

**DEPARTMENT OF PRINTING ENGINEERING
JADAVPUR UNIVERSITY**

**Master of Technology in Printing Engineering and Graphic Communication
FIRST SEMESTER**

Total Periods/Week = 26 Total Marks = 800

Theoretical Courses	Subjects		Periods/Weeks		Marks	Credit Points
	Departmental / Specialization Basket	Subject Code	Subject Name	Lecture		
Paper-I	PG / PT / T / 111A	Computer Graphics	3		100	3
	PG / PT / T / 111B	Color Analysis and Tone Reproduction	3		100	3
	PG / PT / T / 111C	Advanced Printing Technology	3		100	3
	PG / PT / T / 111D	Digital Information Technologies and Architectures	3		100	3
Paper-II	PG / PT / T / 112A	Printing and Packaging Material Technology	3		100	3
	PG / PT / T / 112B	Human Vision and Computer Vision	3		100	3
	PG / PT / T / 112C	Workflow Management in Printing Industry	3		100	3
Paper-III	PG / PT / T / 113A	Digital Printing and Publishing	3		100	3
	PG / PT / T / 113B	Imaging Technology and Devices	3		100	3
	PG / PT / T / 113C	Standardization in Printing and Packaging	3		100	3
Note: The students have to select 3 subjects from the departmental/ specialization basket, i.e. one subject each from the list given in the baskets of Paper-I, Paper-II and Paper-III						
Inter-Disciplinary Basket						
Paper IV	PG / PT / T /	Digital Image Processing and Analysis	3		100	3

	114A					
	PG / PT / T / 114B	Optical Engineering	3		100	3
	PG / PT / T / 114C	Any subject From the interdisciplinary basket of IEE,CSE, IT, ETCE	3		100	3
Paper V	PG / PT / T / 115A	Data Analysis and Statistics	3		100	3
	PG / PT / T / 115B	Multimedia Systems & Communication	3		100	3
	PG / PT / T / 115C	Any subject From the interdisciplinary basket of IEE,CSE, IT, ETCE	3		100	3
Paper VI	PG / PT / T / 116A	Radiometry	3		100	3
	PG / PT / T / 116B	Color in industry	3		100	3
	PG / PT / T / 116C	Any subject From the interdisciplinary basket of IEE,CSE, IT, ETCE	3		100	3
Note: The students have to select 3 subjects from the departmental/ specialization basket, i.e. one subject each from the list given in the baskets of Paper-IV, Paper-V and Paper-VI						
Sessional courses						
Sessional I		Digital Color Imaging Laboratory		4	100	3
Sessional II		Assignment	3		100	

Total Periods/Week =25

Total Marks = 800

**Master of Technology in Printing Engineering
SECOND SEMESTER**

Theoretical Courses	Subjects		Periods/Weeks		Credit Points	
	Subject Code	Subject Name	Lecture	Sessional	Marks	
Departmental / Specialization Basket						
Paper-VII	PG / PT / T / 121A	Design and layout for electronic media	3		100	3
	PG / PT / T / 121B	Advanced Colorimetry	3		100	3

	PG / PT / T / 121C	Total Productive Maintenance in Printing	3		100	3
Paper-VIII	PG / PT / T / 122A	Electronic Image Communication	3		100	3
	PG / PT / T / 122B	Print Media Communication	3		100	3
	PG / PT / T / 122C	Compression and transmission in media systems	3		100	3
Paper-IX	PG / PT / T / 123A	Signals and Systems for Media Technology	3		100	3
	PG / PT / T / 123B	Fundamentals of spectral science	3		100	3
	PG / PT / T / 123C	Web Publishing	3		100	3
Note: The students have to select 3 subjects from the departmental/ specialization basket, i.e. one subject each from the list given in the baskets of Paper-VII, Paper-VIII and Paper-IX						
Inter-Disciplinary Basket						
Paper X	PG / PT / T / 124A	Cross Media Color Reproduction	3		100	3
	PG / PT / T / 124B	Entrepreneurship	3		100	3
	PG / PT / T / 124C	Any subject From the interdisciplinary basket of IEE,CSE, IT, ETCE	3		100	3
Note: The students have the freedom to select 1 subjects from the inter-departmental basket, i.e. one subject from the list given in the baskets of Paper-X						
Sessional courses						
Sessional I		Term Paper Leading Thesis			200	3
Sessional II		Seminar			100	3

Total Periods/Week =18

Total Marks = 600

THIRD AND FOURTH SEMESTER

Theoretical Courses	Subjects	Periods/Weeks	Marks	Credit Points
---------------------	----------	---------------	-------	---------------

Departmental / Specialization Basket	Subject Code	Subject Name	Lecture	Sessional	Examination	Sessional	
1		Thesis Work		22	300		9
2		Viva-Voce on Thesis			100		3
							12

Total Periods/Week =22

Total Marks = 400

Paper I Syllabus

Computer Graphics

Overview of Computer Graphics, Interactive graphics, passive graphics. Advantages of interactive graphics. Image Processing as picture analysis, SRGP, Basic Raster graphics algorithm, Graphics hardware : Image scanner, Display, Geometrical transformation, SPHIGS, Input devices, User interface software, Achromatic and colored light, Visual realism, Illumination and shading, Image manipulation and storage, Advanced raster graphics architecture, Advanced geometric and raster algorithm

Display Devices : Refresh CRT, Random-Scan and Raster-Scan Monitor, Color CRT Monitors, DVST, Plasma-Penel Displays, LED and LCD monitors. Hard copy devices.

Scan conversion : Scan Converting a point, line, circle, ellipse and arcs.

2-D graphics transformations (Rotations, Scaling, Translations, Reflecting, Shearing) Composition of 2-D transformation, 2-D viewing and clipping, Windowing concepts, clipping algorithms (Line, Area and Text-Sutherland-Cohen, Mid-point subdivision), Window-to-view port transformation, Primitive and attributes. Exterior and Interior clipping.

Document Processing Language: Programming for processing in Post Script Language Detail study about vector graphics and Bit Map images, life size and image compression. Linking objects to URL's for internet WebPages. Portable document format, print document format, PDF workflow systems, print job ticket format (PJTF). Raster image processing, linking, electronic dot generator.

