GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Knitting Technology
(Course Code: 4362904)

Diploma programme in which this course is offered	Semester in which offered
Textile Manufacturing Technology	Sixth

1. RATIONALE

Knitting technology has been playing a very important role in textile industry. Due to continuous research and development, new inventions have taken place in the area of knitting. New technologies and equipment have entered the market, to produce better quality fabric at cheaper costs. Knitting is second most popular technique of fabric formation and its unique feature of extensibility of fabric and other favorable properties are in good demand. It not only produces fabrics and shaped garments for apparel and household purposes but also for various technical end applications. Knitting is comparatively simpler and faster technique of fabric formation. The aim of this course is to develop the competency of operating such knitting technological equipment used in the industry. This course is important for textile engineers as liking for knitted textile is increasing day by day due to better comfort provide by knitted textile as compared to woven textile. This course covers all aspects of weft and warp knitting technology and design.

2. COMPETENCY

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

- **Apply knowledge of knitting technologies to develop different design structures of knitted fabrics**.

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) Compare warp and weft knitting techniques.
(b) Knit using latch, beard and compound needles.
(c) Use knowledge of weft knitting to produce different weft knitted structures.
(d) Select needles to maintain weft knit quality.
(e) Use knowledge of warp knitting to produce different warp knitted structures.

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	0	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 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	Identify the important features of knitting.	I	02*
2	Describe the principle of warp and weft knitting.	I	02*
3	Compare warp and weft knitting technology.	I	02*
4	Demonstrate the working of latch, beard and compound needle.	II	02*
5	Describe the weft knitting cycle by latch needle.	III	02*
6	Demonstrate the cam system for weft knitting machine to produce different weft knitted stitches.	III	02*
7	Draw the design of the different primary based weft knitted structures.	III	02*
8	Draw the design of the following weft knitted structures. (a) Single pique (b) Double pique(c) Ponto-de-roma (d) Milano Rib (a) Gabardine(b) Poplin	III	02*
9	Develop design of the derivatives of single and double jersey structure.	III	02*
10	Identify the weft knitted fabric defects.	IV	02*
11	Describe the wrap knitting cycle by beard needle.	V	02*
12	Demonstrate the working of needle bar motion, shogging and swinging motions of warp knitting machine.	V	02*
13	Develop the design and chain link of the following warp knitted structure. (a) Full tricot (b) Locknit (c) Reverse locknit (d) Satin (e) Loop raised (f) Queen's cord (g) Atlas and pillar (h) Sharkskin (i) Tulle (j) Morquisette (k) Voile.	V	02*
14	Calculate production of weft knitting machine.	III	02*
	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 which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Identify components	10
2	Prepare of an experimental setup	20
3	Operate the equipment setup	20
4	Follow safe practices measures	10
5	Record observations correctly	20
6	Interpret the result and conclude	20
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 practical in all institutions across the state.

S. No	Equipment Name with Broad Specifications	PrO. No.
1	Circular Weft Knitting machine: Single jersey knitting machine, Gauge: 14 -30, Dia: 15"-38", Basic 2 track/ 4 track, No of feeders: 3 per inch, Speed of machine: 20 - 28 rpm With suitable motor.	1 to 6
2	Tricot Warp Knitting machine: Working width /gauge: 130"- 290"/E24- E36. Working Speed: 50-1900 rpm, Bars/Knitting Elements: Individual Needle Bar, Sinker bar and min 2 Guide Bars. All Bars and Beds are Made of Carbon-fibre-reinforced Material.	12 to 15

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 course t competency.

a) Work as a leader/ team member.
b) Follow safety practices while using textile equipment.
c) Realize the importance of green energy.
d) Practice environmentally friendly methods and processes.

