levels for a defined experiment
5. Implement various Experimental Design
6. Analyze Experimental Design with Graphical tools

Course Outcomes:

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

1. Understand Basics of Experiential Design and Factors
2. Distinguish the types of data and apply Sampling Plan for data analysis
3. Set and Test the Hypothesis for a given problem and identify Errors in an Experiment
4. Evaluate Factors and Levels for Experimental Design
5. Apply Design of Experiment and ANOVA
6. Evaluate Experimental Design with Graphical tools such as Histograms, Charts and Cause Effect diagrams

Unit 1: Introduction to Experimental Design [6 hours]

Definition of experiments, Strategy of Experimentation, Historical overview, Basic principles of DOE: Replication, Randomization and Blocking, Advantages & applications of DOE, Common terminologies used in DOE; Guidelines for Designing Experiments: problem definition, choice of factors & levels, selection of response variables, experimental design, performing experiments, Statistical analysis of data, Conclusions

Unit 2: Basic Statistical Concepts and comparison of entities **[6 hours]**

Understanding Basic concepts: mean, median, variance, run, factors, responses, replicate, noise, experimental error, Types of Data - Discrete and Continuous, Sampling and sampling distribution, Introduction to Variation, Sigma levels, Measurement System Evaluation (MSE)

Unit 3: Hypothesis Testing **[6 hours]**

Tests of hypothesis: Null and Alternative Hypothesis, Type I and Type II error, p-value in hypothesis testing, t- test, F-test, chi-square test, sample size, Confidence intervals

Unit 4: Analysis of Variance **[6 hours]**

Factor, levels, treatment, experimental unit, types of experimental designs, one way ANOVA and two way ANOVA, sum of squares, degrees of freedom, test statistics, correlation, covariance, Normality test

Unit 5: Factorial Designs **[6 hours]**

Introduction to fractorial designs, 2 level factorial designs, 2^k factorial designs, Fractional factorial designs, Plackett-Burman Designs, General full factorial design,

Unit 6: Quality Planning Tools **[6 hours]**

Histogram, Run chart, Pareto chart, Cause and Effect diagram, Symmetry plot, Multi-Vari chart, Scatter plot, Box plot, Line plot and Probability Distribution plot, Control Chart, Response Optimizer, Process Capability

Guidelines for Student's Lab Journal

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

Term Work

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

1. Case studies to understand basic concepts of experimental designs with advantages and limitations of one factor at a time (OFAT)
2. Conduction of Design of a full factorial experiment at 2-levels of screen mesh and squeeze hardness with appropriate sampling plan.
3. Analysis of 2-levels of screen meshes and squeeze hardness for the response print density with Main Effects and Interaction Plots by matrix method only
4. Analysis of 2-levels of screen meshes and squeeze hardness for the response dot gain with Main Effects and Interaction Plots by matrix method only
5. Performing Measurement System Evaluation of a Densitometer.
6. Setting and Testing of Hypothesis with calculations of p-value, null & alternative hypothesis for print density and dot gain without any statistical software.
7. Calculation of Sum of squares, F-value, p-value, R^2 of ANOVA Table for print density without any statistical software.
8. Calculation of Sum of squares, F-value, p-value, R^2 of ANOVA for dot gain without any statistical software.
9. Designing an experiment with 2 replicates of screen ruling, ink viscosity and dot structure of any printing process for the response print density and dot gain by analyzing Main Effect, Interaction, ANOVA and Lack-of-fit test in statistical software.
10. Identifying the optimized run for print density and dot gain from Response Optimization with the factors such as screen ruling, ink viscosity and dot structure in statistical software.

Text Books:

[T1] M.D. Morris, (2011), Design of Experiments - An introduction based on linear models, CRC Press.

[T2] G. Casella, (2008), Statistical Design, Springer.