Graphic text formats: GIF – Graphic Image Format, TIFF – Tagged information file format, JPEG-Joint Photographer Experts Group, BMP – Bitmaps, EPS – Encapsulated Post-script Format, PICT – picture, RTF – Rich Text Format, DOC – Document format, WPG – Word Perfect Graphic, Txt – Text formats, MS Word, OPI servers, file server & networks, digital file export.

Font Management, Interactive graphics: Concept of Positioning and Pointing. Interactive Graphic Devices (Key Boards, Touch Panels, Light Pens, Graphic Tablets, Joysticks, Mouse-Voice System) Interactive Graphical Techniques: Basic Positioning Methods, Constraints, Gride, Gravity field, Rubber-Bank Methods, Sketching, Dragging, Inking and Painting.

Computer Graphic Software : Introduction, GKS (Primitive, attributes and Viewport, Display subroutines)

Introduction to 3-D Graphics

Literature and study materials:

Computer Graphics: Principles and Practice, James D. Foley
Computer Graphics(Scham's Series)Roy, A. Plastock, Gordon Kalley, McGraw Hill.
Donald Hearn, M. Pauline Baker, "Computer Graphics", Prentice Hall of India.
"Computer Graphics A Programming Approach", Harrington, Steven, McGraw Hill.
"Procedural Elements for Computer Graphics", David F. Rogers; McGraw Hill.
"Principles of Interactive Computer Graphics", Newman, W. Sproul, R.F., McGraw Hill.
PDF : Printing & Workflow, Frank J. Romano, GATF Publication
Adobe Guide on Post Script Language.

Color Analysis and Tone Reproduction

Light, Vision and Photometry, Color Vision and Color Specification Systems, CIE Standard Colorimetric System, Uniform Color Spaces, Measurement and Calculation of Colorimetric Values, Evolution of CIE Standard colorimetric System, Application of CIE Standard Colorimetric System, Basic principles of color measurement: illumination, object, observer, color matching, light intensity measurement, R, G, B Colorimetry: choice of primaries, additivity, basic algebra of colorimetry, changing units, chromaticity, spectrum locus, color mixture on chromaticity diagrams, changing primaries, color matching functions, . Color measuring instruments: tricolor meter, spectrophotometer, spectroradiometer, calibration, illumination/geometries, performance monitoring, Psychophysical methods: ratio, ranking, gray scale, pair comparison, categorical judgment, Color difference formulae and metamerism: development of color difference formulae, psychophysical methods for evaluating color difference, advance color difference formulae, metamerism indices, Color appearance models: Development of color appearance models, psychophysical methods for evaluating color appearance, testing color appearance models, Color notation systems: The principles of color order systems and color specifiers, Color order system: Munsell, NCS, Ostwald, OSA, DIN, Coloroid, Color specifier: Pantone, Color Curve, Illuminant Color: light sources, color temperature, standard illuminants, daylight, fluorescent lamps, illuminant colorimetric shift, illuminant metamerism index, chromatic adaptation transform, color inconstancy index, chromatic adaptation, color rendering index, observer metamerism index.

Literature and study materials:

- "Colorimetry. Fundamentals and Applications" by Ohta and Robertson
- Wyszecki and Stiles book
- "Principles of Color Technology" by Billmeyer, Saltzman and Berns

Advanced Printing Technology

Development of advanced printing technology for the commercial printing such as offset, flexography, gravure, screen, and digital printing. Description in modern printing machines, optional devices, processes and techniques; automatic system, and computer control system. The development of printing technology to reduce the cost and time, but increase the qualities and productivity.

1. Offset - Substrate selection for web offset printing, offset printability, and printing defects. Offset press components, printing units, principles of drying, impression rollers and blankets. Ink variables, and differences between inks for publication, packaging and product printing. Automatic Plate Mounting systems for offset process, Digital Printing.

2. Flexography- Configurations of a Flexo Press, Application of Flexo in Packaging & Label printing, Conventional & Digital Flexo plate-making, Distortion Factors, Flexo printability, Closed and Open Inking System, Function and Benefits of Closed Inking Systems, Anilox Roller-Construction, Benefits, Cell structures, Cell Volume, Selection of Anilox in Relation to Printing.

3. Rotogravure- Substrate selection for rotogravure, gravure printability, and printing defects. Cylinder plating, Plating Variables & Calculation, Hardness, Engraving, proofing, Gravure press components, printing units, Doctor blades- purpose & types, Ink variables, and differences between inks for publication, packaging and product printing.

4. Impression Roller- Function, Elastomers, Properties of Covering materials, Nip width, Electrostatic Assist, Rubber Hardness & its effect on Print Quality.

5. Drive Systems - Common Shaft & Electronic Line Shaft, Working Principle, Limitations of Common Shaft, Benefits of ELS, Pneumatics and Hydraulics used in different Printing Processes.
6. Press Environment Logistics- Handling Systems, Waste disposal, exhaust air purification, cleaning systems pressure, climate requirements, machine maintenance and care.

Literature and study materials:

1. Haward M. Fenton, Frank J. Romano, On Demand Printing, GATF, 1998.
2. Bob Durrant, Development in Web Offset, Pira International, 1993
3. Molly J. Joss, Comparative Guide to Direct-to-Press Technology, 2nd edition, 1999.
4. H. Kipphan, Handbook of Print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg, 2001.
5. Gravure Process and Technology, Gravure Education Foundation and Gravure Association of America, 2003.
6. Harry B. Smith, Modern Gravure Technology, Pira International, 1994.
7. Steve Doyle, Advancements in Printing Plate Technology, Pira International.
8. Tony White, High Quality Flexography, Pira International, 1998.
9. Flexography-Principles and Practices, Volume 1-6, FFTA, 5th Edition, 1999

Digital Information Technologies and Architectures

Use computers to manage data effectively, through appropriate digital technologies and techniques, to support a wide range of information related tasks, Employ established and evolving standards to create data that explicitly represents information in unambiguous, inclusive and useful ways, Describe, assess and exploit recent advances in information and communications technology to work with proficiency and efficiency in an online digital environment.

Paper II

Printing and Packaging Material Technology

The creation of color by light emission, absorption, scattering and interference. The interaction of light with dilute suspensions of pigment particles and dyes in solution. The interaction of light with concentrated pigment dispersions and dyed textile materials. Development of the Kubelka-Munk two flux radiation transfer theory and its application to pigmented and dyed materials. Standard methods of characterisation of the optical properties of pigmented and dyed materials. Computer based methods of color match prediction and color match correction of pigmented and dyed materials. The optical properties of non-homogeneous systems such as metallic finishes, wood stains, and fibre blends.

