GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Printing Technology

Subject Code : DI04058031

Subject Name : Digital Imaging and Color Management

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	PCC

Prerequisite:	Basic knowledge of different pre-press and graphic design
Rationale:	This course deals with digital advancement in graphic art industry. To understand this course student must have knowledge about printer's design. In this course student will acquire the basic knowledge about color, color scanners, color imaging systems. Greater emphasis is laid to understanding the reproduction process utilizing scanners, operating systems, digital image capturing & digital proofing. For digital printing and other printing processes the knowledge of this course is essential.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Evaluate the given original.	R, A, E
02	Propose type of screen.	R, A, E
03	Convert given original in to digital form.	R, A, E
04	Modify given digital image to print ready format.	R, A, E
05	Apply color management process for the given digital image.	R, A, E
06	Suggest color model for the given digital image.	R, A, E
07	Measure different color parameters.	R, A, E

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
Unit – I Basics of color reproduction	1.1 Different types of graphic originals and their characteristics, required physical and optical properties. 1.2 Fundamentals of light and color, color reproduction theories, optical density in graphic reproduction, color viewing requirements – object, observer, light source spectral properties such as line spectrum, continuous spectrum, spectral - reflection, transmission & absorption of light, difference between light and color, visible spectrum, rods & cones in human vision, metamerism and adaptation, Attributes of color-Hue, Value, Chroma.	04	12
Unit– II Raster image processing	2.1 Raster image processing (RIP)-purpose, function, types, ideal and actual reflection of CMY process inks, proportionality failure, additives failure. 2.2 Color correction tools such as under color removal (UCR), grey component replacement (GCR). 2.3 Study of color separation; color correction, screen angles, resolutions, dpi, lpi, ppi, filters, spot colors, moire defect, dot shapes, AM, FM & hybrid screening techniques.	05	16
Unit – III Image capturing devices	3.1 Flatbed scanners- working principle, components of scanner. Factors affecting scan quality, scanning resolution, bit depth of colour-definition and importance, 8 bit RGB. 3.2 Image capturing elements and their working principle, applications, advantages & disadvantages of PMT, CCD, CMOS.	07	18
Unit– IV Data inputs and output methods	4.1 Pixel, resolution, bitmap (raster), vector, RGB to CMYK. 4.2 Use of PostScript format, Page Description Language (PDL), PDF formats for printing industry, preflight-purpose, and workflow.	06	12
Unit– V Color Management	5.1 Concept, purpose, workflow (Device dependent and Device independent colors), advantages. 5.2 Color gamut - definition, color gamut of different processes, comparision of CMYK, RGB, human vision.	08	12

	5.3 International color consortium (ICC), Four C's of color management, Test charts for different devices and production of different color profiles. 5.4 Comparison of profiles, gamut mapping, is rendering intent, perceptual rendering indent, Relative & Absolute colourimetric intent, saturation intent, CIP4. 5.5 Ink saving by Colour profiles and colour gamut.		
Unit– VI Color Measurement	6.1 Physical color specification systems such as Munsell, pantone along with their working principle, advantages, applications and limitations. Standard observer 2° and 10°. 6.2 Working principle, advantages, applications & limitations of 3D i.e. solid color space such as CIE Lab, CIE Luv.	08	12
Unit – VII Quality Assurance	7.1 Spectrophotometer, Colorimeter, Densitometer - Working principle, construction and applications. 7.2 Calculations based on DPI, PPI, LPI, resizing, file size, and colour deviation (Delta E), dot area, dot gain, ink trapping, hue error (simple numerical). 7.3 Maximum printable LPI for different printing processes, screen angles for different processes, substrates and LPI relation.	07	18
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
28	48	24	NA	NA	NA

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Introduction to Prepress, Hugh M.Speirs, PIRA Intentional ISBN:1858029015
2. Colour Control in Lithography, Kelvin Triton, PIRA Intentional ISBN:1858020360
3. Color Essentials, Gary G.Field, GATF Press ISBN: 0883623862