Reference Books:

[R1] Douglas C. Montgomery, (2001), Design and Analysis of Experiments, 5th Edition, John Wiley and Sons Inc

[R2] D. D. Joshi (1987), Linear Estimation and Design of Experiments. Wiley Eastern

[R3] G. M. Smith, (2004), Statistical Process Control and Quality Improvement. 5th Edition, Prentice Hall, NJ, USA

[R4] H. Sahai and M.I. Ageel, (2001), The analysis of variance-Fixed, random and mixed models, Springer.

[R5] David Silverman, (2000), Interpreting Qualitative Data, 5th Edition, Sage Publishing.

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

(308292) Advanced Package Layout Design

Teaching Scheme	Credits	Examination Scheme
Practical: 02 Hrs. / week	01	Term Work: 25 Marks

Prerequisites: Print and Package Layout Design, Print Production Techniques

Course Objectives:

1. Understand basic tools, commands of Package design software.
2. Design lay-outing for cartons and corrugated boxes.
3. Understand folding styles.
4. Understand raw material for carton and corrugated boxes.
5. Understand 3D viewing techniques for package design
6. Develop Structural Design for various Packages

Course Outcomes:

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

1. Implement basic tools, commands in Package Design s/w for print and packaging applications.
2. Apply basic concept to design Cartons and Corrugated boxes.
3. Apply different folding styles.
4. Analyze change in design for variety of raw material thickness.
5. Design 3D model of a package.
6. Create Structural Design for Carton from scratch

Guidelines for Student's Lab Journal

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

Guidelines for Laboratory Conduction:

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

Term Work:

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

1. Introduction to Package Design software.
2. Design a carton using editing tools from scratch
3. Design Crash lock folding carton
4. Design Snap lock folding carton
5. Design Ready Glued Corrugated carton
6. Design Slotted Corrugated carton
7. Using the Keyline, create a product package design
8. Create a print layout using imposition on various machine sizes
9. Create a 3D model of Universal carton
10. Create and export design as a single PDF

References:

[R1] Marianne R. Klimchuk, Sandra A. Krasovec, (2013), Packaging Design: Successful Product Branding From Concept to Shelf, 2nd Edition by

[R2] Advanced Packaging (Structural Package Design), (2010) by Pepin Press

[R3] John Silva, Steven DuPuis (2011), Package Design Workbook: The Art and Science of Successful Packaging by

(308293 A) Elective II: Maintenance Management of Printing Machines

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.

Course Objectives:

The objectives of the Course are:

1. Understand the principles of maintenance management.
2. Understand steps to implement Preventive Maintenance.
3. Understand steps to implement Corrective Maintenance.
4. Understand the benefits of safe and protective maintenance environment.
5. Study various proactive and predictive methods of maintenance.
6. Study breakdown and replacement type of maintenance.

Course Outcomes:

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

1. Learn the tools of maintenance management.
2. Comprehend the needs of preventive maintenance printing machines.
3. Comprehend the methods of corrective maintenance in printing machines.
4. Apply quality and safety measures in maintenance of printing machines and equipment.
5. Apply measures for predictive maintenance.
6. Evaluate breakdown and replacement theories.

Unit I: Aspects of Maintenance Management [6 hours]

Definition, Maintenance Purpose, Maintenance Function, Maintenance Benefits, Maintenance Objectives and Responsibilities, Basic concepts for maintenance organization, Types of maintenance organizations, Evaluation Questions for Maintenance Managers.

Unit II: Maintenance Strategies and Types of Maintenance [6 hours]

Definition, Basis of selecting maintenance strategies, Evolution of maintenance strategies, Improvement of maintenance strategies. Types of Failure, Types of Maintenance – Planned/Unplanned, Preventive, Corrective, Predictive, Breakdown.

Unit III: Preventive and Corrective Maintenance [6 hours]

Introduction, Preventive Maintenance Elements, Plant Characteristics in Need of a PM and CM Program, and a Principle for Selecting Items for PM and CM, Important Steps for Establishing a PM and CM Program, Lubricants and lubrication.

