

**Course Name:** Printing Network Technology and Optoelectronics

**Course Number: (308282)**

**Teaching Scheme**

Lectures: 4 Hrs/Week

Practicals: 2 Hrs/Week

**Examination Scheme**

Theory: 100 Marks

Term work: 25 Marks

Oral: 25 Marks

**Course Objectives:**

1. Understand Fundamentals of Optoelectronics
2. Understand Fundamentals of Modulation
3. Understand Networking
4. Understand Applications in The Field of Printing

**Course Outcomes:**

<b>Course Outcome</b>	<b>Assessment Method</b>	<b>Assessment Type (Direct / Indirect)</b>	<b>Periodicity</b>	<b>Benchmark</b>
Understanding the Fundamental of modulation	Question/Answers Brainstorming	Indirect Indirect	Once/Week Once/Week	$\geq 60$
Understanding types of modulation	Question/Answers Brainstorming Assignments	Indirect Indirect Direct	Once/Week Once/Week Once/Week	$\geq 60$
Understanding basics of fiber optic communication	Question/Answers Brainstorming Presentations	Indirect Indirect Direct	Once/Week Once/Semester Once/Semester	$\geq 60$
Understanding fiber optic cables	Question/Answers Observations Assignments	Indirect Direct Direct	Once/Week Once/Semester Once/Week	$\geq 60$

To understand basics of networking	Question/Answers Brainstorming	Indirect Indirect	Once/Week Once/Week	>=60
To understand operating systems	Question/Answers Brainstorming Observations	Indirect Indirect Direct	Once/Week Once/Week Once/Week	>=60
To understand RFID	Question/Answers Brainstorming Assignments	Indirect Indirect Direct	Once/Week Once/Week Once/Week	>=60
To understand Protocols	Question/Answers Assignments	Indirect Direct	Once/Week Once/Semester	>=60
To understand VOIP and VPN	Question/Answers Brainstorming Assignments	Indirect Indirect Direct	Once/Week Once/Week Once/Semester	>=60
To understand Applications in the field of printing	Question/Answers	Indirect	Once/Semester	>=60
Work in a team to identify problem, factors affecting the problem etc with help of optical kits	Assignments	Direct	Once/week	>=60
Work in a team to identify problem, factors affecting the problem etc with help of software.	Assignments	Direct	Once/week	>=60

## Course Contents

### Unit 1

#### Printing Information, Digitization and Transmission :

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, compounding and their types, multiplexing techniques. Data Encryption and Decryption techniques, security issues in Printing. Data transfer techniques, Data channels and transmission, various data networks.

### Unit 2

#### Optical Fibers and Fiber Optic Communication

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 :**

Infrared LED application in Plate making. Applications of Laser diode in Printing. 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. Concept of Digital library and simple case study.

### **Unit 4**

#### **Introduction:**

What is operating system, types of OS, Functions and features of OS, structure of windows, Unix / Linux, MAC, network OS (NT, Novel), design issues of OS.

### **Unit 5**

#### **Networking:**

What is networking, advantages & disadvantages of networking, design, issues of networking, topologies, types of network, layered structure, ISO / OSI model, TCP / IP model, intranet & internet, network protocols - ICMP, POP3, SMTP, FTP, TFTP, IMAP.

### **Unit 6**

#### **Internetworking:**

Leased lines, ISDN, VSAT, and VPN, Internetworking devices such as modems, repeaters, hubs, switches, routers, gateways, bridges, and routers.

Applications: study of networking application such as video conferencing, VoIP, VoN

### **List of practicals:**

- 1) Verification of sampling theorem. And PAM techniques: Ideal, Natural, flat samples.
- 2) Study of various pulse modulation techniques PWM, PPM.
- 3) Study of compounded PCM using a law and u law and differential PCM.
- 4) Measure the numerical aperture of a fiber with and without visible light source.
- 5) To measure attenuation of optical fiber (length of fiber should be at least 10 meters)
- 6) Test simple fiber optic link for transmission for a )Analog signal and b) Digital signal.
- 7) Study of Linux and MAC
- 8) Study of LAN.
- 9) Study of Modem.
- 10) Study of networking components
- 11) To stimulate file transfer protocol.
- 12) Study of TCP/IP or VOIP

### **Reference Books :**

- 1) A. B. Carlson ``communication system'' MacGraw Hill Publication.
- 2) Taub and schilling ``Principles of communication system'' Tata MacGraw Hill Publication.
- 3) Optical Fiber communication - G. Keiser MacGraw Hill Publication.

