GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Printer's Science
(Course Code: 4335802)

Diploma programmes in which this course is offered	Semester in which offered
Printing Technology	Third

1. RATIONALE

Knowledge of Basic Sciences course enabled students to learn and understand science related to various materials used in printing and allied industry. This course is prepared to provide students with a structured content to learn important materials like substrates, inks, rollers and blankets used for various printing processes. It will cover technical aspects of the manufacturing process of various materials used in printing press. Students will explore various stages, raw materials, applications of different substrates and inks. A combination of technical laboratory applications and theory will provide the foundation for this course. After completion of this course, a student can understand properties and requirements of different raw materials, flow of manufacturing process.

2. COMPETENCY

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

- **Select appropriate substrates and inks for particular product**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Select appropriate paper for particular printing process
b) Test the quality of paper and board
c) Select appropriate film for particular printing process
d) Select appropriate ink for particular printing process
e) Choose substrate and ink to promote sustainability and environment protection

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of Cos, and the remaining 20 marks is the average of 2 tests to be

taken during the semester for 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) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** (in approx. Hrs column) 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
1	Measure grammage of 3 paper and 3 board samples	I	02*
2	Measure thickness, number of plies of the given paper board	I	02
3	Measure pH value of paper samples, inks, fountain solution	I	02
4	Measure bursting strength of a given paper and board samples	I	02
5	Measure tensile strength of a given paper and board samples	II	02
6	Measure COBB value of paper and board sample	II	02
7	Demonstrate folding strength testing procedure for paper and board samples	II	02*
8	Measure tearing strength of a given paper sample	II	02
9	Analyze seal strength of 3 plastic films	II	02
10	Analyze peel strength of 3 plastic films	II	02*
11	Measure smoothness of maplitho and newsprint paper	II	02*
12	Demonstrate objective test of offset ink for length and tack	II	02
13	Perform acids, alkali, detergent resistance tests for offset ink	II	02
14	Perform rub and scratch resistance testing for offset and screen printing samples	III	02*
15	Analyze any two press stability parameters of given ink	III	02
16	Analyze light fastness of offset and screen printed samples.	III	02
17	Measure opacity and density of given printing ink samples.	IV	02*
18	Perform draw down test on CMYK inks	IV	02*
19	Measure dyne value of film	IV	02*
20	Measure viscosity of liquid inks	V	O2*
21	Measure viscosity of paste inks	V	02
22	Measure hardness of roller, blanket, flexographic plate	V	02
23	Measure % of moisture in paper and board		
	Minimum 14 Practical Exercises		**28 Hrs.**

Note

i. *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.*

ii. *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 %
1	Use of tools, instruments and equipments	30
2	Test the substrates and ink samples	30
3	Able to answer the questions	20
4	Individual work and working in groups	10
5	Submission of assigned work	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This 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.
1	**Digital Weighing Balance** Display : green LED Repeatability: ±0.02g Liner: ±0.03g Interface: rs232	1to 28
2	**pH meter, conductivity meter, TDS meter** pH Range: 0.00 to 14.00 pH pH Resolution: 0.01 pH pH Accuracy: ±0.05 pH pH Calibration: automatic, at one or two points with two sets of standard buffers (pH 4.01 / 7.01 / 10.01 or pH 4.01 / 6.86 / 9.18) pH temperature compensation: automatic EC range: 0 to 3999 µS/cm EC resolution: 1 µS/cm EC accuracy: ±2% F.S. EC calibration: automatic, one-point at TDS range: 0 to 2000 ppm (mg/L) TDS resolution: 1 ppm (mg/L) TDS accuracy: ±2% F.S. TDS calibration: automatic, one-point at	1 to 28
3	**Micro Screw Guage** Range: 0-1 Inch Accuracy: ±0.0001 Inch Mass: app. 175g	02
4	**Dyne value pen** No of pen: 20 Dyne value: 30,34,38,40,42,46, Dynes/ CM	1 to 12
5	**Ink proofing kit** Tape width: 20-40 mm Usage: drawdown Model: manual Printing width : 50 mm	12 to 28

S. No.	Equipment Name with Broad Specifications	PrO. No.
	Printing length: 110 mm Roll diameter: 35 mm Roll length : 50 mm	
6	**Spectrophotometer** The instrument should measure both reflected and transmitted colour as well as transmission haze and meet CIE, ASTM and USP guidelines for accurate colour measurement**.** Tristimulus colour 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 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	12,15,16,18
7	**Bursting strength tester** TESTER FOR PAPER / BOARD (TAPPI – T 403 om-91 / TAPPI – T 810 om – 92 / TAPPI – T 807)/ (ISO 2758:2014 / ISO 2759 : 2014) Board tester: Fitted with moulded rubber diaphragm to test material with higher burst values like paperboard, corrugated board, etc. Range: 0-35/70 kg/cm2). Gauges range: 0 to 7 & 0 to 35/70 kg/cm2	04