Unit IV: Condition Monitoring [6 hours]

Condition Based Maintenance using different measurement techniques such as Thermography, Vibration test, Air Leak detector etc. Data mining techniques on data to help identify behavior patterns, accurate early detection of faults in machine, Predictive maintenance by analysis of electrical current and temperature parameters.

Unit V: Effectiveness Performance Evaluation and Safety in Maintenance [6 hours]

Overall Equipment Effectiveness (OEE), Need for Effectiveness Maintenance, Key Performance Indicator (KPI), Maintenance Work Quality, Occupational Health and Safety measures, Safety measures in Electrical equipment, using hazardous chemicals, handling heavy machinery, fire protection, personal protective equipment.

Unit VI: Total Productive Maintenance and Replacement Theory [6 hours]

Definition, Pillars of Total Productive Maintenance, Equipment and Process Improvement using KAIZEN, Replacement or Repair decision making, Roller copperizing, re-rubberizing. Replacement Models, Replacement policy, Replacement of items, Determination of average life. Critical spares,

Guidelines for Laboratory Conduction

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

Term Work :

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

1. Identification of parts used in printing machines e.g. actually identifying parts like gear, bearing, chain etc.
2. To prepare and conduct Preventive Maintenance check Sheet for Printing Press.
3. To prepare and conduct Predictive Maintenance and Corrective record Sheet for Printing Press.
4. Clean, check and calibrate compressors used in printing machines.
5. Study lubrication path in a printing machine.
6. Calculate packing requirements for accurate pressure in printing units.
7. Clean, check and calibrate dampening system in offset press.
8. Prepare new blanket for offset blanket cylinder.
9. To understand and implement 5 S in press room.
10. Clean check and calibrate any ancillary unit used in printing press.

Text Books:

[T1] Venkataraman.K, (2007), Maintenance Engineering and Management, Prentice-Hall of India Private Limited.

[T2] P.Goplakrishnan, A.K.Banerji, (1977), Maintenance and Spare Parts Management.

[T3] B. S. Dhillon, Engineering Maintenance, A modern approach, CRC Press.

[T4] Er.Sushil Kumar Srivastava, Maintenance Engineering.

Reference Books:

[R1] H.P.Garg, (1990), Industrial Maintenance, S. Chand & Company Ltd.

[R2] Kenneth E.Rizzo, Total Production Management, Second Ed., GATF Press.

[R3] N.D.Vohra, Quantitative Techniques in Management, Tata McGraw Hill Publishing Co. Ltd.

[R4] Herschell L. Apfelberg, Maintaining Printing Equipment, GATF Press.

[R5] Lindley R. Higging; Maintenance Engineering Handbook, 4thedition, McGraw Hill International.

[R6] Operator's Manual by GATF

[R7] Levitt, J., Maintenance Management, Industrial Press, New York, 1997.

Unit	Text Books	Reference Books
Unit I	T1	R7
Unit II	T1,T2,T3	-
Unit III	T3	R1
Unit IV	T4	R1 ,R2, R3
Unit V	-	R4
Unit VI	-	R3,R5

(308293 B) Elective II: Basic Communication Systems and Electronic Instrumentation

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: Printing Digital Electronics and Microprocessor & Microcontroller

Course Objectives:

The objectives of the Course are:

1. Classify data transmission methods and various types of coding and decoding techniques.
2. Understand working principles, types of optical Fiber and its transmission issues
3. Describe RFID and Wi-Fi communication system.
4. Understand basic principles of sensing various parameters and fundamentals of instrumentation
5. Learn selection of sensors for typical applications
6. Characterize the various sensors and actuators

Course Outcomes:

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

1. Apply the knowledge to use of communication systems in printing and allied industry.
2. Relate the knowledge of optical fiber communication system and optics related applications in paper/ printing industry
3. Apply the knowledge of Wi-Fi communication system in printing industry.
4. Identify, formulate and solve a problem of process Instrumentation.
5. Demonstrate the understanding of various sensors and transducers
6. Characterize sensors and actuators used in printing process instrumentation.