- 4) Optical Fiber communication principles & practice - J senior - Prentice Hall publication.
- 5) Telecommunication switching systems and networks -T. Vishwanathan Prentice Hall Publication.
- 6) Computer Network by Tanenbaum (P41)
- 7) MS-DOS by Ray Duncan (BPB Publications)
- 8) Data Communication and distributed network by Black (P41)
- 9) IBM PC and clones by Govindarajalu (Tata Mc Graw Hill)

## **(302290)Theory and Design of Printing Machines**

### **Teaching Scheme**

Theory: 3 Hours/Week

Practical: 2 Hours/ Week

### **Examination Scheme**

Paper: In Sem: 30 marks

End Sem: 70 marks

Term Work: 25 marks

### **Course Objectives:**

1. Apply the basic principles of strength of materials; formulate the design procedure in eccentric loading, knuckle joint, cotter joint, and lever.
2. Analyze and design the mechanical system consisting of shaft, coupling, and screws.
3. Analyze and design the mechanical system consisting of spring and bearings.
4. To develop competency in understanding of theory of all types of gears.
5. To understand the analysis of gear train.
6. To develop competency in drawing the cam profile and understand the follower motion.

### **Course Outcomes:**

- a. Students will be able to apply the basic principles of strength of materials, formulate the design procedure, incorporate codes and standards
- b. Students will be able to analyze and design the mechanical system consisting of shaft, coupling, screws
- c. Students will be able to analyze and design the mechanical system consisting of springs and bearings.
- d. Students will be able to determine contact ratio, describe ways to avoid interference and analyze forces in spur gears.
- e. Students will be able to determine gear ratio and holding torque for various gear trains.
- f. Students will be able to identify the types of cams and followers and various motions of follower and will also be able to draw graphically the displacement diagram, velocity and acceleration diagrams.

**Assessment Tools:**

Course Outcomes	In-sem test	Class Test	Sheet Work	Assignment	Benchmark
a	√	√	√	√	More than 60% perform
b	√		√	√	More than 60% perform
c	√			√	More than 60% perform
d			√	√	More than 60% perform
e				√	More than 60% perform
f			√	√	More than 60% perform

**Mapping of Course Objectives to Course Outcomes:**

Course Objectives	Course Outcomes					
	a	b	c	d	e	f
1	√					
2	√	√				
3	√		√			
4				√		
5					√	
6						√

Course Outcomes	Sheet1	Sheet2	Sheet3	Sheet4	Assi 1	Assi2	Assi3	Assi 4	Assi 5	Assi 6
a	√	√								
b		√			√					
c						√				
d			√				√			
e							√			
f				√						

Course outcomes	<----- Program outcomes ----->											
	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_10	PO_11	PO_12
CO_1	2	---	3	--	2	--	2	--	1	--	--	--
CO_2	0	2	2	--	--	--	2	1	1	--	--	--
CO_3	0	1	1	--	--	--	2	1	1	--	--	--
CO_4	1	1	1	--	2	--	1	1	1	--	--	--
CO_5	1	1	1	--	2	2	1	1	1	--	--	--
CO_6	1	---	--	--	2	1	1	1	1	--	--	--
<b>Summary</b>												

### CO-PSO Mapping

CO	PSO1	PSO2
CO.1	2	1
CO.2	2	--
CO.3	2	--
CO.4	2	1
CO.5	2	1
CO.6	2	1

**Prerequisites:** Strength of Machine Elements, Theory of Printing Machines

**Course Contents:**

**Unit- I: Design Process:** [6 hours]

Machine Design, Traditional design methods, Basic procedure of Machine Design, Forming Design specifications, Requisites of design engineer, Design of machine elements, Sources of Design data, Use of Design data book, Use of standards in design, Selection of preferred sizes.

**Design of Simple Machine parts:** Factor of safety, Service factor, Design of simple machine parts - Cotter joint, Knuckle joint and Levers, Eccentric loading.

**Unit II: Shafts, keys and couplings** [8 hours]

Transmission shaft, A.S.M.E. code for shaft design, Shaft design on torsional rigidity basis. Design of keys – square, saddle and sunk keys.

Design of couplings – Flange coupling, Bush pin type flexible couplings.

Basic types of screw fastenings, cap screws, set screws, locking devices, I.S.O. Metric screw threads.

**Unit III: Springs:** [8 hours]

Types, Material and applications of springs, spring stiffness, Wahl's factor, Spring index. Helical compression and tension spring – strength and deflection equation, end types. Helical torsion spring – strength and deflection equation, end types.

**Rolling Contact Bearing:** Types of rolling contact Bearings, Selection of rolling contact bearings from manufacturer's catalogue (Single row deep groove), Mounting of Bearings, Lubrication of Bearings, Types of failure of rolling contact bearings, causes and remedies.

**Unit IV: Gears:** [8 hours]

Classification of gears. Spur gears- Terminology in gears, law of gearing, conjugate action, involute & cycloidal profile, path of contact, interference, undercutting, methods to avoid interference & undercutting, rack shift, effect of centre distance variation.

Helical gears – Normal & transverse module. [Theoretical treatment only] [8 hours]



**Unit V: Gear trains:****[6 hours]**

Worm & worm gears. Bevel gears- Terminology, geometrical relationship, applications. Internal gears. [Theoretical treatment only]

Types of gear trains – compound, epicyclic, compound reverted, velocity ratio by tabular method for epicyclic gear train, holding torque. [8 hours]

**Unit VI: Cam & followers****[ 6 hours]**

Types of cams & followers, types of follower motions. Determination of cam profiles for given follower motion, cams with specified contours. [8 hours]

**Term Work**

(Record of the following drawings and assignments)

**List of Drawings**

- 1) Component drawing and assembly drawing of complete drive for printing machine after measuring on printing machine. Fits, tolerances and part list to be shown on drawing sheet. (Two full imperial size drawing sheets)
- 2) Design and drawing of two sub-assemblies of the following – Cotter Joint, Knuckle Joint, Flange Coupling, Lever
- 3) Construction of various cam profiles.
- 4) Construction of gear tooth profiles.

