GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: FLEXOGRAPHIC PRINTING PROCESS
(COURSE CODE: 3355805)

Diploma Programs in which this course is offered	Semester in which offered
Printing Technology	5th Semester

1. RATIONALE

This Course provides an understanding of the historical developments of Flexographic Printing Process. It covers information regarding flexographic image carrier, detailed process, technical advancements and its limitation. This course will be particularly useful for students seeking a future in packaging fields as well as Label Industry.

2. LIST OF COMPETENCY:

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competencies…….

- Demonstrate printing through Flexographic printing process

3. COURSE OUTCOMES:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Describe Flexographic process.
ii. Configure Flexographic machine.
iii. Select appropriate plate, cylinder, inks and other accessories for Flexographic printing job.
iv. Print packages and labels on Flexographic Printing machine.
v. Operate and maintain Flexographic Printing machine.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	0	2	6	70	30	20	30	150

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Student Activity; **P** –Practical; **C** – Credit;; **ESE** –End Semester Examination; **PA** – Progressive Assessment.

5. DETAILED COURSE CONTENTS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-I Introduction of Flexography Printing Process.	1a. Describe Flexographic printing process. 1b. State merits and demerits of Flexographic printing process. 1c. Differentiate between Flexographic and other process. 1d. Describe Image Processing for Flexographic printing process	1.1 History and development 1.2 Advantages and Disadvantages of Flexographic printing process. 1.3 Comparison with other Printing process. 1.4 Image Processing for Flexographic printing process - Original, Films, Need for special colors and variables. 1.5 Application of Flexographic printing process.
Unit– II Design Consideration	2a. Identify design consideration for flexographic reproduction. 2b. Describe different parts of plate. 2c. Describe effect of thickness on elongation 2d. Compute image elongation for the given data 2e. State application of Different parts of printing Plate – Floor, Shoulder, Base, Back, and Floor-depth.	2.1 Design consideration for flexographic reproduction. 2.2 Effect of thickness on elongation. 2.3 Shrinkage allowance. Calculation of image elongation 2.4 Different parts of printing Plate – Floor, Shoulder, Base, Back, and Floor-depth.
Unit– III Image Carriers	3a. Illustrate procedure for Flexographic Rubber printing. 3b. State procedure for making of Flexographic Photopolymer printing plate. 3c. State merits and demerits of Flexographic Photopolymer printing plate 3d. State procedure for making of Flexographic CtP printing plate. 3e. State merits and demerits of Flexographic CtP printing plate. 3f. Listing the components , describe Computer to plate (CtP) process with block diagram	3.1 Rubber plates – Different stages in Rubber plate making – a) master pattern metal engraving : engraving, etching of metal, screen ruling, screen angle, dot shapes, spectral requirements for flexography b) matrix moulding: matrix press (vulcanizer), setting the thickness of control bearers, Procedure of matrix moulding c) Rubber plate moulding: Types of Rubber, storage method, deciding plate thickness, setting the thickness of control bearers. d) Metal backed rubber plate, magnetic plate mounting system. 3.2 Photopolymer plates- a) Varieties of photopolymer – physical & chemical. b) Liquid & sheet plates- construction,

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	3g. Compare visible light and thermal ablation method of computer to plate 3h. State advantages of CtP plates system over conventional plate making methods	stages in making, trouble-shooting, comparison & quality control. c) Plate mounting equipments, problems and remedies in plate mounting 3.3 Computer to plate (CtP) a) Block diagram, components, ideal systems, comparison between visible light and thermal ablation method, advantages of CtP plates system over conventional plate making methods b) Plates for CtP Flexography- laser engraved rubber rollers, integral mask systems.
Unit– IV Printing machines	4a. Differentiate between different configurations of flexographic printing machine with its construction, application, merits and demerits. 4b. Describe plate cylinder and its mounting. 4c. Explain impression cylinder and its construction and loading. 4d. Differentiate between various inline operation, drying systems and static electricity and its elimination.	4.1 Different machine configurations. - Construction, application, merits and demerits, problems in different configurations. a) Inline b) Stack c) Common impression cylinder d) Sheet fed presses e) Hybrid presses (Flexo Printing Machine with arched bridge Stack Type, 4.2 Plate cylinder- construction and its types: integral, demountable, sleeves, and magnetic, zero setting, plate mounting devices and tapes. 4.3 Impression cylinder- loading method: pneumatic or hydraulic. Impression (Tympan bar) construction , tension control, Impression adjustment 4.4 Inline converting operation- slitting, laminating, punching coating, dye cutting etc. 4.5 Drying systems. 4.6 Static electricity- causes for generation of static electricity, troubles created by static electricity and methods used to eliminate static electricity