S. No.	Equipment Name with Broad Specifications	PrO. No.
8	**Tensile strength tester** Crosshead travel: 650 mm (25.6") Throat depth: 125 mm (4.9") (5 kN) 67 mm (2.6") (7.5 kN) Height: 1089 mm (42.9") Width: 330 mm (13") Depth: 570 mm (22.4") Weight: 70 kg (155 lbs Range: 0.01-1200 mm/min (0.0004 - 47.2"/min) Accuracy at steady state: <50 mm/min = ±0.5% of indicated speed or ±0.05 mm/min (whichever is greater) 50 - 500 mm/min = ±0.2% of indicated speed >500 mm/min = ±1% of indicated speed Resolution: 0.001 mm/min (0.00004"/min) Voltage: 230 V AC 50 Hz or 110 V AC 60 hz Operating temperature: 10 - 40°C Humidity range30% - 80%, non-condensing As per: ASTM D3039 IS standard ISO 1924-2:2008	05
9	**Tearing strength tester** Force for pendulum : 1600, 3200 & 6400 gm force Constant radius of Tear: 38 mm Unit Scale range: 0 -100% Slit Size: 20 mm Zero: adjustable zero Point Calibration Check weight At: 1600gf, at 3200gf, at 6400g Clamps: flat type Legs: Adjustable legs Material of main body: mild steel blades single edged	08
10	**COBB Tester** Test area (standard): diameter 112,8 mm 100 cm2 Water depth: 10 mm Water volume: 100 ml Conditioning roll mass: 10 ± 0,5 kg Diameter of conditioning roll: 90 ± 10 mm Power supply : manually operated Surface that can be tested: 100 cm2 ISO 535, DIN-EN 20535, TAPPI T-441	06
11	**Falling bar viscometer** Falling rod size: diameter 12mm x 300 mm Falling rod weight: 132g Timing precision: 0.01 s Viscosity range of interest: 2-200 Pa.s (non Newtonian fluid) Mass of the weight load: 25,50,100,200,500,1000 g Total weight: 18 kg Power supply: 220V 50Hz	22

S. No.	Equipment Name with Broad Specifications	PrO. No.
12	**Zahn cup and ford cup viscometer** **Zahn Cup:** ASTM D 816, ASTM D 1084,and ASM D 4212 Volume of cup: 44 ml Length of handle: 40 ±0.1 mm Height of cup: 58 ±0.1 mm Measurement of temperature: 25°C ±1.0 °C Material: stainless steel Calibration: certificate included **Ford Cup** **As per ASTM D1200** Diameter orifice: 2.1mm – 5.8mm viscosity range : 10 – 1200 cSt flow times : 30-100 sec Supplied with a certificate of conformity Sheen 406/1, 406/2, 406/3, 406/4 & 406/5 equivalent	21
13	**Hardness tester** Durometer - Rubber Hardness Series A Type: Handheld Dial Durometer Range: 10 to 90 Dial Reading: 10-90 Indenter shape: blunt taper Depth: 1.3 in Height: 7.4 in Width: 2.3 in Tip Angle: 35 degrees ASTM D 2240, DIN 53 505, ISO 7619, ISO868, JIS K 6253, JIS K 7215	23
14	**Hygrometer** Display: digits LCD with backlight Measuring range : 0-95% Operating conditions: Temperature: 0-60°C Humidity: 5%-85%RH Resolution: 0.1 Accuracy: ± 0.5%	24
15	**Smoothness Tester** **Bendtsen porosity** Roughness and porosity tester in mm/min. Gurley units porosity conversion. Display: LCD Full statistic functions: min./max., average, standard deviation, variance, porosity value in µm/Pa.s. Measuring range: 0 to 5000 ml/min Pressure selection: 0.74, 1.4, 2.20 kPa. Automatic sample detection trough included sensor.	11

S. No.	Equipment Name with Broad Specifications	PrO. No.
16	**Rub Resistance Tester** Test weight: 2 psi Counter: 4- digit digital preset type Least count of counter: 1 Rotational speed: 60 rpm ± 2 rpm Motor high torque capacity Diameter of upper Clamp: 48 ± 2 mm Diameter of lower Clamp: 120 ± 2 mm Power: 220V, 50Hz, single phase	14

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.

a) Work as a leader/a team member.
b) Follow safety practices
c) Practice Good housekeeping
d) Follow ethical practices
e) Realize the importance of green energy.