**Assignment**

A journal consisting of report on above subassemblies and at least three assignments based on theory.

**Reference books**

1. Shigley J.E. Mechanical Engg. Design, McGraw Hill Publication.
2. Spotts M.F., Design of Mechanical Elements, Prentice Hall International
3. Bhandari V.B., Design of Machine elements, Tata McGraw Hill Publication.
4. Design data – P.S.G. College of Technology, Coimbatore.
- 5) Thomas Bevan – Theory of Machine, CBS Publishers and Distributors, Delhi.
- 6) Joseph E. Shigley – Theory of Machine and Mechanisms, McGraw Hill International Book Company.

**Pune Vidyarthi Griha's  
College of Engineering and Technology, Pune**

**Curriculum Book**

<b>Course Title: Offset Machines</b>		<b>Course Number: 308281</b>	
<b>Year: TE</b>		<b>Semester: I</b>	
<b>Type of Course</b>	Professional Core		
<b>Teaching Scheme:</b> 4 Hrs/Week		<b>Laboratories:</b> 2 Hrs/Week	
<b>Course Assessment Method Examples</b>	<b>Direct methods</b>	On-line/In-sem Examination: 30 Marks	Theory/End Semester Examination: 70 Marks
		Term-work: NA	Practical: 50 Marks
<b>Indirect Methods</b>	<b>Indirect Methods</b>	Assignments, Class Tests	Q&A
<b>Course Prerequisites</b>			
<b>Course Objectives</b>			
	<b>Assessment Method Used</b>		
1	Learn basic mechanical parts of offset printing machines		
2	Learn various computer to plate technologies used in sheet fed and web fed machines		
3	Understand inking and dampening systems used in sheet fed and web fed machines		
4	Understand sheet travel or web travel in the machine		
5	Learn ink drying mechanism for sheet fed and web machines		
6	Learn different parameters to control quality(evaluation) of printing in sheet fed and web offset		
7	Understand process control in offset		
8	Learn different electrical drives used in different units in offset machines		
9	Understand the significance of make-ready, green initiatives and trouble shooting in offset		
<b>Course Outcomes</b>			
C301.1	<b>Identify</b> the different parts and construction of each part of the machine and various imaging techniques in CTP and state significance of technology used		
C301.2	<b>Demonstrate</b> effective ink transfer and water transfer		

C301.3	<b>Differentiate</b> sheet and web transfer and <b>examine</b> methods used for sheet and web drying
C301.4	<b>Interpret</b> different tests used for ink, paper and fountain and understand and <b>compare</b> various press standards for offset
C301.5	<b>Describe</b> drives used for sheet-fed and web fed offset machines
C301.6	<b>Execute</b> make-ready operations and <b>evaluate</b> waste management methods for green printing
<b>Course Contents</b>	
<b>Unit-I</b>	<b>Basics of Offset Workflow and CTP technologies [8 hours]</b>
	Sheet fed Process Flow diagram, construction of printing units, Offset Printing used for commercial and packaging, automatic plate changing, Surface preparation for Offset, lay outing preparation, CTP –thermal and violet, CTCP and other technologies, Role of Silver halide layer, Digital Plate Surface preparation, thermal plate and Violet plate processing
<b>Unit-II</b>	<b>Inking Systems and Dampening Systems used in Sheet fed and Web Offset Process [8 hours]</b>
	Study of different inking systems, different metering systems of ink duct, roller diameters roller materials for conventional and hybrid UV machines, ceramic and duct roller, temperature ranges maintained on machine, heatset and coldest inks, UV, EB inks. Construction of Dampening System, Developments and modifications in dampening system construction, Dampening Roller materials, fountain solutions & their characteristics, metering of dampening solution. Role of different constituents used in fountain solutions.
<b>Unit-III</b>	<b>Sheet /Web Travel through the machine and sheet / Web drying methods [6 hours]</b>
	Feeders – study of all parts of feeders, mechanisms sheet transfer, shaft less feeders, Web tension control, load cells, web handling, factors affecting tension- press related tension and paper related tension, modulus of elasticity of paper, Registration control- auto registration control Auxiliary equipments used on web offset- remoisturisers unit, anti-static devices, temperature controlled oscillators, Total blowers, grippers, mechanism in delivery system, IR dryers and UV dryers