4. Print and Production Manual, Michael Barnard, Pira International, United Kingdom ISBN 1 85802 238 X
5. Color & Its Reproduction, Gary G.Field, GATF Press, ISBN-13: 978-0883622018
6. Handbook of Print Media, Prof. Dr.-Ing. habil. Helmut Kipphan, Springer-Verlag Berlin Heidelberg New York ISBN 3-540-67326-1

(b) Open source software and website:

1. https://www.youtube.com/watch?v=_2LLXnUdUIc – basics of color
2. https://www.youtube.com/watch?v=5Z417hM-RAA – color theory
3. https://www.youtube.com/watch?v=bXoZVDNt7cE – rods and cone function
4. https://www.youtube.com/watch?v=O8U2ctwWXjQ – structure of human visual system
5. https://www.youtube.com/watch?v=yz-tX6GG9Rw – additive and subtractive theory
6. https://www.youtube.com/watch?v=Nuf_SxGk-iE – tristimulus color theory
7. https://www.youtube.com/watch?v=aA4j9zMM2Ds – ultimate guide to computer color
8. https://www.youtube.com/watch?v=vmX8CJjG2yc – color gamut
9. https://www.youtube.com/watch?v=jAbBOyP86k8 – color perception
10. https://www.youtube.com/watch?v=vkOuRKFtNOY -proofing
11. https://www.youtube.com/watch?v=MVMUbKAIr68 – types of scanner
12. https://www.youtube.com/watch?v=z78PBaAldRQ –working of colorimeter
13. https://www.youtube.com/watch?v=pxC6F7bK8CU – working of spectrophotometer
14. https://www.youtube.com/watch?v=ffWyywysnMw – working of densitometer
15. https://www.youtube.com/watch?v=FMBa5VD5BFU&t=112s – raster image processor

Suggested Course Practical List:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Analyze originals collected from any three sources.	I	02
2	Convert given digital file into print file using RIP operation.	II	02
3	Use AM, FM, hybrid screen for the print file prepared in practical no. 2.	I	02
4	Use flatbed scanner for scanning the given pre-printed original.	II	02
5	Use and practice layer handling tool in Photoshop.	II	02
6	Use and practice pen tool and paths in Photoshop.	II	02
7	Use and practice masks and channels in Photoshop.	II	02
8	Use and practice filter in Photoshop.	II	02
9	Use of RIP software for changing screen angles, ruling and screening.	II	02
10	Change image resolutions of given file and suggest required correction.	II	02
11	Convert given RGB image to CMYK image.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
12	Edit and re-size image scanned by flatbed scanner.	III	02
13	Edit and re-size digital image captured by mobile phone camera.	III	02
14	Edit and re-size digital images captured by digital camera.	III	02
15	Use and practice color adjustment hue, contrast, balance, and tone in Photoshop.	IV	02
16	Use and practice pantone color model to given file.	V	
17	Prepare four color separations of given print file.	IV	02
18	Prepare print ready file with preflight check for given job.	III, IV	02
19	Use and practice change of screen angles during separation for given job.	IV	02
20	Measure density of colour patches using densitometer.	VI	02
21	Calculate ink trapping, hue error, dot gain, dot area and print contrast using densitometer.		
22	Measure L* a* b* value of colour patch using spectrophotometer.	V, VI	02
23	Calculate color deviation using spectrophotometer.	V, VI	02
24	Print color charts on two different digital printers.	V	02
25	Calculate ink trapping and dot gain on coated and uncoated substrate using spectrophotometer.	VI, VII	02
26	Plot dot gain curves for coated and uncoated substrate using spectrophotometer and suggest solid ink density according to substrate.	VI, VII	02
	Minimum 14 Practical Exercises		**28 Hrs.**