Unit 1: Printing Information, Digitization and Transmission [6 Hours]

Necessity of Printing Information, transmission at long distance. Necessity of Modulation and different types of modulation (Block diagram and conceptual treatment only). Pulse modulation and their types (theoretical treatment and simple mathematical approach only), sampling theorem, quantization, Binary coding, companding and their types, multiplexing techniques. Data Encryption

and Decryption techniques, security issues in Printing. Use of communication in the field of printing.

Unit 2: Optical Fibers and Fiber Optic Communication [6 Hours]

Types, working principles and characteristics of optical Fiber, Fiber configuration and performance comparison, Fiber connector types and their features. Losses in fibers (to be covered in detail). Basic fiber optic communication system (block diagram treatment only). Applications of optical communications such as paper and currency Note counting security applications, paper thickness measurement and control. (only block diagram treatment with simple mathematical applicable if any) Fiber optic communication set up used in paper industry. (complete end to end set up - block diagram and concept).

Unit 3: Modern Technologies and applications [6 Hours]

Infrared LED application in Plate making. Fundamentals of wireless communication. (Frequency ranges, applications and block diagram only). Wi-fi technology (Block diagram, concept and frequency ranges only) and applications in Printing. RFID i.e. Radio Frequency Identification and its applications in Printing. RFID smart ticket application. Use of RFID in inventory management.

Unit 4: Sensors and Instrumentation [6 Hours]

Fundamentals of measurements Need of Instrumentation, General Instrumentation System, Static and Dynamic characteristics of instruments, input & output impedance, Fundamentals of measurements, Measurement and measurement system, industrial measuring parameters and their units, Types of Errors, Statistical Analysis, Probability of Errors, Limiting Errors, Calibration of instruments, calibration report & certification, traceability and traceability chart, definitions of sensors and transducers, classification of transducers, static and dynamic characteristics, selection criteria, importance.

Unit 5: Displacement and speed measurement [6 hours]

Resistive: Potentiometer, Strain gauges, Inductive: LVDT and Eddy current type, Capacitive: Capacitance pickups, Differential capacitive type, Piezoelectric, Ultrasonic transducers and Hall effect transducers, Optical transducers and Electromagnetic tachometer

Unit 6: Temperature and pressure measurement [6hours]

Temperature Scales, Standards and Units and relations, Classification of temperature sensors Bimetallic Thermometer, Filled system thermometers, SAMA classifications, Resistance Temperature Detectors (RTD), Thermistor, Thermocouples

Guidelines for Laboratory Conduction

1. Clean all workspace and components parts every time before starting of practical.
2. Check for the electrical connections before start up and end of the practicals.
3. Before switching On the Power supply to circuit boards, get the connections checked by your professor.
4. Write the experiment in the journal neatly and get it checked within a week.

Term Work:

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

1. Verification of sampling theorem. Observe the AM, FM and PAM techniques: Ideal, Natural, flat samples.
2. Study of various pulse modulation techniques PWM, PPM.
3. Measure the numerical aperture of a fiber with and without visible light source.
4. Study of compounded PCM using A law and μ law and differential PCM
5. Study of losses in the optical fiber
6. Measurement of displacement using LVDT
7. Measurement of temperature using IC sensors (AD590 and LM35).
8. Study of tachometer
9. Characterization of thermocouples (J/K/R/s)
10. Characterization of RTD (PT 100)

Text Books:

[T1] Atul Godse and Uday A.Bakshi, (2013), Analog Communications, ISBN-10 : 935038891X, ISBN-13 : 978-9350388914, 2nd Edition, Technical publications.

[T2] Ajoy Ghatak and K. Thyagarajan, (1998), Introduction to fiber optics, ISBN:9780521577854, 0521577853, Cambridge University Press.