<b>Unit-IV</b>	<b>Process Control in Offset Process and Evaluation of Print Quality [8 hours]</b>
	Inspection and basic checks of paper, ink, fountain and washes required for production as well as use of color control strip for achieving aimed solid ink densities, tone value increase, trapping and conformance to various standards such as GRACoL, SWOP, FOGRA and ISO. Study of various test chart elements. Use of color characterisation data charts. Understanding various test elements to understand behaviour of inking, dampening, printing pressures, Test elements such as grey balance, color gamut, tone value increase, register. Understanding ISO 12647-3 for cold set newspaper, Measurement of basic quality checks for paper, inks and other consumables.
<b>Unit- V</b>	<b>Drives and electronic controls used in Sheetfed / Web Offset Presses [6 hours]</b>
	Motion control systems for registration, main drives, ink keys, duct roller settings. Different electronic controls used for feeders, printing units, inking, dampening, delivery units.
<b>Unit-VI</b>	<b>Make ready Operations, Troubleshooting and Requirements of Green Initiatives in printing [8 hours]</b>
	Types of Make ready operations, faster makeready using automatic ink key presetting, inline register control. Environmental problems due to waste generated from press room, storage & disposal of ink, Disposal of founts and washes, Deinking procedures, Sheet and Web Offset troubleshooting, press troubles, paper and ink problems, infeed troubles-splice breaks, web breaks, Printing unit problems- gear streaks, uneven impression, slurring, doubling, inking related problems, dampening related problems, print quality related problems. Use of recycled papers, using certified resources such as Forest Stewardship council (FSC) or Sustainable Forestry Initiative (SFI), Deinking
<b>List of Practicals</b>	Students have to perform 8 out of 10 experiments
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	Setting of ink duct and tracing ink path on the inking unit and checking adjustment by printing simple test forme
4	Setting of dampening system and testing using simple test forme

5	To set and operate feeder (stream feeder)		
6	To print single colour job and study registration		
7	Simple evaluation and quality checks for ink, fountain solution, paper, washes.		
8	Evaluation of test chart for analyzing print quality		
9	Conventional platemaking, planning layout, plate exposing, development		
10	Understanding image quality metrics using MATLAB software		
<b>Reference Books</b>			
R1	--	The Lithographer's Manual	GATF
R2	Ernest Hutchings	Photo offset	
R3	GATF	Quality & Productivity in the Graphic arts	GATF
R4	Durrant	A surveys of printing process	
R5		Printing Machines	
R6		Litho Printing	
R7	Kelly	Solving sheet-fed offset press problems	GATF
R8	Porter, A.S.	Manual for lithographic press operation	Litho training services Ltd. London
R9	Mishra C. S.	Technology of offset printing	Anupam Prakashan, Delhi
R10	Krisnamurthy, V. S.	Basics of Modern printing processes	Maxseltype, Madras
R11	Kelly	Sheet-fed Offset Press Operating	GATF
R12		Manual of Advanced Lithography	
R13	Hugh Speirs	Introduction to Offset Lithographic Printing	PIRA Publications
<b>Self-Learning Material (OCW, Handouts, Web Recourses, Research papers etc.)</b>	<ol style="list-style-type: none"> <li>1. Handbook of Print Media</li> <li>2. www.pia.org</li> </ol>		
<b>Contents beyond Syllabus</b>	VOCs used in the industry and problems occurring due to their use		
	Regenerative Thermal Oxidisers used in web offset		
<b>Additional Experiments (If any)</b>	Observation of test chart elements used for fingerprinting of a press		
<b>Bridging</b>	Special lecture on Green Printing		

<b>Courses</b>	Industrial visits
<b>Assignments</b>	
1	Study of standard test images as given in ISO 12640-1 and ISO 12640-2 and BVDM Roman 16
2	Survey of image quality metrics
<b>Tutorials</b>	NIL
<b>Presentations</b>	1. Types of CTP plates
	2. Servo Motors used in Offset presses

## CURRICULUM BOOK

<b>Course Title: Technology of Flexography</b>		<b>Course Number: 308289</b>	
<b>Year: TE</b>		<b>Semester: II</b>	
<b>Type of Course</b>		Professional Core	
<b>Teaching Scheme: 4 Hrs./Week</b>		<b>Laboratories: 2 Hrs./Week</b>	
<b>Course Assessment Method Examples</b>	<b>Direct Methods</b>	In Semester Examination: 30 Marks	End Semester Examination: 70 Marks
		Term-work: N/A	Practical: 50 Marks
	<b>Indirect Methods</b>	Class Test	Q&A session, Brainstorming
<b>Course Prerequisites</b>	Basic Printing Techniques, Material Science, Ink Technology		
<b>Course Objectives</b>	<b>Assessment Method Used</b>		
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.		
<b>Course Outcomes</b>			
C308.1	Compare between various methods of Flexography plate-making.		
C308.2	Explain negative requirements, mounting and de-mounting techniques, storage and handling of flexo plate and compute distortion of negative for flexo plate production.		
C308.3	Evaluate the relationship between flexo plate variables and printability.		
C308.4	Explain the Digital flexo plate-making and analyze different types of dots on flexo plates.		
C308.5	Identify different press configurations, inks for various flexo applications, compare conventional and shaft-less technology and explain modern trends in flexography.		
C308.6	Correlate between fountain, anilox parameters and printability.		