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 are 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 attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit–I Basics of Knitting technology	1a. Differentiate between woven and knitted fabric structure and properties. 1b. State the general terms used in knitting. 1c. Describe the principle of weft knitting. 1d. Describe the principle of warp knitting. 1e. Differentiate between warp and weft knitting. 1f. Classify weft and warp knitting machine.	1.1 Introduction to knitting. 1.2 Comparison of woven and knitted fabric structure and properties. 1.3 Reasons for growth of knitting. 1.4 Basic terms and definition used in knitting- stitch, stitch length, stitch density, course, wale. 1.5 Principle of weft knitting. 1.6 Principle of warp knitting. 1.7 Comparison of weft and warp knitting 1.8 Classification of weft and warp knitting machine.
Unit–II Knitting Needles	2a. Identify different parts of the spring beard ,latch and compound needle. 2b. Describe the functions and working of spring beard, latch and compound needle. 2c. Explain the merits and demerits of spring beard, latch and compound needle.	2.1 Spring Beard needle-Construction, knitting action, Advantage & disadvantage. 2.2 Latch needle- Construction, knitting action, Advantage & disadvantage. 2.3 Compound needle-Construction, knitting action, Advantage & disadvantage.
Unit–III Weft knitting	3a. State the types of yarns used for weft knitting. 3b. Explain passage of material through circular weft knitting machine. 3c. Describe the function of the circular weft knitting machine elements. 3d. Describe knitting cycle in weft knitting by latch needle. 3e. Identify the weft knitting structural elements. 3f. Differentiate between the different weft knitted stitches. 3g. Interpret the design features and	3.1 Yarns for weft knitting. 3.2 Passage of material through simple circular weft knitting machine. 3.3 Circular weft knitting machine elements: • Needle cylinder. • Construction and function of sinker. • Cam system. 3.5 Knitting cycle in weft knitting by latch needle. 3.6 Weft knitting structural elements: Needle loop, Sinker loop, face loop stitch, Reverse loop stitch, Technical face side, Technical back side, Close loop, Open loop. 3.7 Formation of various weft knitted stitches: Knit, Tuck, Miss or Float. 3.8 Design features and properties of

	properties of various weft knitted structure. 3h. Explain the different weft knitted structures with sketches. 3i. Identify different types of weft knitted structure. 3j. Explain the ornamentation of single and double jersey structure. 3k. Describe derivatives of single and double jersey structures. 3l. Calculate production of weft knitting machine.	various weft knitted structure. • Basic weft knitted structures: Plain, Rib, Interlock, Purl. 3.9 Non-jacquard double jersey structure: Single pique, Double pique, Ponto-de-roma, Milano Rib, Gabardine, Poplin. 3.11 Ornamentation of weft knitted structure: • Single jersey structures, Horizontal stripes, Twists, Fancy yarns. • Double jersey structure 3.12 Derivatives of weft knitted structure : • Single jersey: Knit and Float; Knit and Tuck; Knit, Float and Tuck (Accordian type structure). • Double jersey: Rib structures: Half cardigan, Full cardigan, Interlock structures: Eight lock. 3.13 Production of circular weft knitting machine.
Unit–IV Needle Selection and Quality of Weft Knit Design.	4a. Differentiate needle selection for weft knit design. 4b. Explain use of computer in designing and patterning. 4b. Describe the test for weft knit quality. 4c. Identify weft knitted fabric defects. 4e. Explain environmental aspects in knitting industry.	4.1 Needle selection for weft knit design. • Non-Jacquard, Jacquard. 4.2 Use of computer in designing and patterning. 4.3 Quality of weft knit fabrics. 4.4 Test for weft knit quality. 4.5 Weft knitted fabric defects causes and remedies. 4.6 Environmental aspects in knitting industry.
Unit–V Warp Knitting	5a. State different types of yarn used for warp knitting. 5b. Differentiate between warp knitting Elements. 5c. Describe warp knitting cycle by beard needle. 5d. Describe needle bar, guide bar swinging and shogging mechanism. 5e. Explain pattern mechanism for warp knit design. 5e. Construct the chain link for warp knitted structure. 5f. Describe the various warp knitted structural elements. 5g. Interpret the different warp knitted structure with sketches.	5.1 Yarns used for warp knitting, yarn preparation for warp knitting. 5.2 Wrap knitting machine elements. 5.3 Knitting cycle in warp knitting by beard needle. 5.4 Needle bar mechanism, Guide bar swinging mechanism, Guide bar shogging mechanism, Pattern mechanism for warp knit design-pattern chain links-chain link notations and preparation. 5.4 Warp knitted structural elements: open lap, closed lap, underlap, overlap, swinging, shogging. 5.5 Warp knitted structure, properties and their representation: Full tricot, Locknit, Reverse locknit, Satin, Loop raised, Queen's