[T3] D.V.S. Murty, (2012), Instrumentation and Measurement Principles, ISBN:9788120335691, 8120335694, PHI, New Delhi

[T4] Kalsi H. S., (2004/2010), Electronic Instrumentation, ISBN:9780070583702, 0070583706, 2nd or 3rd edition TMH.

Reference Books:

[R1] A. B. Carlson, (2011), Communication system, MacGraw Hill Publication.

[R2] Taub and schilling, (2008) Principles of communication system, ISBN: 9780070648111 0070648115, Tata MacGraw Hill.

[R3] G. Keiser, (2003), Optical Fiber communication, ISBN:1259006875 9781259006876, MacGraw Hill Publication

[R4] E.O. Doebelin, (1966), Measurement Systems, McGraw Hill.

[R5] B.G. Liptak, (2003), Process Measurement & Analysis, Chilton Book Company.

[R6] Andrew Parr, (1998), Industrial Control hand book, Newnes Industrial Press.

[R7] C. S. Rangan, G. R. Sharma and V. S. Mani,(1997), Instrumentation Devices and Systems, ISBN:0074633503 9780074633502, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

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

(308293 C) Elective II: E-Publishing

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: Print Layout and Design, Digital Printing Techniques

Course Objectives:

The objectives of the Course are:

1. To understand different file formats for web, create and publish web pages on web server
2. To understand, create and format textual content for electronic publications
3. To understand the use of database systems, concept of human interaction design
4. To understand principles of layout and composition
5. To get an insight for use of business models in the development and evaluation of an e-commerce application, Style-sheets, XSL, XSLT, CSS
6. To understand Digital Asset Management, Web Applications Development, CMS (content Management System) and ECM suites

Course Outcomes:

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

1. Application of Database systems and Information architecture.
2. Effective textual content for electronic publications
3. Evaluating usability in HCI Design
4. Develop style sheets, layout for cross media devices using HTML, CSS and XML.
5. Develop E-book and E-commerce web applications
6. Apply the use of CMS and ECM suites

Unit 1: Digital Information Technologies and Architecture [6 hours]

Introduction to computing, internet and web, Web 2.0 technologies (blogs, wikis, etc.), Metadata, Semantic web, database systems and searching, collection and analysis of information, information architecture and its meaning.

Unit 2: Writing for Electronic Media [6 hours]

Create and format textual content for electronic publications, including emerging categories such as blogs, wikis and widely used social media platforms like Facebook, Linkedin, Twitter, and others. Overview of different editing techniques and trends, Plagiarism.

Unit 3: Human Computer Interaction Design **[6 hours]**

Interaction Design, Different creativity techniques and methods in user-centred projects, Understanding of important Interaction Design paradigms such as User-Centred Design, Participatory Design and Contextual Design, Usability evaluation techniques such as User Testing, Guerrilla Testing and Heuristic Evaluation, Understanding User Interactions, International accessibility standards and guidelines, User experience design.

Unit 4: Multimedia **[6 hours]**

Design and Layout for Electronic Media, Focus on adaptive design instead of scalable design, understanding of the principles of layout and composition including the use of the grid system, Use web editing packages such as HTML, CSS, Adobe Dreamweaver, Google web designer and many other to compose and layout web pages, understanding of the principles of typography, Indexing, Types of PDFs (editable, non-editable, iPDF), teletext.

Unit 5: Publication & E-commerce **[6 hours]**

Information regarding E-publications formats like e-pubs. E-pub readers like Adobe Digital Editions, mobile readers etc in brief (since this is a worldwide used e-publishing solution used on a large scale), rules and regulations for e-publishing use of business models in the development and evaluation of an e-commerce application, Style-sheets, XSL, XSLT, CSS Layout and workflow for cross media devices, POD, Mobile, Tablets, CD, Websites, File extension and
Compatibility

Unit 6: Web Application Development **[6 hours]**

Information technologies for e Media workflows; use of XML for E-Publishing from UI design to XML (or SQL), Digital Asset Management, Web Applications Development, Introduction to Javascript, .net and PHP, CMS (content Management System) and ECM suites (Enterprise Content Management), methodology, need and use, Technologies to facilitate Web-To-Print, Social Media and personalized internet experiences.

