

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

Semester-IV

CourseTitle: Digital Printing

(Course Code: 4345806)

Diploma programme in which this course is offered	Semester in which offered
Printing Technology	4 th Semester

1. RATIONALE

Digital Printing course is aimed at introducing and providing learner with knowledge and practice of latest advancements in non-impact printing technologies. This course also helps learner with to understand evolving segments of technologies in digital printing arena. The advancements in digital technology have lead to revolution in printing and new technology integration is taking place in printing industry. The purpose of this course is to enhance the knowledge and skill level of students in different digital technologies so that students can choose appropriate technology depending upon the nature of work and can make the optimum use of it to improve the quality of printing and reduce the cost.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Choose appropriate digital technology according to nature of work and make optimum use of it in printing**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

- a) Identify the application area of the digital printing process.
- b) Select digital printing techniques as per the job requirement.
- c) Suggest tools and material required for a given product.
- d) Operate equipment and machines in the digital printing department.
- e) Identify the output requirements for given product.
- f) Analysis of printed product output.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	CA	ESE	CA	ESE	
3	-	0	3	30*	70	00	00	100

(): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.*

Legends: *L*-Lecture; *T* – Tutorial/Teacher Guided Theory Practice; *P* -Practical; *C* – Credit, *CA* - Continuous Assessment; *ESE* -End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	Not applicable		
	Total		

Note

- More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Not applicable	
	Total	

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
	Not applicable	

7. AFFECTIVE DOMAIN OUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this competency.

- Work as a leader/a team member.
- Follow ethical practices.
- Follow safety practices.
- Practice good Housekeeping.
- Practice environmental friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Introduction of Non Impact Printing Technology	1a. List application of digital printing technology. 1b. Identify the stages of digital printing process. 1c. Describe the factors that accelerate the development of digital printing technology. 1d. Compare digital printing technology with conventional printing technologies. 1e. List different sustainable development in digital printing	1.1 Definition, application, and factors that accelerated the use and development of digital printing technologies. 1.2 Comparative study of conventional & digital printing technology. 1.3 Advantage, limitation of digital printing techniques. 1.4 Workflow of various digital printing processes 1.5 Sustainable development in digital printing, various factors that affect sustainability,
Unit – II Computer to Press	2a. Describe direct imaging press. 2b. Compare computer to film, Computer to plate and computer to print 2c. Justify the need for Print-on-demand (POD), variable data printing (VDP), & customization	2.1 Direct imaging presses - Principle, types, and Press configurations. comparative study of computer-to-film, computer-to-plate, and computer to print 2.2 Classification of digital printing techniques. 2.3 Print-On-Demand (POD), variable data printing (VDP), distribute-and-print, remote publishing (Web2Print), and customization 2.4 Eco friendly development in computer to press technology,

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – III Toner based Digital Printing system	3a. Describe the working of electrophotography. 3b. Describe photo mechanics behind latent image formation in electrophotography. 3c. List major components of dry and liquid toner 3d. Identify the application of ion deposition, electrostatic, & magnetographic digital printing 3e. List different sustainable development for toner based printing systems.	3.1 Electrophotography working principle, stages, characteristics, types of the photoconductor, construction of OPC drum, functions of charge generation material and charge transport material 3.2 Photo-mechanics behind latent image formation in electrophotography. 3.3 Types, requirements and the general composition of dry and liquid toner. 3.4 Principle, working, advantages, limitation, and application of ion deposition, electrostatic and magnetographic toner-based digital printing system 3.5 Eco friendly toners, imaging, advanced technology for sustainable development, newer drying systems,
Unit– IV Ink Jet and Thermal Transfer Digital Printing systems.	4a. Classify an inkjet printer. 4b. Describe the working of inkjet printer 4c. Describe the working of thermal transfer printer 4d. List substrate used for an inkjet and thermal transfer printing. 4e. Compare the electrophotography and an ink jet digital printing technology. 4f. List different sustainable solution for inkjet and thermal printing systems	4.1 Inkjet technology- principle, classification, press configuration, ink types. 4.2 Thermal transfer- principle, classification, press configuration, ink types. 4.3 Substrate & ink used for inkjet and thermal transfer digital printing system, 4.4 Comparative study of electrophotography and inkjet digital printing technologies. 4.5 Troubles and remedies related to digital printing processes, 4.6 Eco friendly inks, substrates, different features that comes under sustainable development
Unit– V Hardware, Software & digital proofing	5a. Identify the hardware and software used for digital printing system. 5b. Justify the necessity of digital proofing. 5c. List factors affecting output resolution.	5.1 Technical specification of digital printing hardware and output device. 5.2 Digital proofing systems- purpose, soft proofing, hard proofing, remote proofing, pre-flight, advantages and application of digital proofing technology. 5.3 Factors affecting output resolution in