	5h. Calculate production of warp knitting machine.	cord, Atlas and pillar, Sharkskin, Tulle, Morquisette, Voile. 5.6 Production of circular warp knitting machine.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Knitting technology	04	4	4	2	10
II	Knitting Needles	04	2	6	2	10
III	Weft knitting	16	6	10	8	24
IV	Needle Selection and Quality of Weft Knit Design	06	2	4	2	08
V	Warp Knitting	12	6	8	4	18
Total		**42**	**20**	**32**	**18**	**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.*

10. 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 small reports of above 5 page for each activity, also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Collection of different warp and weft knitted fabric samples.
b) Prepare a report on circular weft knitting machine element and weft knitting cycle.
c) Prepare a report on warp knitting machine element and warp knitting cycle.
d) Visit a nearby knitting unit, and prepare a report with suitable machinery sketches.
e) Present a seminar PPT on any of relevant topic of the knitting technology.
f) Prepare chart of different warp and weft knitted structure design, properties and application.
g) Prepare internet based assignment course topic wise.
h) Explore library/internet facilities for preparing report on weft and warp knitting techniques.
i) Literature survey of knitting technology.

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/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 how to address issues on environment and sustainability.
g) Guide students for using data manuals.

12. 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 (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 dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-15** ***(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) **Sample collection:** Collect the sample of different weft and warp knitted fabric sample and prepare a chart with specifications.
b) **Knitting Needles:** Collect sample of different types of needle and prepare a report on construction and knitting action of needles.
c) **Weft Knitting:** Prepare a chart or small model of basic weft knitting machine, Create wire models of basic weft knitted structure and different types of stitches with important features.
d) **Needle Selection and Quality of Weft Knit Design:** Prepare a report on needle selection and quality parameters of weft knit design.
e) **Knitted fabric defects analysis:** Prepare a report on identification of various defects observed in knitted fabric, provide reasons for those defects and suggest possible remedies to avoid them.
f) **Warp Knitting:** Prepare a report on Warp knitting machine elements and knitting cycle, Create wire models of warp knitted structure with chain link notation.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Knitting Technology	D.B. Ajgaonkar	Universal Publishing corporation, Mumbai ISBN 10 818502734X ISBN 13 9788185027340
2	Knitting Technology	David. J. Spencer	Pergamon Press ISBN, 0080247628
3	Fundamentals and Advances in Knitting Technology	Sadhan Chandra Roy	Woodhead Publishing India in Textile ISBN-10: 9789380308166 ISBN-13: 978-9380308166
4	Knitting Fundamentals, Machines, Structures and Developments	N. Anbumani	New Age International Publications ,Jan 2006 ISBN-10. 8122419542 ISBN-13. 978-8122419542
5	Advances of Knitting Technology	Au, K F	Woodhead Publishing ISBN: 9780081017173

14. SOFTWARE/LEARNING WEBSITES

i. http://en.wikipedia.org/wiki/Warp_knitting
ii. www.to-knit-knitting-stitches.com/related-knitting-websites.
iii. https://archive.nptel.ac.in/courses/116/102/116102008/
iv. https://archive.nptel.ac.in/courses/116/102/116102056/
v. https://www.slideserve.com/adrian-gonzales/warp-knitting-basics
vi. https://www.slideshare.net/88azmir/weft-knitting
vii. https://www.textileblog.com/category/knitting/
viii. https://www.fibre2fashion.com/industry-article/8087/weft-knitted-fabrics-and-derivatives

15. PO-COMPETENCY-CO MAPPING

Semester VI	Knitting Technology (Course Code: 4362904)						
	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 5 Project Management	PO 7 Life-long learning

Competency .	Apply knowledge of knitting technologies to develop different design structures of knitted fabrics.						
CO a): Compare warp and weft knitting techniques.	1	-	2	1	-	1	2
CO b): Knit using latch, beard and compound needles.	2	1	2	2	-	2	3
COc): Use knowledge of weft knitting to produce different weft knitted structures.	2	2	3	2	1	2	3
CO d): Select needles to maintain weft knit quality.	-	1	2	3	2	-	2
CO e): Use knowledge of wrap knitting to produce different warp knitted structures.	2	3	2	2	1	2	3

*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

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Smt. P. M. Parmar Lecturer in Textile Manufacturing Technology	R. C. Technical Institute, Sola, Ahmedabad.	079-27664785	pritimparmar84@gmial.com
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