Guidelines for Student's Lab Journal

1. Students should write the journal in own hand writing with either black or blue pen.
2. Hand writing and Figures must be neat and clean.
3. All the diagrams, workflows and figures must be drawn on blank sheet and should be neatly labeled

4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain serial number, title of the experiment, page number and the signature of staff along with date.

Guidelines for Laboratory Conduction

1. Check for the Computer, printer, scanner, LAN connectivity before start of the practicals.
2. Check and note down the set-up details of hardware and software as per the format given
3. Follow the format given for procedure and note down all the observations as per the format given.
4. Check the status of printer while taking 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 record of the following experiments presented in the form of journals.

1. Use of HTML & CSS tags to embed graphics in web page
2. Introduction to XML
3. Design a webpage layout using design software
4. Create index using software commands for e-book
5. Design a interactive website banner
6. Define a Sitemap for web application
7. To test usability of HCI design
8. Cross media designing
9. Study Content management system
10. Publish a 3 page website locally

Text Books:

[T1] Deitel & Deitel, Neito, Sadhu, (2001), XML How to Program, Pearson Education Publishers.

[T2] Eric Ladd, Jim O' Donnel, (1999) Using HTML 4, XML and Java, Prentice Hall of India-Que

References Books:

[R1] Michal' L Kleper, The Handbook of Digital Publishing

[R2] Harold Henke, (2001), Electronic Books and ePublishing: A Practical Guide for Author's 1stedition, Springer.

[R3] William E Kasdorf, (2003), The Columbia Guide to Digital Publishing, Columbia University Press.

[R4] Cady & McGregor, (1996), Mastering the Internet, 2nd edition, Business Promotion Bureau Publications.

[R5] Scot Johnson, Keith Ballinger, Davis Chapman, (1999), Using Active Server Pages, Prentice Hall of India.

Unit	Text Books	Reference Books
Unit I	T1,T2	R1, R2, R3
Unit II	T1	R2
Unit III		R1, R2
Unit IV		R3
Unit V		R4
Unit VI		R5

310294: Internship**

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
**	04	Term Work: 100 Marks

Course Objectives:

- To encourage and provide opportunities for students to get professional/personal experience through internships.
- To learn and understand real life/industrial situations.
- To get familiar with various tools and technologies used in industries and their applications.
- To enable students to develop professional skills and expand their professional network with the development of employer-valued skills like teamwork, communication.
- To nurture professional and societal ethics in students.
- To create awareness of social, economic and administrative considerations in the working environment of industry organizations.

Course Outcomes:

On completion of the internship, learner will be able to

CO1: To demonstrate professional competence through industry internship.

CO2: To apply knowledge gained through internships to complete academic activities in professional manner.

CO3: To choose appropriate technology and tools to solve given problem.

CO4: To demonstrate abilities of a responsible professional.

CO5: To use ethical practices in day to day life.

CO6: To analyze various career opportunities and decide carrier goals.

CO - PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	3	2	1	1	2	2	2
CO2	3	2	1	2	2	3	2	1	1	2	2	2
CO3	2	-	-	-	-	-	-	-	2	2	2	2
CO4	-	-	3	1	1	1	1	-	-	2	2	2
CO5	-	-	2	-	-	1	1	-	-	2	2	3
CO6	-	-	-	-	-	-	-	-	-	2	1	2

**** Guidelines**

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be

simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

Duration:

Internship to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.

Internship Work Identification:

Student may choose to undergo Internship at Industry/Govt. organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry [1]. Internship proposals need to be sanctioned by College authority.

Contacting various companies for Internship and Internship work, identification process should be initiated in Semester V in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also it will allow students to work in vacation period after Semester V and before academics of Semester VI examination.