1. Materials for Printing – Study of materials for pre-press films used for image-setter, plates used for plate-setter, chemicals used for processing of plates, light sources used such as laser, UV etc, plating chemicals for Gravure cylinders such as copper chrome nickel etc. plating tanks plating calculations such as current, density, time etc, Different Types of CTP Plates like Thermal, Violet etc.
2. Substrates used for printing and packaging- Paper such as Machine Glazed, Super Calendered, News Glazed, Map litho, Newsprint, Roto-newspaper, Paper properties and its interaction with ink, Plastics such as Polyolefin like Polyethylene, BOPP, properties and application, Aluminium foil, Metalized films. Factors to be considered for selecting substrate for package
3. Testing of materials for printing and packaging
4. Inks used for Print Packaging – Solvent based, PU, Vinyl, PA, NC, Water based, UV inks, Paste Inks, Ink Composition, Ink Ingredients, drying mechanism, Surface Energy.
5. Importance of recycling of substrates, FSC, Green Printing, Environmental issues, Paper sizes in metric & English units, Biodegradable substrate and its characteristics.
6. Ink requirements – Brief study of various printing techniques with reference to the printing ink quality requirements, Ink formulation principles and raw material, Different drying mechanisms including UV curing EB curing, Study of formulation composition of litho, flexo, gravure & screen printing inks with reference to the essential properties required.
7. Specialty Inks – Special types of printing inks such as Metallic inks; Water based inks, ink jet printing inks, electrographic inks, security and special effect printing inks, Thermographic, Scented,

Fluorescent, Decorative Product Inks.

8. Costing – Cost estimation & cost systems study for understanding costing of various printing & converting jobs with reference to paper and plastic substrates.

69 Quality Control & Environment – Purpose, Quality control for substrate and ink, BIS and ISO, Total Quality Control, EMS – 14000, Quality control for Paste and Liquid inks. Hygiene Management System, BRC-IOP, HACCP, Food Safety, Environmental study of material waste causing pollution,

Pollution prevention methods. Environmental laws for print industry, VOC & its significance in printing inks, Hazardous waste.

Literature and study materials:

1. Christopher J. Bierman, Handbook of Pulping and Paper Making, Academic Press, California, 2nd Edition, 1993.
2. James P Casey, Pulp and Paper – Chemistry and Chemical Technology Vol. I to IV, Third Edition, 1960.
3. Apps E. A. Printing Ink Technology, Leonard Hill (Books) Ltd. Efen Street, London, 1958.
4. Ronald E.; Printing Inks Pira International Ronald E. Todd, Leatherhead, 1996.
5. Chris H. Williams; Printing Ink Technology, Pira International, 2001.
6. Dr. Nelson R. Eldered, What Printer Should Know About Ink, GATF Press Pittsburgh, 2001.
7. Laden P. O, Chemistry & Technology of Water based Inks, Blackie Academic & Professional - Imprint of Chapman Hall, 1st Edition, 1997.
8. Reger V. Dickerson, War or Waste, Graphic Communication Association Alexandria, Virginia.
9. Lawrence A. Wilson, What Printer Should Know About Paper, GATF Press Pittsburgh, 1998.
10. Bureau of Indian Standards, Manik Bhawan, New Delhi.
11. Technical Association for Pulp and Paper Industry, Atlanta, U. S.
12. A. S. Athayle, Plastics in Packaging, Tata McGrawHill Publication, 1992.
13. A. S. Athayle, Plastics in Flexible Packaging, Multi-Tech Publishing, 1992.
14. "Principles of Color Technology" by Billmeyer, Saltzman and Berns

Human Vision and Computer Vision

Introduction to visual perception: visual perception and the main components of the human visual system. The visual process: image formation, transduction, codification, retinal and cortical processing. Receptive fields, LGN and cortex processing. Image size and amplification. Accommodation. Contrast sensitivity Basic numbers in human vision. Radiometry and photometry fundamentals: radiation, radiometric quantities, units and applications, photometric quantities, units and applications. • Photopic and scotopic vision, spectral sensitivities and Purkinje Shift. contraction of visual field, Troxler phenomenon intensification, autokinetic movement phenomenon. Night myopia. Visual Fields, spatial and temporal summation. Perimetry. Fundamentals of color perception: color matching and the trichromacy, spectral sensitivities of photoreceptors. The mathematics of color mixing. Acquired and inherited color vision deficiencies. Fundamental of spatial and temporal aspects of visual perception.. Perception of objects and shapes. Perception of movement. Binocular vision and depth perception. Stereo acuity, Psychophysical methods of assessing of the perceived quality of images. Introduction to computer vision: what is computer vision? The Marr paradigm and scene reconstruction, Model-based vision. Other paradigms for image analysis: bottom-up, top-down, neural network, feedback. Pixels, lines, boundaries, regions, and object representations. "Low-level", "intermediatelevel", and "high-level" vision. Image Processing Shape from X Shape from shading. Photometric stereo. Occluding contour detection, Motion Analysis. Motion detection and optical flow structure from motion. Object recognition model-based methods. Appearance-based methods. Invariants. Computer vision applications.

Literature and study materials:

- *Foundations of vision*, Brian A. Wandell, Sinauer Associates, 1995.
- *Eye, brain, and vision*, David A. Hubel, W. H. Freeman & Co, 1988.
- *Sensation and Perception*. E. Bruce Goldstein. 6th edition Wadsworth Publishing. ISBN: 0534639917, 2002
- *Vision science: photons to phenomenology*, Stephen E. Palmer, The MIT Press, 1999.
- *Visual space perception*, Maurice Hershenson, The MIT Press, 1999.
- *Introduction to Visual Optics*. Alan H. Tunncliffe. Association of British Dispensing Opticians. ISBN 0-900099-28-1, 1993.
- *Computer Vision and Applications: A Guide for Students and Practitioners*. Bernd Jahne. Academic

Press, 2000.