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
		digital printing devices. 5.4 Calculate output resolution of digital printing device.
Unit– VI Digital Printing Press, Application and Advances	6a. Describe wide format printer. 6b. Explain working of color laser and ink jet printer 6c. List advantage of multi color ink jet printer. 6d. Justify the need of integration of prepress, press & post press.	6.1 Wide format printer- construction, classification, working, application, & technical specifications of a general wide format printer. 6.2 Monochrome & multi color laser printer – working, advantages, application and limitation. 6.3 Monochrome & multi color inkjet printer – working, advantages, application & limitation. 6.4 Print solution through the integration of prepress, press and post press.

Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction to Digital Printing Technology	4	4	4	0	08
II	Computer to Press	6	2	4	4	10
III	Toner based Digital Printing system	10	4	4	8	16
IV	Ink Jet and Thermal Transfer Digital Printing systems.	10	2	4	8	14
V	Hardware, Software & digital proofing	6	2	4	4	10
VI	Digital Printing Press, Application and Advances	6	4	4	4	12
Total		42	18	24	28	70

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the

various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Give seminar on relevant topic.
- b. Collect minimum 10 technical specifications of a computer to film, computer to plate and computer to print technology.
- c. Collect minimum 05 printed samples of Ion deposition, electrostatic and magnetographic printing process.
- d. Visit digital press setups in local area to learn the workflow of signage production.
- e. Visit the thermal transfer printer setup and identify the applications of thermal transfer printing.
- f. Visit tonner refilling shop in the local area and observe the process.
- g. Visit wide format press setup in the local area to observe workflow of wide format printer performed on printed jobs.
- h. Attend the installation and maintenance workshop of digital printer hardware.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) Guide student(s) in undertaking micro-projects.
- c) '**L**' in **section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- d) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- e) With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- f) Guide students on addressing environmental and sustainability issues.
- g) Guide student(s) in undertaking micro-projects
- h) Arrange visit to nearby digital printing press for understanding various printing activities.
- i) Use of video/animation films to explain various concepts of digital printing techniques.
- j) Use different instructional strategies in classroom teaching.
- k) Display various graphic products printed by different digital printing processes.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations

where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- a. Collect the information of photoconductor manufacturer and list the material used for photoconductor material and write a report
- b. Enlist photocopy machine manufacturer along with technical specifications.
- c. Identify the working condition required for a digital print setup and prepare a report by viewing the relevant video/industrial visit.
- d. Collect a minimum of 10 printed samples of Print-On-Demand (POD), variable data printing (VDP). Submit a comparative report on it.
- e. Enlist the chemicals used in the digital printing press and write report on it.
- f. Collect information about quality standard followed in the digital printing press and prepare report on it.
- g. Survey safety norms followed at digital printing press also prepare a report on it
- h. Visit the local digital press, identify the substrate and ink used for digital printing techniques and prepare sample book of substrate and ink.
- i. Visit the digital press and observe the workflow of any one type of product and prepare report
- j. Prepare a test chart. Perform printing operation with any two substrates by using an inkjet printer and submit your observations for image test elements.
- k. Prepare a test chart. Perform printing operation with any two types of printer and submit your observations for image test elements.
- l. Survey wide format printer manufacturing companies and write a report.
- m. List the unit cost of substrate and write a report.
- n. Collect information of handling print waste with figures, tables and comparative charts and strategies used. Compile as a report.
- o. Collect information of environment friendly inks available for digital printing process also prepare report on it.
- p. Collect information of sustainable features given in different non impact printing process and write report on it