Student can take internship work in form of on-site work from any of the following but not limited to:

- Working for consultancy/ research project,
- Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute /
- Learning at Departmental Lab/Tinkering Lab/ Institutional workshop,
- Development of new product/ Business Plan/ registration of start-up,
- Industry / Government Organization Internship,
- Internship through Internshala,
- In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship,
- Research internship under professors, IISC, IIT's, Research organizations,
- NGOs or Social Internships, rural internship,
- Participate in open source development

[1] https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

Internship Diary/ Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor.

Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

Internship Work Evaluation:

Every student is required to prepare a maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Programme Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on-Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.

Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks + Internship Diary/Workbook and Internship Report - 50 Marks

Internship Diary/workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries
- Adequacy and quality of information recorded
- Data recorded
- Thought process and recording techniques used
- Organization of the information

Evaluation through Seminar Presentation/Viva-Voce at the Institute-

The student will give a seminar based on training report before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on following criteria:

- Depth of knowledge and skills Communication & Presentation Skills
- Team Work
- Creativity
- Planning and Organizational skills
- Adaptability
- Analytical Skills
- Attitude and Behavior at work
- Social Understanding

- Ethics
- Regularity and Punctuality
- Attendance Record
- Log Book
- Students feedback from External Industry Supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate whathe/she has observed and learned in the training period.

The report shall be presented covering following recommended fields but limited to,

- Title/Cover Page
- Internship completion certificate
- Internship Place Details- Company background-organization and activities/Scope and Objectives of the study / supervisor details
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results / Analysis /Inferences and Conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library Books, Journals, Magazines and other sources)

Feedback from Internship Supervisor (External and Internal)

Post internship, faculty coordinator should collect feedback about student with following recommended parameters:

Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership…..

(308295) Audit Course

In addition to credits course, it is recommended that there should be audit course (non-credit course). The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided 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 following but not limited to)

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

Guidelines for Assessment (Any one or more of 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
308295-I	Design Thinking
308295-II	Supply Chain Management

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

(308295 - I) Audit Course: Design Thinking

Prerequisites: None

Course Objectives:

- To understand the concepts of Design Thinking
- To understand the approach to new product development

Course Outcomes:

On completion of the course the learners will be able to

CO1: To learn the concepts that drive design thinking

CO2: To identify customer needs and user groups

CO3: To analyse the steps of Design Thinking for the process of innovation

Course Contents

1. Introduction to Design Thinking and the 5 Major steps in Design Thinking
2. Empathize Phase: Customer Journey Mapping
3. Analyze Phase: 5-Whys and How might we...
4. Solve Phase
5. Ideation: Free Brainstorming & Make/Test Phase
6. Prototype

Reference Books:

1. Brown, T., & Katz, B. (2019). Change by design: How design thinking transforms organizations and inspires innovation (Vol. 20091). New York, NY: Harper Business.
2. Cross, N. (2011). *Design thinking: Understanding how designers think and work*. Berg.

CO-PO Mapping

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

(308295 - II) Audit Course: Supply Chain Management

Prerequisites: None

Course Objectives:

- To understand the methods to manage the interactions of the business functions
- To understand insights on demand management function and its integration with supply chain.
- To learn to utilise the enterprise knowledge and resources across the supply chain activities.

Course Outcomes:

On completion of the course the learners will be able to

CO1. To develop a sound understanding of the important role of supply chain management

CO2. Become familiar with current supply chain management trends

CO3. Understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations

Course Contents:

1. Introduction to supply chain management
2. The management components of supply chain management
3. Supply chain processes
4. Electronically linking the supply chain
5. Supply chain performance measurement
6. Implementing supply chain management

Reference Books:

1. Hugos, M. H. (2018). Essentials of supply chain management. John Wiley & Sons.
2. Sarkar, S. (2017). *The Supply Chain Revolution: Innovative Sourcing and Logistics for a Fiercely Competitive World*. Amacom.

CO-PO Mapping:

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