The ADOs are best developed through 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

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that is formulated for the development of the COs and competency. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics

Unit – I **Paper and board manufacturing process**	1a. List raw materials for paper 1b. Demonstrate cellulose pup manufacturing process 1c. List out stages in paper manufacturing 1d. Illustrate functioning of paper manufacturing machine 1e. Differentiate between mechanical pulping and chemical pulping 1f. Distinguish between fourdriner process and twin wire process 1g. Classify different papers 1h. Suggest the pulping process, raw materials, paper finish for particular paper 1i. Illustrate functioning of paper board manufacturing machine 1j. Classify different boards	1.1 Introduction to paper and pulp, cellulose fiber sources, Non fibrous materials: sizing agents, fillers and loading materials, coloring agents, Additives, chemical processing 1.2 Manufacturing of pulp, raw material preparation, mechanical pulping, chemical pulping, semi chemical pulping, Screening, cleaning, bleaching 1.3 Stages involved in manufacturing of paper, stock preparation, beating and refining metering and blending, addition of non fibrous additives 1.4 The construction and working of paper manufacturing machine: flow box, wire section, press section, drier section. 1.5 Types of papers: printing and writing papers, uncoated papers, coated papers, new print paper, map litho paper etc 1.6 Paper board manufacturing machine, 1.7 Finishing treatments: calendaring coating, conditioning, super-calendaring, cutting, slitting, bundling, packing 1.8 Paper board – terminology, structure and raw materials used 1.9 Functioning of paper board manufacturing machine 1.10 Classification of paperboards on different basis
Unit– II **Properties of paper and board**	2a. Explain strength related properties of paper 2b. Classify surface related properties of paper 2c. Identify chemical composition related properties of paper 2d. Select optical properties of paper 2e. Identify structural properties of paper 2f. Recognize different storing methods for paper and board	2.1 Mechanical strength properties: Bending resistance, elongation, hardness, ply bond/scott bond bursting strength, tearing strength, folding strength, tensile strength wet strength, stiffness 2.2 Surface properties: water absorbency, smoothness, pick resistance 2.3 3Chemical composition related properties: relative humidity, pH, Moisture content, Ash content 2.4 Optical properties: Brightness, color, gloss, opacity, whiteness

		2.5 Printing properties: printability and runnability 2.6 Structural properties: Basis weight and grammage, caliper and bulk, compressibility and resiliency, dimensional stability, grain direction, curl and sheet flatness, internal bond strength, and porosity 2.7 Relative Humidity, Hygrometry, requirements for pressroom and storage, printing requirements, climate, building construction, AC equipment
Unit– III **Film Manufacturing and end use requirement**	3a. List applications of polymer substrates 3b. Illustrate manufacturing process of polymeric substrates 3c. Determine properties of polymer substrate 3d. Explain packaging requirement of polymer film	3.1 Classification and application of polymer substrates 3.2 Manufacturing process of film: blown extrusion, sheet and film extrusion, co-extrusion process, 3.3 Different film material: PE, HDPE, LDPE, PS, PP, PET, PVC,PVOH, EVA, PA, PC etc. 3.4 Different resistance properties of polymeric films: tensile strength, tear strength, impact strength, heat seal strength, of, haze and gloss, WVTR, gas permeability, dimensional stability, maximum and minimum use temperature, environmental stress crack resistance 3.5 Surface treatments methods used in applications of polymeric films
Unit– IV **Printing inks**	4a. Determine different ink terminologies 4b. Identify different ingredients used for ink manufacturing 4c. Recognize ink requirement of different printing processes 4d. state formulation for different printing inks 4e. Identify different ink manufacturing process. 4f. explain different drying methods used for various printing processes 4g. Identify different testing done on printing inks	4.1 Classification and general properties of inks used in printing 4.2 Pigments: classification, examples and applications 4.3 Vehicles: classification, functions and compositions 4.4 Resins: natural resins and synthetic resins 4.5 Additives: Plasticizers, waxes, wetting agents, stiffening agents 4.6 Dryers: liquid dryers, paste dryers, inhibitors, accelerators 4.7 General requirement of offset, screen, gravure, flexographic ink 4.8 Formulation of offset, screen,

	4h. Identify different testing done on printed substrates	gravure, flexographic ink 4.9 Manufacturing process of ink: oil based ink, milling and mixing, liquid ink manufacturing process 4.10 Ink drying methods: absorption, oxidation, polymerization, evaporation, UV drying, EB drying, LED drying, IR drying 4.11 Testing on printing ink: Flow properties, press stability, drying time on paper, lithographic performance, printability, ink film thickness 4.12 Testing on print: color and gloss, rub resistance, light resistance, resistance to water, solvent, alkali, acid, soap, detergent, oil and fats, waxes
Unit – V Sustainability in substrate and ink manufacturing	6a. Discuss different recycling process for paper and substrate 6b. List different renewable sources for paper 6c. Recognize different environmental impact of paper and plastic industry 6d. Identify different deinking processes. 6e. Identify impact of solvents and VOC	6.1 Recycle of paper, recycling process, 6.2 Renewable sources for paper, FSC 6.3 Eco friendly paper 6.4 Environmental impacts of paper and plastic industry 6.5 Sustainability Challenges in the Paper and plastic Industry 6.2 Deinking: conventional deinking, enzymatic deinking, ultrasonic treatment, floatation deinking, wash deinking 6.3 Impacts of solvents and VOCs