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Handbook of Print Media	Helmut Kipphan Ed.	Heidelberg Druckmaschinen AG, Springer Heidelberg, Published in

S. No.	Title of Book	Author	Publication with place, year and ISBN
			2001 ISBN 978-3-540-29900-4
2	The Digital Print: Preparing Images in Light room and Photoshop for Printing	Jeff Schew	Peachpit Press, United states of America ISBN-13: 978-0-321-90845-2
3	Print and Production Manual	Michael Barnard	Pira International, United Kingdom ISBN 1 85802 238 X
4	Handbook of Industrial Inkjet Printing	Dr. Werner Zapka	WILEY-VCH, Verlag GmbH & co, ISBN-978-3-527-33832-0
5	Understanding Color Management	Abhay Sharma	Wiley and Sons Ltd, ISBN-9781119223689
6	Digital Printing Pocket Primer	Frank J. Romano	Windsor Professional Information, LLC ISBN:1-893190-01-3
7	Environmental Performance of Digital Printing	Pentti Viluksela, Merja Kariniemi & Minna Nors	VTT Technical Research Centre of Finland. ISBN 978-951-38-7630-2

13. SOFTWARE/LEARNING WEBSITES

- a. <https://www.youtube.com/watch?v=JEVurb1uVFA> – different types of non impact printers
- b. <https://www.youtube.com/watch?v=EwvmNv1leUo> – Electrophotographic Printing Process
- c. <https://www.youtube.com/watch?v=gEBPwRCpqBE> – different digital printing technology
- d. <https://www.youtube.com/watch?v=9yeZSaigBj4> – Thermal ink jet printing
- e. <https://www.youtube.com/watch?v=TSGfitxIkzi> – piezojet inkjet process
- f. <https://www.youtube.com/watch?v=VzEPjyISZjI> – electrostatic inkjet process
- g. <https://www.youtube.com/watch?v=99Jz2JFmp1c> – continuous inkjet printing
- h. <https://www.youtube.com/watch?v=lvvPka0Xd3I> – sublimation transfer
- i. <https://www.youtube.com/watch?v=GZEnnBKFUTQ> – wide format inkjet process
- j. https://www.youtube.com/watch?v=IXh_1U1unyk – digital proofing systems
- a) <http://agpcptech.weebly.com/> - lecture notes
- b) <http://printwiki.org/> - glossary

15. PO-COMPETENCY-CO MAPPING

Semester IV	Digital Printing (Course Code: 4345806)									
	POs and PSOs									
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design / development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning	PSO 1 Design and develop the product and process for the need of the industries and society.	PSO 2 Analyze and improve productivity, quality and cost effectiveness for the various pre-press, press and post press process involved in printing to meet the industries requirement.	PSO 3 (If needed)
Competency	Choose appropriate digital technology according to nature of work and make optimum use of it in printing									
Course Outcomes										
CO a) Identify the application area of the digital printing process	3	2	-	-	2	2	2	2	-	
CO b) Select digital printing techniques as per the job requirement.	3	2	2	-	2	-	-	-	2	
CO c) Suggest tools and material required for a given product.	3	-	2	3	-	2	2	-	2	
CO d) Operate equipment and machines	3	-	-	-	-	-	-	2	2	

in the digital printing department										
CO e) Identify the output requirements for given product.	3	2	-	-	-	2	2	-	2	
CO f) Analysis of printed product output	-	2	-	-	-	2	2	-	-	

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	S. D. Gohel	R. C. Technical Institute, Sola, Ahmedabad	8460609775	sandy_printmedia@yahoo.com
2	V. B. Patel	R. C. Technical Institute, Sola, Ahmedabad	9825219434	vinita_printing@yahoo.com
3	D. D. Raval	R. C. Technical Institute, Sola, Ahmedabad	9879551606	ravaldevang9@gmail.com