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit– V **Ink Metering Systems.**	5a. Describe different ink metering system with its purpose. 5b. Explain construction of fountain roll, anilox roll. 5c. State different specifications of anilox roll. 5d. Describe different engravings method of anilox roller.	5.1Purpose of ink metering 5.2Different ink metering systems. a)Standard two roll inking systems. b)Two roll inking systems with doctor blade c)Reverse angle doctor blade systems d)Chambered doctor blade systems 5.3Fountain roll- construction, types of roll coverings, requirements and properties, drive mechanism, storage and quality control. 5.4Anilox Roll a)Specifications- cell wall, land, depth, opening, cell count, cell volume, cell angle, depth to opening ratio. b)Different types of engravings on Anilox roll and methods of engraving. Considerations for choosing proper anilox roll.
Unit - VI **Inks for Flexography**	6a. Select ingredients used in flexographic ink. 6b. Describe physical and chemical properties, application, advantages, disadvantages and end user requirements	6.1 comparison of liquid ink and paste ink 6.2 ingredients of Flexographic ink- dyes, pigments, Vehicles, and solvents with their types, 6.3 classification of Flexographic ink- water based, solvent based, U.V. inks- composition , properties, and areas of application, advantages and disadvantages 6.4 Different end user requirements of flexographic products- ink adhesion, scratch, rub and block resistance, weather resistance, gloss, coefficient, of friction test, etc. 6.5 Solvent recovery.
Unit – VII **Substrates for Flexography**	7a. Explain different substrates. 7b. Describe different Surface Treatments its need and theory behind Surface treatment and environmental control in press room.	7.1Different Types and its properties. 7.2Labels materials and its construction. 7.3Absorbent substrates- paper, paperboard, corrugated board, printing characteristics and properties. 7.4Non-absorbent substrates- Polyethylene, Polyester, OPP, BOPP, PVC, PS, Cellophane, Metalized paper and films, pressure sensitive film and substrates printing

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		characteristics and physical properties. 7.5 Surface Treatments- Need and theory behind surface treatment, Method employed Corona, Gas Flame, and Chemical Coating. 7.6 Dispatch, Bar coding 7.7 Environmental Aspects
Unit – VIII Issues related to Flexography Printing	8a. Identify problems occurring and troubleshoot them. 8b. Describr registration procedure of Flexographic print.	8.1 Problems and their causes with remedies. 8.2 Identification of Flexographic print. 8.3 Storage of Plates and rollers. 8.4 Flexographic proofing system. 8.5 Registration control

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks (Duration – 2.5 Hours)			
			R Level	U Level	A Level	Total
I	Introduction of Flexography Printing Process.	10	0	4	4	08
II	Design Consideration	10	2	2	4	08
III	Image Carriers	04	0	2	4	06
IV	Printing machines	06	2	4	4	10
V	Ink Metering Systems.	04	2	4	4	10
VI	Inks for Flexography	06	0	4	4	08
VII	Substrates for Flexography	06	2	4	4	10
VIII	Issues related to Flexography Printing	10	2	4	4	10
	Total	**56**	**10**	**28**	**32**	**70**

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF PRACTICALS:

The practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills **(Outcomes in cognitive, psychomotor and affective domain)** so that students are able to acquire the competencies.
Following is the list of practical exercises for guidance.