<b>Course Contents</b>
<b>Surface Preparation for Flexo</b>
Flexo artwork, Design considerations, Types of Flexo Plates, Processing of Rubber and Photopolymer plates, Comparison between Rubber and Photopolymer Plates, Types of photopolymer plate-making, Processing machines: Compact and Inline flexo plate wash outs Safety regulations, Solvent recovery units and its safety regulations.
<b>Requirements of Photopolymer Plates</b>
Layout considerations, Specifications of negative, Distortion, Storage and Handling of raw and used plates, Mounting and De-mounting of plates
<b>Conventional Flexo Plates</b>
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.
<b>Digital Flexo Plates</b>
Characteristics of Digital Flexo Plates, Digital Workflow, Types of images, Imaging of CTP, Ablation technique, Digital Engraving, Types of lasers used. Digital Imaging technologies for flexo. Impact of digital flexo plate making on evolution of flexo printing. Dot structure and techniques of achieving Flat top dot on flexo plates. Elastomers used in direct engraving. Comparison of Direct engraving and digital photopolymer
<b>Flexography Process</b>
Introduction, Types of Flexo Press, Press Configurations, Types of dryers, Efficiency of dryer, Sections of a Flexo Press, Flexo Products and application. Categorizing Flexo presses into high end and low end commercials In High end: Narrow Web and Wide Web New advancements in auto registration technologies Impact of servo motors in improving flexo printing techniques. Flexo plate mounters and post printing cleaners Post press attachments on flexo machines.
<b>Ink Metering for Flexography</b>
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.
<b>Practicals</b>
Introduction to Flexo Plate processing Machine.
Performing Wash-out Test on 2.84 mm photopolymer plate.



Performing Back-Exposure Test on 2.84 mm photopolymer plate.		
Performing Main-Exposure Test on 2.84 mm photopolymer plate.		
Performing Post –Exposure and Light Finishing Test on 2.84 mm photopolymer plate.		
Preparation of PP plate with a 4-mil negative.		
Preparation of PP plate with a 7-mil negative.		
Study of Flexo machine principles.		
To print single color with Conventional PP Plate by a Flexo process on PE substrate.		
To print single color with Conventional PP Plate by a Flexo process on PE substrate.		
<b>Author</b>	<b>Title of Book</b>	<b>Publication &amp; Edition</b>
Tony White	High Quality Flexography	Pira International
H. Kipphan	Handbook of Print Media	Springer-Verlag Berlin Heidelberg
Flexography Technical Association of America	The Flexography Beginner, Volume VI	Foundation of FTA
Flexography Technical Association of America	Flexography Principles and Practices	Foundation of FTA, 4 <sup>th</sup> edition
Flexography Technical Association of America	Flexography Principles and Practices	Foundation of FTA, 5 <sup>th</sup> edition
P. Laden	Chemistry and Technology of Water Based Inks	Blackie Publication
W. R. Durrant	Machine Printing	Heinemann Professional Publishing

<b>Self-Learning Material (OCW, Handouts, Web Resources, Research papers etc.)</b>	Vainstein, J. (2005). <i>A Study of Conditions and Variables that affect the Printing of Shrink Films on Water-based Flexography</i> . (Master's Thesis). Rochester Institute of Technology, USA.
	Rong, X., and Keif, M. (2007). A study of PLA printability with flexography. In <i>59th Annual Technical Association of Graphic Arts Technical Conference Proceedings: Pittsburgh, PA</i> .
	Laurent, G. G. (2002). <i>Measurement and prediction procedures for printability in flexography (MP3 Flexo)</i> (Doctoral dissertation, Doctoral dissertation, Royal Institute of Technology, Stockholm, Sweden).
	Teleman, A., Christiansson, H., Johansson, P. Å., Fahlcrantz, C. M., and Lindberg, S. (2005). Correct measurements of half-tone print mottle on flexo printed linerboard.

	Pekarovicova, V., Pekarovicova, A., Fleming P. D., (2006). Shrink Sleeve Flexo Inks. <i>Proceedings of the 58th TAGA Annual Technical Conference</i> , Vancouver, British Columbia.
<b>Contents beyond Syllabus</b>	Safety Precautions in Flexo Lab
	Fingerprinting of a Flexography Press
	ELS System for Flexo
<b>Additional Experiments (If any)</b>	NIL
<b>Bridging Courses</b>	Use of statistical tools for flexography print optimization.
	Analysis of Flexo photopolymer plates
	Analysis of Flexo prints
<b>Assignments</b>	NIL
<b>Tutorials</b>	NIL
<b>Presentations</b>	Flexo Plate mounting systems
	Effect of flexo process variables on printability