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Paper and board manufacturing process**	10	6	8	6	20
II	**Properties of paper and board**	6	2	6	4	12
III	**Film Manufacturing and end use requirement**	8	6	6	4	16
IV	**Printing inks**	14	8	4	6	18
V	**Sustainability in substrate and ink manufacturing**	4	2	2	0	4
Total		**42**	**24**	**26**	**20**	**70**

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

Note*: This specification table provides general guidelines to assist students in their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to 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.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related ***co-curricular*** activities that can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct the following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidence for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare journals based on practical performed in laboratory
b) Give seminar on relevant topic
c) Undertake micro projects
d) Market survey for innovative ideas
e) Collect specimen of different substrates and inks
f) Prepare catalogue for different types of paper
g) Collect different types of ink
h) Recent trend on paper for recyclability
i) Recent trend for film for recyclability
j) Prepare report on latest government guideline for uses of plastic

11. 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/subtopics.
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 how to address issues on the environment and sustainability.
g) Guide students for using type manuals, color charts, Pantone books.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, 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 a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro-project should be about **14**-**16** ***(fourteen to sixteen) student engagement hours*** during the course. The students 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) Identify and collect paper samples from various printed products
b) Collect the information of paper samples and list finishing operations performed on it
c) Survey regarding paper manufacturing companies and write a report.
d) Collect the printed paper samples of various printing processes.
e) Survey safety norms followed during paper manufacturing and write a report
f) Survey the cost of different paper samples used for printing
g) List the unit cost for different paper samples and write a report
h) List the unit cost for different paper boards samples and write a report
i) Identify polymer substrate used for different printing process.
j) Collect information about types of inks used of different printing process
k) Survey the type of substrate and ink type used for it.
l) Survey the energy source used for different ink drying methods and write report
m) Enlist the hazardous chemicals used in paper manufacturing industry.
n) Enlist the safety rules followed by ink manufacturing industry.
o) Collect the information on green printing and write a report
p) List down printing unit which uses green energy for printing plant and prepare report regarding requirement of energy and cost calculation
q) Prepare a report on deinking process.
r) Prepare a report on alternative sources for plastic in current market

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with the place, year, and ISBN
1	Printing materials : Science and Technology	Bob Thompson	Pira International Printing Guide ISBN 1858029813, 978185802981
2	What the printer should know about paper	William H. Bureau	GATF Press, Pittsburgh, USA,1997, ISBN-13 : 978-0883622100
3	What the printer should know about ink	Dr. Nelson R. Eldred	GATF Press, Pittsburgh, USA,2001, ISBN-13 : 978-0883622841
4	Materials in Printing Processes	L C Young	Focal Library Library of Printing Technology ISBN: 0240507568, 9780240507569

S. No.	Title of Book	Author	Publication with the place, year, and ISBN
5	The Wiley Encyclopedia of Packaging Technology	Kit L. Yam	Wiley, ISBN: 9780470541395, 9780470087646
6	The Printing Ink Manual	R H Leach, Robert Leach, Ray Pierce	Springer ISBN:

14. SOFTWARE/LEARNING WEBSITES

a) https://www.youtube.com/watch?v=E4C3X26dxbM : paper making
b) https://www.youtube.com/watch?v=SDyJVr1q9kg : paper making
c) https://www.youtube.com/watch?v=_TIXpY5oE0E : mechanical pulping
d) https://www.youtube.com/watch?v=dwctkBfPyvs : paper production
e) https://www.tappi.org/
f) https://www.sappi.com/
g) https://www.youtube.com/watch?v=aSjz7OUR31c: blown film manufacturing
h) https://www.youtube.com/watch?v=pgRjZK2rvmk: cast extrusion
i) https://www.youtube.com/watch?v=Fypi6dAJB8E: ink manufacturing process

15. PO-COMPETENCY-CO MAPPING

Semester I	Text Generation (Course Code: 4325801)						
	POs						
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
Competency .	Select appropriate substrates and inks for particular product						
Course Outcomes COA) Select appropriate paper for particular printing process	3	2	-	3	2	-	2
COB)	3	2	-	3	2	-	2

Test the quality of paper and board							
COC) Select appropriate film for particular printing process	3	2	-	3	2	-	2
COD) Select appropriate ink for particular printing process	3	2	-	3	2	-	2
COE) Choose substrate and ink to promote sustainability and environment protection	3	2	-	3	3	-	2

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
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