Note*: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of* ***Programme Outcomes/Course Outcomes in affective domain*** *as given in a common list at the*

beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain

Sr. No.	Unit No.	Practical / Exercises (Outcomes in psychomotor domain)	Approx Hrs. Required
01	I	Identify the different parts of Flexographic machine and demonstrate their working.	06
02	IV	Set the feeding unit of Flexographic machine	04
03	IV V VI VIII	Set Printing unit of Flexographic machine Set Doctor blade of Flexographic machine Set impression roller of Flexographic machine Registration control of Flexographic machine	08
04	IV	Set Delivery unit of Flexographic machine	02
05	III III III III III	Preparation of Rubber Plates Preparation of Sheet photo Polymer Preparation of Liquid Photopolymer Transfer from Computer to Flexographic Plate Apply Cylinder correction methods	04
06	VIII	Operate Flexographic proofing machine.	04
		Total Hrs.	**28**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Students will prepare Assignments for the above mentioned Topics.
ii. Students will learn Flexographic printing process used in industry and compare chart of various facility or innovative function.
iii. List common troubles in Flexographic printing.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Arrange Industrial Visit of Flexographic Printing Process.
ii. Arrange visits to Exhibition of Flexographic Printing Process.
iii. Arrange Experts Seminar of industry person in the area of Flexographic Printing Process.

10. SUGGESTED LEARNING RESOURCES

A. List of Books:

S. No.	Title of Books	Author	Publication
1	Hand book of Printmedia	Helmut Kipphan	Springler (ISBN 3-540-67326-1)
2	Flexography Principles and Practices		FTA
3	Flexographic primer		GATF

B. List of Major Equipment/ Instrument.

I. Flexo Printing Machine with arched bridge Stack Type, for
II. **Printing material :-** Film, paper, aluminum foil, pet ,bopp,pvc
III. film,polyster,bolyster,poly,matelized film etc
IV. **Number of colors:-** 1 - 10 colors
V. **Web Width:-** 20" to 80"
VI. **Web roller:-** Aluminum rollers or steel rollers
VII. **Machine speed:-** Up to 250 m/min
VIII. **Unwind type :-** Single fixed shaft type or 2 shaft turret type unwinder
IX. **Reel diameter :-** 1000 mm(approx)
X. **Unwind shaft :-** Air shaft, tapper cone with solid shaft or shaft ness
XI. **Tension controller :-** Manually & auto registration control system (A.C. Motor)
XII. **In feed unit:-**Synchronized control (A.C. Motor)
XIII. **Printing Unit:-**
XIV. **Frame:-** Cast iron
XV. **Cylinder :-** Diameter - 100 mm to 300 mm
XVI. **Chucking :-** Shaft with taper cone
XVII. **Drying system :-** Single chamber impingement slot dryer (electric, thermic oil, hot air generator, etc.)'
XVIII. **Doctor Blade :-** Manual & numetic doctor blades
XIX. **Ink system :-** S. S. ink tray
XX. **Registration system:-** Manually & auto registration control system
XXI. **Out feed unit:-** Synchronized control (A.C. Motor)
XXII. **Rewinder:-**
XXIII. **Reel diameter :-** 1000 mm(approx)
XXIV. **Rewind shaft :-** Air shaft, taper cone with solid shaft or shaft ness
XXV. **Tension controller :-** Manual & Fully automatic control system (A.C. Motor)

i. Image Processing unit for Flexographic printing process with consumables
ii. Computer to plate (CtP) unit for Flexographic printing process with consumables
iii. Flexographic Rubber printing machine

C. List of Software/Learning Websites.

i. http://flexographicprintingmachine.co.in/
ii. http://flexographic-printing-machine.com/Flexographic-printing-machine.html
iii. http://flexoprintingmachine.co.in/index.html#

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE.

Faculty Members from Polytechnics

- **Prof. B. l. Patel,** I/C Head of Department of Printing Technology, RCTI, Ahmedabad.
- **Prof. S. D. Gohel,** Lecturer in Printing Technology, RCTI, Ahmedabad.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Nishith Dubey,** Professor, Department of Vocational Education and Entrepreneurship Development.
- **Prof. Joshua Earnest,** Professor, Department of Electrical and Electronics Engineering