**Pune Vidyarthi Griha's  
College of Engineering and Technology, Pune**

**Curriculum Book  
Academic Year 2015-2016**

<b>Course Title: Colour Management and Standardization</b>		<b>Course Number: 308283</b>	
<b>Year: TE</b>		<b>Semester: I</b>	
<b>Type of Course</b>	Professional Core		
<b>Teaching Scheme:</b>	4 Hrs/Week	<b>Laboratories:</b> 2 Hrs/Week	
<b>Course Assessment Method Examples</b>	<b>Direct methods</b>	In-sem Examination: 30 Marks	Theory/End Semester Examination: 70 Marks
		Term-work : 25marks	Practical : 50marks
	<b>Indirect Methods</b>	Assignments, Presentations, MCQs	Seminars, Quiz, Q&A session, Group Discussion
<b>Course Prerequisites</b>	1. Understanding Color Physics and its Application in color management		
<b>Course Objectives</b>	<b>Assessment Method Used</b>		
1	- To recognize knowledge of color physics to memorize human vision perception, object and Illuminant properties.		
2	- Memorize the various color systems used for color measurement		
3	- Perform the visual and instrumental color assessment.		
4	- To apply the basic concept of color difference and mathematics of various equations to calculate colour difference between sample and reference.		
5	- To understand the concept of color matching		
6	- To understand the need and concept of color management		
7	- Learn various press standards used for printing process.		
<b>Course Outcomes</b>	Interpret Apply Employ Use Practice Schedule Sketch Prepare Modify Predict Extrapolate Manage Choose Solve		
<b>C3O3.1 :</b>	<b>Apply</b> the knowledge of color physics to understand human vision mechanism, illuminate properties and object properties.		

<b>C303.2 :</b>	<b>Apply</b> knowledge of various color systems <b>to evaluate</b> color coordinates for CIE, xyY, Luv, Hunter Lab, CIELAB, CIE CAM02 color systems.
<b>C303.3:</b>	<b>Understand</b> the basic principles of color measuring instruments and <b>able to perform</b> a visual and instrumental color assessment.
<b>C303.4 :</b>	<b>Apply</b> the knowledge of Kubelka Munk Theory for color matching in printing industry.
<b>C303.5 :</b>	<b>Create</b> a custom color profile for monitor, scanner and printer.
<b>C303.6 :</b>	Learn various standards used in printing industry and <b>able to create</b> house standards for various printing process.

### Course Contents

<b>Unit-I</b>	<b>Understanding Colour physics</b>
	Colour Science, Electromagnetic spectrum, Psychological point of view, Color Theory, Additive colour synthesis, substrates colour synthesis, Reflectance properties of process ink Colour Perception, Human vision mechanism – Trichromancy, Opponency; Illuminant : Source & Illuminant, Colour Temperature, Spectral Power Distribution, Viewing condition, Object properties: Transmission, Absorption, scattering
<b>Unit-II</b>	<b>Colour Systems</b>
	Colour systems & colour spaces, Basic perceptual attributes of colour, Colour Systems based on colour mixing, Colour Systems based on uniform Colour perception – the munsell colour system, the natural colour system, OSA uniform colour scale system, Colour Systems based on Colour matching – The CIE colour systems, Concept of standard observer, Standard Illuminant, color matching experiment, CIE, xyY, Luv, Hunter Lab, CIELAB, CIE CAM02
<b>Unit-III</b>	<b>Color Measurement</b>
	Colour measurement, Basic principles of colour measurement systems, Colour Charts, Colour Reference Catalogue, Colour Measuring Instruments: Densitometer, colorimeter, Spectrophotometer; Visual Colour Assessment, Instrumental Colour Assessment, Colour Tolerance, Colour Difference, Colour processing software MATLAB, Color gamut calculations and mapping
<b>Unit-IV</b>	<b>Colorants</b>

	Dyes verses Pigment, Classification of colorants, Metamerism : Cause of metamerism, 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: Colour mixing laws, Visual based color matching, Instrumental based color matching.
<b>Unit- V</b>	<b>Color Management</b>
	Need for colour management system , Concept of colour management, Colour system, Device dependant (conventional) workflow, device independent (modern) workflow, International colour consortium (ICC), Four c's of colour management, Color Management Tools: Test charts for different devices, Production of different colour profiles, Rendering indent: Perceptual rendering indent, Relative & Absolute colorimetric intent, Saturation intent, Colourful, Chroma Plus, Gamut mapping, Logo Classic
<b>Unit-VI</b>	<b>Press Standardisation</b>
	Press standardization, need for standardization, Press optimization, variables in printing process such as gravure, flexo, offset, digital, types of test forms for standardization, Proof to Press colour management, Printer calibration, Printer linearization, Proofer calibration.
<b>Practical</b>	Any Eight
	1. Study the effect of substrate on Trapping and Gray balance.
	2. Calculate CIE tristimulus values X, Y, Z for given patches.
	3. Study the effect of different Illuminants on CIE colour Co-ordinates.
	4. Perform the visual color assessment for measuring color difference
	5. Perform the Instrumental color assessment for calculating color difference
	6. Calibrate the monitor and create a monitor profile.
	7. Generate and Measure a Printer test chart and develop an ICC printer profile.
	8. Measure a scanner test chart and create a scanner profile.
	9. Perform Proofer calibration for a given media.
	10. Develop a Soft proof and Hard proof.
	11. Study the colour processing software : Mat Lab