Workflow Management in Printing Industry

1. Introduction – Conventional Workflow, Digital Workflow & its significance, Comparison between Conventional and Digital workflow.
2. Types of Workflow – Workflow for Pre-Press to Press, Workflow types and their architecture, Production Module, Conversion to PS or PDF, Job Ticket, Pre-flight checking, Trapping, Proofing, Corrections, Imposition, Image replacement, Ripping, Imaging, Archiving, Conversion.
3. Process & Business Module – Process Management Task, Job Entry, Creating Folders on Servers, Job/ Process Engineering, Schedule Process, Retrieve elements, Process error trapping & notification, correction handling, intervention Notification/Handling, Customer communication handling, CIP3 , Transfer upstream of color requirements, Transfer upstream of printer requirements, color management support, Archive job, Business Management Task, Open job order, Estimating, Job tracking, Proofing approval, Job costing, Shipping, Close order, Billing.
4. Infrastructural Requirements – Networking, Cabling, Machine configuration requirements, Languages & software's used in workflow, Platforms, OPI, APR -Servers
5. Integrated Systems – Key elements of integration system such as Electronic Desktop Publishing, Electronic Imposition, Pagination, File Formats such as JDF, PDF, PJTF, CIP 4, PPF, Digital Proof, Inspection & Corrections, and Functions of elements in integrated system.
6. Finance Management – Scope, Cost Benefit analysis, Return on Investment, Study & comparison of various Digital workflows, latest developments in workflow management systems.

Literature and study materials:

1. William Stallings, Data and Computer Communications, Pearson Prentice Hall, 5th edition.
2. Andrew S. Tannenbaum, Computer Network, Prentice Hall PTR, 2002.
3. Jessica Keyes, Multimedia Handbook, Mc Graw Hill Publication, 1994.
4. H. Kipphan, Handbook of Print Media, , ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg, 2001.
5. Richard M. Adams II & Frank J. Romano, Computer-to-Plate-Automating the Printing Industry, GATF Press, 2nd edition.

Paper III

Imaging Technology and Devices

Overview of optical imaging: domains of image science. Electromagnetic waves and rays, Basics of signal processing. Fourier analysis in two dimensions. Linear systems. Two-dimensional sampling theory: the Whittaker-Shannon theorem, Diffraction. The Rayleigh-Sommerfeld formulation of diffraction. Fresnel and Fraunhofer approximations, Fundamentals of wave scattering, Diffraction-limited imaging. Image formation with coherent and incoherent illumination. Analysis of optical resolution, Frequency analysis of optical imaging systems. Frequency response for diffraction-limited optical systems: coherent and incoherent imaging. Optical transfer function (OTF), modulation transfer function (MTF) and phase transfer function (PTF): characterization and measures, Aberrated imaging systems. Generalized pupil function. Apodization. Image quality in aberrated systems, Fundamental of wavefront modulation. Spatial light modulators. Diffractive optical elements, Spatial filtering. The VanderLugt filter. The Joint Transform Correlator. Optical pattern recognition architectures: the Matched Filter. Image processing tools for pattern recognition, Optical image restoration. Optical Transfer Function for image motion and vibration. Effects of atmospheric blur and target acquisition.

Light fundamentals: brief review of radiometry and photometry. Luminous efficiency. Color temperature. Color rendering index, Light sources: incandescent light bulbs. High-intensity discharge lamps. Xenon arc lamps. Flash lamps, Fluorescent lamps. Inductive lighting. LED and OLED. Laser, photometric curves. CIE illuminants and standard sources. Types of reflection and

transmission. Filtering. Polarization. Lighting geometry, Lighting in machine vision: common lighting techniques. Structured lighting. Color lighting. Lighting products dedicated to machine vision. Examples of applications.

Photodetectors. Applications in photometric and colorimetric instrumentation, Color scanners, Displays, Scientific electronic cameras, Digital still cameras and video cameras.

Charge-Coupled Device (CCD): linear and array architectures. Charge transfer. Progressive scan. Time delay and integration. CCD performance, CMOS sensor: linear and array architectures. Design variants. CMOS performance, Color cameras: linear and array architectures. Bayer mask. RGBE filter. Dichroic beam splitter prism, Foveon X3 sensor. Multispectral devices.

Optical holography. Recording and reconstructing thick holograms. Digital holography. Holographic data storage. Holographic interferometry. Speckle and applications.

Literature and study materials:

- Light: science and magic: an Introduction to photographic lighting, Fil Hunter, Steven Biver and Paul Fuqua, Focal Press, 2007.

-Handbook of machine vision, Alexander Hornberg, Wiley-VCH, 2006.

-CCD arrays, cameras, and displays, Gerald C. Holst, SPIE Optical Engineering Press, 1996.

-Light and light sources: High-Intensity Discharge lamps, Peter Flesh, Springer, 2006.

- Solid-state imaging with Charge-Coupled Devices, Albert J.P. Theuwissen, Kluwer Academic Publishers, 1996.

-Goodman, J.W., "Introduction to Fourier Optics", 2nd Ed. McGraw-Hill (New York, 1996).

-VanderLugt, A., "Optical Signal Processing", Ed. John Wiley & Sons, 1992.

- Hariharan, P. "Optical holography. Principles, Techniques and Applications", Cambridge Studies in Modern Optics, Cambridge University Press, New York, 1996.

-T. M. Kreis, Handbook of Holographic Interferometry, Optical and Digital Methods. Berlin: Wiley-VCH, 2005.

- Hunt, R.W.G., "The Reproduction of Colour ", 6th Ed. John Wiley & Sons, 2004.

- Bass, M., "Handbook of Optics, Vol. 1 Fundamentals, Techniques and Design", 2nd Ed. Optical Society of America, 1995.

- Berns, R.S., "Billmeyer and Saltman's Principles of Color Technology", 3rd Ed. John Wiley & Sons, 2000.

- Chirigov, V. G., "Liquid Crystal Devices. Physics and Applications", Artech House, 1999.

- Holst, G. C., "Electro-Optical Imaging System Performance", 4th Ed. JCD Publishing and SPIE Optical Engineering Press, 2006.

- Holst, G. C., Lomheim, T. S., "CMOS/CCD Sensors and Camera Systems", JCD Publishing and SPIE Press, 2007.

- Sproson, W. N., "Colour Science in Television and Display Systems", Ed. Adam Hilger, 1983.

- Yadid-Pecht, O., Etienne-Cummings, R. (Eds.), "CMOS Imagers: From Phototransduction to Image Processing", Kluwer Academic Publishers, 2004.

Digital Printing and Publishing

1. Digital printing technologies: overview of digital printing, electro photography, ink-jet (thermal, piezoelectric, continuous), thermography, computer-to-plate (CTP), computer-to-press (direct imaging DI) etc.