Major equipment/ Instruments required

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	**Flatbed Scanner** Scan resolution: 4 800 x 4 800dpi Scan speed (A4, 300dpi): Approx. 8s A4 size, 8 bit, Min. 1200 dpi	4,8
2	**Computer** Windows 11 or Windows 10, 64-bit, with latest Updates Intel Core i3/5/7/9 or AMD Ryzen 3/5/7/9/Threadripper, EPYC OpenCL 1.2-enabled video card with 3+ GB VRAM	4-16

S. No.	Equipment Name with Broad Specifications	PrO. No.
	8+ GB or more recommended 512 GB or more hard disk space 1280 x 720 screen resolution at 100% (96 dpi) DVD drive optional (for box installation); Internet nodes	
3	**Color printer** A3 Color Laser Printer, Copy and Scan Print speed up to 30 ppm (black), 50 ppm (color) USB 2.0, Ethernet, Hardware Integration Pocket **Black and white printer** Laser printer Multi-function Monochrome Black, toner cartridge Copy and scan print speed up to 30 ppm (black) USB 2.0, Ethernet, Hardware Integration Pocket	22
4	Available Print Software – Adobe Photoshop (version 21.1 and above)	4-13
5	**Densitometer, Spectrophotometer** The instrument should measure both reflected and transmitted color as well as transmission haze and meet CIE, ASTM and USP guidelines for accurate color measurement. Tristimulus color calculations are performed from 360 nm to 780 nm. Two reflectance measurement areas Automated UV calibration and control Measurement principle: dual-beam spectrophotometer Wavelength resolution: <2 nm Effective bandwidth: 10 nm equivalent triangular Reporting interval: 10 nm Photometric range: 0 to 150% Photometric resolution: 0.003 % Automatic UV control: 400 nm cut off filter for UV control and UV exclusion. Measurement time: <5 seconds	19-21

S. No.	Equipment Name with Broad Specifications	PrO. No.
	Colorimetric repeatability: < 0.03 ΔE* CIE L*a*b* on white tile in LAV and SAV modes (20 readings range) < 0.05 ΔE* CIE L*a*b* on blue denim tile in LAV and SAV modes Spectral repeatability: Max 0.20 peak-to-peak between 435 nm and 695 nm Interface: RS-232C serial, 19,200 baud, DB9 (female) terminal Operating environment: 10° to 40°C (50° to 104° F), 10 % to 90 % RH, non-condensing. The instrument should come with software for easy data retrieval and statistical computation. Accessories: calibrated instrument white tile, certificate of traceability, black calibration light trap, transmittance zero calibration plate, green diagnostic tile, Wavelength diagnostic filter, reflectance sample clamp, LAV and SAV apertures and other accessories.	
6	Raster Image Processor software	2, 3, 18

Suggested Project List: -

1. Collect the information of various prepress department setup installed in local area/ city.
2. Enlist various software used for the designing, imposition, ripping and give details of work flow of software.
3. Collect samples of daily newspapers to analyze print variation and quality checks.
4. Prepare dummy of book work.
5. Collect information from Prepress unit in Local area about software handling, job category and repeat order.
6. Prepare dummy of Carton.
7. Print and display information about colorimeter.
8. Print and display information about spectrophotometer.
9. Collect different specification of scanners and prepare report on it.
10. Print same image with different screen angle conclude results.
11. Print same image with different types of screen and conclude its results.
12. Print same image with different resolutions and conclude its results.
13. Print same image on different substrates and conclude its results.
14. Collect printed color charts.
15. Compare density of process colors printed on coated and uncoated substrates.

Suggested Activities for Students:

Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

1. Prepare journals based on practical performed in laboratory.
2. Give seminar on relevant topic.
3. Undertake micro-projects.
4. Visit press setups in local area to learn workflow of prepress.
5. Visit pre-press setups in local area to learn workflow of commercial job production.
6. Visit Pre-press setups in local area to learn workflow of publication job production.
7. Visit Pre-press setups in local area to learn workflow of packaging job production.
8. Visit Pre-press setups in local area to learn workflow of label job production.

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