12. Applications of Mat-Lab software for colour processing.			
Text Books	Author	Title of Book	Publication & Edition
R1	Phil Green	Understanding Digital Color	GATF press
R2	Gray G. Field	Color & its reproduction	GATF press
R3	Fred W. Billmeyer, Jr. Max Saltzman	Principles of Color Technology	John Wiley & sons, A Wiley inter science publication
R4	Abhay Sharma	Understanding Color Management	
R5	Richard M. Adams, Joshua B. Weisberg	The GATF practical guide to Color Management	GATF press
R6	R.W.G Hunt	The Reproduction of Color	Fountain Press, England
R7	E.P. Danger	The Color Handbook	Gower Publication
<b>Self-Learning Material (OCW, Handouts, Web Recourses, Research papers etc.)</b>	Web Recourses : <a href="http://www.hunterlab.com/">http://www.hunterlab.com/</a> . <a href="http://graphics.stanford.edu/courses/cs248-07">http://graphics.stanford.edu/courses/cs248-07</a>		
	Handbook of Print Media <a href="http://www.pia.org">www.pia.org</a>		
	Presentations: 1. <b>Computational Photography</b> , MIT, Bill Freeman and Fredo Durand 2. <b>Color</b> , Jim Rehg Some slides by David Forsyth and Frank Dellaert 3. <b>Causes of color</b> , Color Slides by D.A. Forsyth 4. <b>Color Theory</b> , Kurt Akeley, CS248 Lecture 17, 27 November 2007		
	Research Papers : 1. H35 color Difference Visual V01.DOC ' <b>The CIE System and Colour-Difference Equations</b> ', Colour4free, page 1-6 2. Axiphos GnbH, ' <b>Color difference formulae</b> ', August 2003 3. The optical Society of America, ' <b>Uniform color Scales</b> ', AN7 4. <b>János Schanda</b> , ' <b>CIE COLORIMETRY 1931 - 2006</b> ', Virtual Environment and Imaging Technologies Laboratory Pannon University, Hungary		
<b>Contents beyond Syllabus</b>	Understanding Human vision deficiency		
	Study of Profile structure _head and tags		
	Develop the Matlab function for Color calculation		
<b>Additional Experiments (If any)</b>	Write a program to develop a Matlab function for color calculation.		

<b>Bridging Courses</b>	-
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<b>Assignments</b>	
1	Explain the concept of Standard observer.
2	Explain CIE Color Systems
3	Explain CIE color difference equations.
4	Explain 4C's of Color management.
5	Explain Rendering Indents used in color management.
<b>Tutorials</b>	
<b>Presentations</b>	a. Human vision perception
	b. Colour physics of Illuminant
	c. Transmission, absorption and scattering mechanism of objects
	d. Colour Matching experiment
	e. Colour system
	f. Color Difference equations
	g. Concept of Metamerism
	h. Need and concept of color management
	i. Four C's of color management
	j. Press standardization

**Course Name: C303 Year of Study:2015-16**

<b>C303.1</b>	Understand the color science of observer, object and Illuminant.
<b>C303.2</b>	Understand the basic principles of various color system and able to do color transformation for various color system.
<b>C303.3</b>	Understand the basic principles of color measuring instruments and able to do a visual and instrumental color assessment.
<b>C303.4</b>	Understand the concept of color matching and its application in printing industry.
<b>C303.5</b>	Learn how to do a calibration and develop a custom color profile for monitor, scanner, printer.
<b>C303.6</b>	Learn various standards used in printing industry and learn how to develop house standards for various printing process.

Table–3.1.1

1.1.2. CO-PO matrices of coursesselectedin3.1.1

(six matrices to be mentioned;o nepersemesterfrom3rdto8thsemester)(05)

<b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
C303.1	3	2	-	-	1	2	1	-	-	-	-	-
C303.2	3	2	-	-	2	2	-	-	-	-	-	-
C303.3	3	2	-	2	1	2	2	-	2	2	-	-
C303.4	3	3	-	2	2	3	2	-	1	2	-	-
C303.5	3	2	-	2	3	3	2	3	2	2	1	1
C303.6	2	2	-	2	2	3	2	3	3	2	1	1

Table3.1.2



Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
C311	3	3	-	3	3	3	3	1	2	2	1	1