2. Digital Prepress: digital photography, scanners, screening techniques, page description languages- PostScript, PCL, PDF (PDF/X and it's flavors), raster image processor (RIP), workflow integration, color management.

3. Digital Proofing: technologies used for digital proofing, hard proofing, soft proofing, halftones simulation (dot proofing), remote proofing, preflight, SWOP/GRACoL certification for proofing systems.

4. Evaluation of Quality: objective (colorimetric) and subjective (visual) assessment of printing technology (devices), image quality attributes, print quality verification tools, standardization - ISO, SWOP, GRACoL.

5. Variety of Applications: customization and direct marketing, Print-on-Demand (POD), variable data printing (VDP), distribute-and-print, remote publishing (Web2Print), wide-format printing, specialty applications (particularly of inkjet) like 3D printing, printing on microscopic items etc.

6. Trends in Digital Printing: evolution of technologies, current market share of different technologies, promising developments (e.g. Xerox iGen3, HP Z-series inkjet printers with in-built spectrophotometer etc), future trends, eco-friendliness

Literature and study materials:

1. Brett, G, Digital Prepress Technologies, Leatherhead: Pira International, 2001.
2. Brett, G, Short-run Digital Colour Printing, Leatherhead: Pira International, 2001.
3. H. Kipphan, Handbook of Print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg, 2001.
4. Lake, M., The future of Digital Colour Printing: Key global markets and Forecasts, Leatherhead: Pira International, 2004.
5. Martin, G., Non-impact Printing, Leatherhead: Pira International, 1993.
6. Smyth, S., Digital Commercial Printing, Leatherhead: Pira International

Standardization in Printing and Packaging

1. Introduction – Understanding Pre-Press, Printing Processes such as Offset, Flexo, Gravure, and Post-Press, Pre-Press requirements for the processes, Process configurations, Process Variables.
2. Printing Standards – SWOP (Specifications for Web Offset), GRACOL, IFRA, ISO Standards etc, Implementation of standards for Quality Printing, Standardization of Pre-Press & Press, Calibration Process.
3. Quality Control in Printing – Density, Dot gain, Contrast, Trap, Color deviation, Color Variation, Quality control aids in Printing, Automatic Viscosity controller, Auto registration marks, Trakatron Line, Color Spaces, Gamuts, CIE LAB
4. Quality Management – Quality challenges, Fundamental concepts of Quality, Quality Cost, Specification of Quality, Quality Assurance, Concepts of Six Sigma & its implementation in Printing Industry.
5. Statistical Print Process Control – Process, Variations, Types of Variation, implementation of SPC, Control Charts and its types, Use of Control charts for print application, Control charts for variables, Control charts for attributes
6. Process Analysis - Understanding Process Capability, Capability indices, Process Performance & indices, Corrective actions, Parametric and Non-parametric, Analysis of Variance concepts. SNAP and INCQC specifications.

Paper IV**Digital Image Processing and Analysis**

Introduction and overview of image processing; Image formation & sensing; sampling & quantization; pixel connectivity; digital images format . Arithmetic/logic operations; 1-1 image processing; gray level transformations, Histogram processing; thresholding, Spatial filtering; smoothing; sharpening; Laplacian; gradient and other derivative filters, Filtering in the frequency domain; lowpass filters; highpass and other filters; Fourier transform, Image restoration; noise reduction using spatial filters; adaptive filtering; noise reduction using frequency domain techniques; image degradation; inverse filters, Point, line and edge detectors; operators, Image segmentation; region growing; region splitting and merging; region adjacency graph, Color images; color spaces; color space transformations; pseudocolor transformations; Color image transformations and color image processing, Image analysis; texture analysis; features extraction; shape descriptors, Pattern recognition; template matching; correlation; graph matching; objects recognition.

Literature and study materials:

- Digital Image Processing, 3rd Edition (DIP/3e), by Rafael C. Gonzalez and Richard E. Woods, Prentice Hall (2008)
- Digital Image Processing Using MATLAB (DIPUM), by Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, Prentice Hall (2004).
- Color Image Processing: Methods and Applications (Image Processing), by Rastislav Lukac & Kostantinos N. Plataniotis, CRC (2006)
- The Image Processing Handbook, Fifth Edition (Image Processing Handbook), by John C. Russ, CRC (2006)

Optical Engineering

Introduction: Overview of light models: geometrical, electromagnetic and quantum. Basic concepts: refraction index, ray and optical length. Light propagation: rays in homogenous and heterogeneous media. Reflection and refraction laws. Fundamentals of Electromagnetic Optics: Electromagnetic waves characteristics. Electromagnetic spectrum. Plane and spherical waves. Intensity. Coherence. Polarization: Unpolarized, partially polarized and polarized lights. Types of polarized light: linear, circular and elliptical. Reflection and refraction: Fresnel formulas. Polarization and reflection: Brewster angle. Birefringence. Polarizers. Half- and quarter-wave plates. Liquid crystals. Classical interaction of light with matter: Absorption. Chromatic dispersion. Scattering. Polarization in the Atmosphere. Interferences and diffraction: Double-slit Young's experiment. Multiple-wave interferences. Diffraction phenomena. Huygens-Fresnel Principle. Fresnel and Fraunhofer diffraction. Fraunhofer diffraction through different apertures: rectangular and circular apertures. Diffraction gratings. Imaging systems: Paraxial Optics. Principal planes and points. Focal planes and points. Spherical refractive surface. Mirrors. Prisms. Thin lenses. Thick lenses. Basic optical instruments: the human eye and the photographic camera. Quality of imaging systems: Third-order aberrations. Chromatic aberrations. Diffraction-limited systems, resolving power, Quantum Optics: Photons. Matter quantization. Basic processes between energy levels: absorption, spontaneous emission and stimulated emission.

Literature and study materials:

- "Optics" E. Hetch. Addison Wesley 2000.
- "Fundamentals of Photonics" B.E.A. Saleh and M.C. Teich. Wiley, 1991.
- "Introduction to Color Imaging Science" H-S Lee. Cambridge 2005.

Paper V

Data Analysis and Statistics

Basics of multidimensional statistical analysis. Principal component analysis, non-negative matrix factorization. Data classification: Bayesian classifier, k-NN classifier, basics of neural networks, Data clustering: k-means clustering, Self-Organizing map, Spectrum estimation and reconstruction: PCA, polynomial, classification/clustering based method, Classification and clustering validity testing: leave-one-out, ground truth. Application of basic statistical and data analysis methods to color and image data. Introduction to complexity theory. Why is complexity an important topic? What are the elements that influence the fact that a program solves in an acceptable amount of time a problem? How complexity is computed: recurrences, asymptotics, Concrete complexity, Greediness. Characterization. Examples: minimum spanning trees, other graph algorithms, Divide and conquer. Characterisation. Examples to be added. Many algorithms correspond to trees, Dynamic Programming 1 (due to the importance of this family of algorithms in image processing and pattern recognition.), Examples: HMM algorithms (Forward, Backward, Viterbi), edit distance algorithms. Organising the data, Huffman encoding, red/black trees, heaps, hashing, NP-hard problems. NP completeness, NP-hardness. Reduction techniques. Classes P and NP, polynomial certificate, reductions, Visiting different NP-complete problems. Giving different examples of reductions and therefore of NPcomplete problems: Graphs (coloring, dominating set, clique), strings (longest common subsequence), Randomisation as a means to get results faster with a possible error. Monte Carlo and Las Vegas algorithms. Examples., Combinatorial optimisation: accepting not to find the best solution but hoping for a good one. Gradient descent, Tabu search, genetic algorithms, Ant colonies,

Literature and study materials:

- Sergios Theodoridis, Konstantinos Koutroumbas. "Pattern Recognition", third edition. Academic Press.
- Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Addison Wesley, 2003.
- R.O.Duda, P.E. Hart, and D.G. Stork: Pattern Classification. 2nd ed., Wiley, 2001.

Multimedia Systems & Communication

Demonstrate the importance of planning in a multimedia production environment and some of the tools and techniques used e.g. storyboarding and navigation charts; evaluate techniques used to

capture, edit, store and present multimedia data, in particular images and movies, Demonstrate competencies in the use of a widely used multimedia authoring tool e.g. Macromedia Flash; evaluate the issues involved in multimedia delivery on the World Wide Web, Use a multimedia scripting language to add further interactivity to their applications.

1. Latest developments in multimedia, video, television graphics, animated television graphics, collaboration of different media such as audio, video & animation, authoring.
2. Images in multimedia, digital imaging, image editing, introduction to oops, applying object design to animation process, interactive devices, types of monitors, light pens.
3. Multimedia standards, formats, compression techniques, streaming media, interactivity, recording, editing, morphing.
4. Future of multimedia, software agents, internet radio, internet chat, Online Shopping.
5. Web basics, web publishing, Programming languages such as HTML, DHTML, XML for web page creation, front page software used for creation of web page, internet addresses, IP addresses, protocol and layering, Blogging, Chatting, Mobile communication Systems, Browser and security, search engines, bookmarks.
6. Digital Camera Work, Resolution, Color, Camera Raw, Capturing for Press & online, Meta data & Asset management.

Literature and study materials:

1. William Stallings, Data and Computer Communications, Pearson Prentice Hall, 5th edition.
2. Andrew .S. Tannenbaum, Computer Network, Prentice Hall PTR, 2002.
3. Jessica Keyes, Multimedia Handbook, Mc Graw Hill Publication, 1994.

**Paper VI
Radiometry**

Fundamentals of radiometry: Radiometric quantities and important laws, Photometric quantities: Photometry versus radiometry, radiometric and photometric quantities, Sources: Thermal sources (blackbody and incandescent lamps), gas discharge, luminescent, laser, solid state (light emitting diodes).

Secondary light sources. Transmission, reflection, absorption, Photo detectors: Important features and types (thermal, photoemissive, photoconductive and photovoltaic detectors), Electronics reviews: detector electronics, detector interfacing, Noise in detection. Performance limits, Matrix detectors, Design and calibration of a radiometric system. Measurement uncertainty, Radiometric, spectroradiometric and photometric instruments, Radiometric measurements of satellite observation and remote sensing, Radiometry of laser and coherent sources.

Literature and study materials:

- Wolf, W. L., "Introduction to Radiometry", Ed. By SPIE-The International Society for Optical Engineering (Bellingham, 1998).
- Grum F. and Becherer J., "Radiometry", vol. 1 of "Optical Radiation Measurements", Ed. By Academic Press, 1979.
- Boyd R. W., "Radiometry and the detection of optical radiation", Ed. By John Wiley & Sons, 1983.
- Parr A. C., Datla R. U. and Gardner J. L., editors, "Optical Radiometry", Elsevier Academic Press, 2005.

Color in Industry

Introduction to industrial colorimetry, Color atlases in industry, • Industrial color tolerances, • Color assessment cabinets, Colorant formulation, Whiteness and tint , Color fastness, Metallic and pearlescent colors, Color in soil science, Color in food science, Color in liquid samples: olive oils, wines, etc., Color in graphic arts, Colorimetry in the paper and textile industries.

Literature and study materials:

- G. Wyszecki and W.S. Stiles, Color Science, 2nd Edition. Wiley Classics Library, 2000.

- R. S. Berns, Billmeyer and Saltzman Principles of Color Technology, 3rd ed., John Wiley & Sons, New York, (2000).
- J. Shanda. Colorimetry (Understanding the CIE System). Wiley, 2007.
- R.D. Lozano. El Color y su medición (in Spanish language). Ed. Americalee, 1978.
- The reproduction of colour, R.W.G. Hunt, 6th Ed. John Wiley & Sons Inc., 2004.
- Colour physics for industry, R. McDonald, Society of Dyers & Colourists, (1997).
- ASTM Standards on Color and Appearance Measurements, 5th Ed. American Society for Testing and Materials, 1996.