Table3.1.3\*

**Pune Vidyarthi Griha's  
College of Engineering and Technology, Pune**

**Curriculum Book**

<b>Course Title: Substrates and Coatings Technology</b>		<b>Course Number: 308286</b>	
<b>Year: TE</b>		<b>Semester: II</b>	
<b>Type of Course</b>	Professional Core		
<b>Teaching Scheme:</b>	3 Hrs/Week	<b>Laboratories:</b> 0 Hrs/Week	
<b>Course Assessment Method Examples</b>	<b>Direct methods</b>	On-line/In-sem Examination: 30 Marks	Theory/End Semester Examination: 70 Marks
		Term-work	Practical/Oral
	<b>Indirect Methods</b>	Assignments, Presentations, MCQs	Seminars, Quiz, Q&A session, Group Discussion
<b>Course Prerequisites</b>			
<b>Course Objectives</b>	<b>Assessment Method Used:</b> Group Discussion, Q&A session, Quiz		
1	Understand manufacturing of porous and polymeric substrates		
2	Get detailed knowhow about the polymeric substrates and their surface treatments		
3	Understand how substrate and ink interact with each other during ink transfer		
4	Learn how to correlate substrate characteristics and print quality		
5	Get detailed knowhow about absorbent substrates and their surface treatments		
6	Understand various paper coatings and its effect on paper properties, various coating formulation and application methods		
7			
8			
<b>Course Outcomes</b>	<b>The student shall be able to</b>		
CO1	Understand absorbent and non-absorbent stocks and their manufacturing		
CO2	Deal with various polymeric substrates for print transfer		
CO3	learn substrate and ink interaction		
CO4	Understand and correlate substrate and ink properties for better print		
CO5	Know about the surface treatments to enhance ink transfer and have better print definition		
CO6	Understand paper coating treatments, coating formulation for substrate enhancement		
<b>Course Contents</b>			
<b>Unit-I</b>	<b>Manufacturing of Substrates</b>		
	Manufacturing of polymeric substrates, Extrusion, Co-extrusion, manufacturing defects Such as gels, black specks, Causes and Remedies of Manufacturing Defects,		

	Manufacturing of porous substrates, calendering process, Inspection systems for substrate manufacturing		
<b>Unit-II</b>	<b>Non-absorbent Substrate</b>		
	Variety of Non-absorbent substrates, Polymer substrate and their properties, Role of plasticizers in polymers, Role of impact modifiers and other additives in polymers, Degradation of polymers, Mechanical behaviour of polymers, need of surface treatment, methods of surface treatment, corona treatment, flame treatment, plasma treatment, effect of treatments on Polymer substrates		
<b>Unit-III</b>	<b>Substrate and Ink Interaction</b>		
	Substrate's surface energy and its components, methods to approximate surface energy: dyne pens, sessile drop method, geometric mean equation, acid-base theory ; interfacial tension, ink's surface tension, ink spreading on substrate: spreading co-efficient, ink-Substrate bonding: work of adhesion, mechanism of ink transfer, nature and extent of Ink spreading after transfer, substrate and ink film distortion under pressure, drying and setting of ink on substrate, effect of ink vehicle penetration on coating structure.		
<b>Unit-IV</b>	<b>Substrate Characteristics and Print Quality</b>		
	Topography, micro and macro roughness, smoothness and porosity, compressibility, absorptivity, surface energy, substrate behaviour in nip, effect of substrate properties on ink transfer and print quality.		
<b>Unit- V</b>	<b>Absorbent Substrates</b>		
	Variety of absorbent substrates, Manufacturing of Paper, Calendering process, Significance of Paper properties on Print Quality, Surface and Internal sizing, Sizing considerations, Measurement of sizing, Sizing Agents used- rosin, AKD, ASA, Trouble shooting of sizing problems, Effect of Plasma modification on surface Properties and printability of coated papers		
<b>Unit-VI</b>	<b>Coatings Techniques</b>		
	Fundamentals of coating for Paper and Board, Coating components, Coating processes and Equipments, Coating formulation, Coating rheology, Drying process, Types of Drying, Coat Weight calculation, Evaluation of coated paper, Performance evaluation of paper in printing, Effect of Coating Pigment on Color and Light fastness		
<b>Text Books</b>	<b>Author</b>	<b>Title of Book</b>	<b>Publication &amp; Edition</b>
T1			
T2			
<b>Reference Books</b>			
R1	A. S. Athalye	Plastic Processing Handbook	Multi-tech Publishing (2002)

R2	Aaron L. Brody, Kenneth S. Marsh	Encyclopedia of Packaging Technology	2nd Edition A Wiley- Interscience Publication.(1997)
R3	Abdel-Bery, E. M.	Handbook of Plastic Films	Rapra Technology Limited, Shawbury, Shrewsbury, Shropshire SY4 4NR, UK
R4	Cantor, K	Blown film extrusion-An introduction	1 <sup>st</sup> ed., Munich- Hanser,2006
R5	Casey J.P	Pulp and Paper Chemistry and Chemical Technology	3rd Ed., Vol 3, John Wiley & Sons.
<b>Self-Learning Material (OCW, Handouts, Web Recourses, Research papers etc.)</b>	<a href="http://www.paperonline.org">www.paperonline.org</a>		
	<a href="http://www.paperonweb">www.paperonweb</a>		
	<a href="http://www.pulpandpaper.net">www.pulpandpaper.net</a>		
<b>Contents beyond Syllabus</b>	Printed Electronics and Substrate		
	Barrier coatings		
	Bio-degradable Plastics		
<b>Additional Experiments (If any)</b>			
<b>Bridging Courses</b>			
<b>Assignments</b>			
1	Inkjet Paper and coatings		
2			
3			
4			
5			
<b>Tutorials</b>	Mid-Sem Examination by SPPU		
<b>Presentations</b>			

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