Sessional 1

Digital Color Imaging Laboratory

1. Write spectral color and image data reading and writing routines by Matlab
 2. Verification of photometry laws.
 3. Spectroradiometric measurements of light sources.
 4. Spectrophotometric evaluation of materials.
 5. Colorimetric characterization of displays.
 6. MTF evaluation of array detectors.
 7. Optical-quality evaluation of multispectral imaging systems in terms of the MTF.
 8. Characterization of digital camera
 9. Simulating diffraction using MATLAB.
 10. Measure of the modulation transfer function (MTF) of an imaging system.
 11. Characterization of printers
- Other Color Imaging Experiments

Paper VII

Design and layout for electronic media

Analyze and respond to a creative brief using appropriate visual metaphors, Demonstrate an understanding of the principles of layout and composition including the use of the grid system, Use web editing packages, HTML mark-up and stylesheets to compose and layout web pages, Demonstrate an understanding of the principles of typography and use graphics packages and web technologies to format type, Create or scan and edit digital images for use in electronic publications

Advanced colorimetry

Weighted color difference equations. Color tolerance experiments. CIE94 and CIEDE2000 color-difference Formulas, Effects of viewing conditions. Achromatic adaptation models. The structure of chromatic adaptation (CAT) models, The appearance attributes of colored materials viewed against a neutral grey background. The appearance attributes of colored areas within images. The influence of surrounding and background color on the appearance of a central color element, The structure of color appearance models: CIECAM97's, CIECAM02. CAM implementation. CAM testing, S-CIELAB color-difference formulae. Image appearance models: iCAM, Visual appearance(color + gloss, translucency and texture), Visual color matching. Instrumental color matching. Image color matching. Introduction to psychophysical methods of assessing of the perceived quality of images, Management of the transfer of color information between image capture devices and image production devices. Device characterization, Gamut mapping algorithms, Device calibration. Concepts of device dependent and device independent methods of color specification. Image quality Measurements. Rendering HDR Images, Whiteness Measurements. Industrial Colorimetry.

Literature and study materials:

- M.D. Fairchild, Color Appearance Models, Second Edition, Wiley-IS&T Series in Imaging Science and Technology, Chichester, UK (2005).
- R. S. Berns, Billmeyer and Saltzman Principles of Color Technology, 3rd ed., John Wiley & Sons, New York, (2000).

- W.D. Wright, 50 years of the 1931 CIE standard observer for colorimetry, AIC Color 81, Paper A3 (1981).
- G. Wyszecki, Current developments in colorimetry, AIC Colour 73, 21-51 (1973).
- Digital color management: Encoding Solutions, E. Giogianni & T. Madden, Addison Wesley, (1992).
- Colour Engineering, Achieving device independent colour, P. Green & L. MacDonald, John Wiley and Sons Ltd, (2002).
- The reproduction of colour, R.W.G. Hunt, Foutain Press, (1995).
- Colour physics for industry, R. McDonald, Society of Dyers & Colourists, (1997)

Total Productive Maintenance in Printing

1. Introduction – Defining TPM, Need & Objectives, Benefits, Stages of implementing TPM in Printing, Tools in TPM – 5 Why, 4M, 5W1H, QA, QX & QM Matrix, One-Point Lesson, Equipment Maintenance – Mechanical Systems Maintenance, Pneumatic Systems Maintenance, Electrical & Electronic Parts- Maintenance.
2. Autonomous Maintenance – Mission, Target, 5S, Routes of Autonomous Maintenance such as initial cleaning, eliminating sources of dirt, inspection & lubrication standards, General inspection, Autonomous inspection, Standardization & Autonomous Management.
3. Focus Improvement – Mission, Target, Effect of Focus Improvement, Overall Equipment Efficiency, Histogram, Pareto Analysis, Brainstorming, Data Collection, Routes of FI to overcome Losses such as Process Waste, Set-Up Waste, Productivity Waste, Short-Stop & Speed Loss.
4. Planned Maintenance – Mission, Target, Routes for Planned Maintenance such as Understanding & Restoring Basic conditions, Maintenance Informative System, Periodical Maintenance, Predictive Maintenance such as Lubricant analysis, Vibration Analysis, Web Break, Noise monitoring, Evaluation of Planned Maintenance, Breakdown Reduction & Analysis for Pre-Press, Press & Post-Press, Mean down Time Reduction, Methods to increase Life-span of spare parts.
5. Quality Maintenance – Mission, Target, Press Optimization & Standardization, Methods for Defect Reduction, Over usage Reduction, Statistical Process Control, Control Charts for subgroups, individual, Run Chart, Runs Test, Quality Tools such as Cause & Effect Diagram, Capability Analysis.
6. Supporting Pillars – Mission, Target & Routes of Training & Education, Office TPM, Safety, Health & Environment, Cost, Logistics, Early Equipment Management.

Literature and study materials:

1. Kenneth E. Rizzo, Total Production Maintenance-A Guide for the Printing Industry, 2nd Edition, GATF Press, July 2001.
2. Nakajima S, Introduction to Total Production Maintenance Productivity Press, 1984.
3. P. Kandasamy, K. Thilagavathi, K. Gunavanthi, Probability Statistics and Queueing Theory, S. Chand Publication, Edition I, 2004.
4. R. C. Mishra & Pathak K, Maintenance Engineering & Management, Prentice Hall of India Publication, 2002.
5. J. Juran, Handbook of Quality Control, Tata Mc Graw Hill Publication, 5th Edition, 1951.
6. N. K. Mehta, Machine Tool & Numerical Control, Tata Mc Graw Hill Publication, 1996.
7. S. R. Mujumdar, Pneumatic Systems: Principles & Maintenance
8. J. K. Sharma, Operation Research-Theory and Application, MacMillan India Ltd., New Delhi
9. Col. D. S. Cheema, Operation Research, Laxmi Publications (P) Ltd.,

Paper VIII

Electronic Image Communication

Imaging infrastructure: display hardware, image storage media and communications technology., Colour spaces: device dependency, gamma correction and sRGB, Lossless image compression: run length, LZW and vector quantization, Colour quantisation: uniform, popularity and median-cut algorithms; performance evaluation; error diffusion, - Digital halftoning: comparison with conventional halftoning; clustered-dot, dispersed-dot; screen angles; AM and FM, Image file

formats: properties, dependencies, details and comparison, Imaging on the web: HTTP, HTML, style sheets and colour fidelity, Image security: cryptography, digital signatures, watermarks and steganography, Page description languages: PCL, Postscript and EPS.

Print Media Communication

1. Introduction to various methods for surface designs with the focus on technical skill and discipline.
 2. Professional practices in competitive and challenging field of surface design. skills used in creating and exploring technical and production design, for paper and board, textiles, ceramics, glass and plastics.
 3. Developing knowledge and solving problem in the field of creative media production including computer aided design, drawing, photography, screen printing. Giving emphasis on developing disciplined approach to design process, considering color and possible product range co-ordinates for final production.
 4. Book design and production, study covering book typography from continuous text to reference and integrated titles. Applications of desk top publishing, treatment of illustration, covers and jackets, costing, estimating and production theory of printing
 5. Newspaper design: Study of methods of designing modern newspaper pages, variety of front-page design methods. Design of inside pages, giving thought to placement of editorial content and problems involved in designing section pages, special pages and editorials.
 6. Standard format versus tabloid format page sizes, column width and the space between columns. Use of computer in creating design for news paper pages.
- Application of printing design concept, Application of digital technology as a tool for creating visual solutions to printing design problems, emphasis given to arrangement of typographic and pictorial elements to illustrate and expand the concepts. Study of appropriate digital software, incorporating typographic makeup

Literature and study materials:

1. Wendy Richmond, Design and Tech - Erasing the Boundaries, Van Nostrand Reinhold, 1990.
2. Alastair Compbell, Designer's Handbook, Laurence King Publishing, 2006.
3. Henry Wolf, Visual Thinking Methods for Images, Rizzoli International Publications, 1990.
4. IFRA publications
5. RIND survey publications

Compression and transmission in media systems

Fundamentals: introduction to compression, quantization, differential coding, transform coding, variable length coding, Run length and dictionary coding

- Still image compression: JPEG, Wavelet transform, Non standard image coding
- Motion estimation and compression: motion analysis and compensation, Block matching, PEL recursive technique, Optical flow, 2D motion estimation
- Video compression: digital video coding, video standards of MPEG-1, applications of MPEG-1, video standard of MPEG-4, video standards of H.261 and H.263
- Compressed video transmission: buffer constraints, video synchronisation, decoding and presentation, video buffer management, video transcoder, transport packet scheduling and multiplexing

Literature and study materials:

Compressed video transmission: buffer constraints, video synchronisation, decoding and "Image and Video Compression for multimedia Engineering (2nd edition – 2008)" by Yun Q Shi and Huifang Sun
."Transporting Compressed Digital Video" by Xuemin Chen

Paper IX

Signals and Systems for Media Technology

Basic math concepts. Notation. Vocabulary. Representation of systems, Complex exponentials., Spectrum plots. AM, Fourier series. FM, Definition of orthogonality. Walsh functions and other basis sets, Sampling theorem. Aliasing., construction. Ergodic processes/Markov models. Choice, uncertainty and entropy. Shannon's fundamental theorem for a noiseless channel. Entropy coding. FIR filters. Impulse response. Convolution. Implementations of general LTI systems. Response of FIR systems. Properties, Definitions. Convolution and the z-transform. Poles and zeros, Definitions. Impulse response and frequency response, Inverse Z-transform. Stability. Partial fraction expansion. The DFT. Fast algorithms, The DTFT Real-world modulation and demodulation methods. Spread-spectrum, Discrete channels with noise. Continuous channels. Error detection and correction.

Fundamentals of spectral science

Spectral measurements: theory and instruments, Spectral characterization of image acquisition systems: experimental determination of spectral response curves, influence of noise, • Mathematical modelization of spectral functions: reflectances, illumination, color signals, etc. Linear and non-linear models: principal and independent component analysis, • Spectral estimation from camera responses: models, algorithms, a priori necessary information, selection of data sets, use of color filters, filter selection, quality evaluation of the spectral signals obtained, influence of noise, Spectral accuracy performance: theoretical and experimental evaluation, • Experimental spectral image acquisition systems, • Applications of spectral imaging.

Literature and study materials:

- Acquisition and Reproduction of color images: colorimetric and multispectral approaches. J.Y. Hardeberg, 2001 (Universal Publishers)
- Color image science: Exploiting Digital Media. MacDonald, Luo, 2002 (John Wiley and Sons)
- Spectral Imaging: Eighth International Symposium on Multispectral Color Science. Mitchell Rosen, Francisco H. Imai, Shoji Tominaga, 2006, SPIE.
- Remote sensing digital image analysis: an introduction. Richards, Xia., 2006 (Springer).

Web Publishing

ActiveX, CGI (Computer network protocol), Computers / Client-Server Computing, Computer Animation, Computer Graphics , Desktop Applications, Desktop Publishing, Interactive & Web Page Design, World Wide Web, HTML, Java, Electronic publishing/ Web publishing, Web servers Web sites, DBMS

Paper X

Cross Media Colour Reproduction

Additive colour reproduction: spectral and trichromatic colour reproduction, TV cameras, matrixing, Subtractive colour reproduction: limitations, spectral sensitivities for film, - Photographic technology, coloured couplers, inter-image effects, colorimetric densities, analytical densities, Evaluation and characterisation of imaging media: evaluating devices and media, calibration and characterisation, generic and analytical models, Scanner technologies: CCDs and photomultipliers, noise, quantisation, bit depth, Digital camera technologies: trilinear CCD and 2D CCD, viewing conditions, - Characterisation and evaluation of scanners and cameras: dynamic response, linearisation, grey balance, repeatability, uniformity, CRT display technology: phosphors, gamma, offset, ambient flare, - Flat panel and projection displays: LCD, PDP, FED, LED, Characterisation and evaluation of displays: GOG model, short- and long- term repeatability, calibration, Overview of printing systems, Substrated, colorants and digital imaging engines, Analogue printing

technologies, device-independent color reproduction, Characterisation and evaluation of printers. colorant properties and applications; color reproduction by printing, painting, dyeing, photography and television; psychology of color.

Literature and study materials:

- Color Engineering, Achieving device independent color, P. Green & L. MacDonald, John Wiley and Sons Ltd, (2002).
- The reproduction of colour, R.W.G. Hunt, Foutain Press, (1995).

Entrepreneurship

Printing industry in India-Background, Printing plant layout, Work-flow in printing establishment, Organizational structure of a printing press, Elements of computing production and evaluating norms, Office routine and procedure, Functional and planning aspects in running a printing press. Material Management, Scope and function of estimating, Introduction to cost estimation, Interrelation of cost estimating and other plant activities. Procedure for estimating ,quoting and selling. Production standards and budgeted hourly rates for use of standard production data, Methods of establishing production standards, Maintenance of records, Establishing pro- rata costing, Computer aided printing estimating and management, Customer Relation and Enterprise management, market research, management of resources including human resources, management of technology and innovations, issues related to sourcing and finance management. Introduction to Laws relating employment, taxes, excise, customs, power, communication, utilities, and infrastructure facilities, valuation, contracts and negotiations, export zones . Laws affecting a printing establishment, publisher and authors. Green Printing