GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P22)

with effect from AY 2022-23

Programme: Diploma in Rubber Technology (Sandwich Pattern) **Term / Semester - IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME22407	Production and Industrial Engg.	3	2		5	5	60	20	20	-		25	**125**
RT22403	Basic Machine Tools and Operation	3	2	-	5	5	60	20	20	25	-	25	**150**
MG22402	Entrepreneurship Development	1		2	3	3					25	25	**50**
RT22404	Vulcanization Systems	3	4	-	7	7	60	20	20		25	25	**150**
RT22402	Rubber Comp. and Product Testing	3	4		7	7	60	20	20	25		25	**150**
RT22405	Rubber Comp. Materials	3	4		7	7	60	20	20	25*		25	**150**
RT22401	Thermoplastic Elastomer	3			3	3	60	20	20		-		**100**
	Total	**19**	**16**	**2**	**37**	**37**	**360**	**120**	**120**	**75**	**50**	**150**	**875**
Student Centered Activity (SCA)					**03**								
Total Contact Hours					**40**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

*** Indicates assessment by External Examiner else internal assessment, # indicates self, on- line learning Mode, @ indicates on line examination**

Note: Duration of Examination--TS1&TS2 -1hour, TH- 2:30 hours, PR/OR – 3 hours per batch, SCA- Library - 1 hour, Sports- 2 hours, Creative Activity-2 hours

Self, online learning Mode through MOOCS /Spoken Tutorials / NPTEL / SWAYAM / FOSSEE etc.

Coordinator,
Curriculum Development,
Department of Rubber Technology

In-Charge
Curriculum Development Cell

Head of Department
Department of Rubber Technology

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: **ME22407**				**Course Title**: **Production and Industrial Engineering**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				**Examination Scheme**						
L	**P**	**TU**	**Total**	**TH (2 Hrs 30 min)**	**TS1 (1 Hr)**	**TS2 (1Hr)**	**PR**	**OR**	**TW**	**Total**
3	**2**	**--**	**5**	**60**	**20**	**20**	**-**	**-**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Manufacturing involves resources like men material and machines. All these resources are to be used in such that produce is ready at a proper time, quality as per customer requirement, at most competitive price. This is only possible when all the resources are used in a most productive way.

This course will expose the students, the concept of productivity, production systems production planning, work study and modern production system.

This course will help students to take the right decisions to optimize resources utilization by improving productivity and manage effectively, to eliminate unproductive activities and design of products and processes, to use the charts to record, the activities of the people, materials and equipment to find alternative methods which minimizes waste and to implement the best method.

Course Outcomes: Student should be able to

CO1	Interpret production systems and productivity and plant layout.
CO2	Prepare the process plan for given job
CO3	Describe the production planning and control functions and modern techniques of production control.
CO4	Apply the techniques and tools for method stud
CO5	Apply the techniques and tools for time study
CO6	Describe the principles of motion economy & ergonomics

Course Content Details:

Unit No	Topics / Sub-topics
1	**Production Systems & Plant Layout** 1.1 Types of Production Systems-Batch production, Job Production and Continuous production system, and their comparison 1.2 Productivity: Definition of productivity, Labour productivity, Material productivity and Machine productivity. Methods of improving productivity 1.3 Plant Layout: Objectives, Types of plant layout, Principles of plant layout design, Factors affecting plant layout, Symptoms of bad plant layout **Course Outcome: CO1 Teaching Hours:08 Marks: 10 (R-2, U-4, A-4)**
2	**Process planning** 2.1 Process planning for a product, Sequence of operations, Operation sheet 2.2 Types of operations, Combining of operations 2.3 Determination of inspection stages **Course Outcome:CO2 Teaching Hours:07 Marks: 10 (R-2, U-4, A-4)**
3	**Production Planning and Control (PPC) & Modern production control Techniques** 3.1 Importance and definition of PPC, Functions of PPC, 3.2 Operation routing, Job Sequencing (n jobs and 2 machines) 3.3 Gantt chart, Line balancing 3.4 Production economics, Elements of costing 3.5 Just in time system, Kanban, Lean manufacturing system, Flexible manufacturing system, Kaizen **Course Outcome:CO3 Teaching Hours: 08 Marks: 10 (R-2, U-4, A-4)**
4	**Method Study** 4.1 Definition and objectives of method study, Procedure of method study, Selection of work for method study 4.2 Charting techniques: Outline process chart, Flow process chart, , Flow diagram, Travel chart 4.3 Critical examinations and analysis, primary and secondary questions, Comparison of present and proposed methods **Course Outcome:CO4 Teaching Hours: 08 Marks:10 (R-2, U-4, A-4)**

5	**Time Study** 5.1 Definition and objectives of time study. Procedure, Equipment required to conduct time study, 5.2 Factors affecting rate of work, Types of elements, Rating and allowances, 5.3 Calculation of standard time 5.4 Introduction to Maynard Operation Sequencing Technique (MOST) **Course Outcome:CO5 Teaching Hours:07 Marks:10 (R-2, U-4, A-4)**
6	**Principle of motion economy & Ergonomics** 6.1 General considerations related to human body, tools and equipment and work place layout. 6.2 Two handed process chart, Multiple activity chart, THERBLIGS 6.3 Definition, importance and objectives of ergonomics, Man- machine system and its three aspects 6.4 Design of information display, Design of controls, and environmental factors **Course Outcome:CO6 Teaching Hours:07 Marks:10 (R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Production Systems & Plant Layout**	2	4	4	10
2	**Process planning**	2	4	4	10
3	**Production Planning and Control (PPC) & Modern production control Techniques**	2	4	4	10
4	**Method Study**	2	4	4	10
5	**Time Study**	2	4	4	10
6	**Principle of motion economy & Ergonomics**	2	4	4	10
	Total	**12**	**24**	**24**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Design of plant layout for manufacturing of given product (In group of 4 students)	4
2	1	CO1	Assignment on production systems and productivity	2
3	2	CO2	Preparation of Process plan and operation sheet for given component (In group of 4 students)	4
4	3	CO3	Preparation of PPC documents for assigned product	2
5	3	CO3	Assignment on job sequencing and line balancing	2
6	4	CO4	Preparation of outline process chart and flow process chart for the assigned task	2
7	4	CO4	Method study for the existing system and improved system for performing assigned task	4
8	5	CO5	To conduct time study for a assigned activity	4
9	5	CO5	Case study on application of MOST	2
10	6	CO6	Preparation of two handed process chart for the given task	2
11	6	CO6	Ergonomic analysis of man-machine system on any machine in workshop	2
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Introduction to Work Study	International Labor Organization, Geneva, Oxford & IBH, 4th Revised Ed, 2015	978-8120-4060-25
2	Production Planning and Control	L C Jhamb, Everest Publishing House, 7th Ed, 2002	978-8186-3142-41
3	A Text Book of Production (operations) Management	L C Jhamb, Everest Publishing House, 7th Ed, 2002	978-8186-3142-41
4	Industrial Engineering and Management	O. P. Khanna, Dhanpatrai Publications, 2018	978-8189-9283-53
5	Industrial Engineering and Production Management	Martand Telsang, S. Chand Publisher, 2nd Revised Ed, 2006	978-8121-9177-35

E-References:

1. **www.inc.com.>john_-rampton**
2. **www.vbengg.com/plantlayout-design**
3. **http://doi.org/10.1007/1-4020-0612-8**
4. **www.ddegjust.ac.in.upload.pom-326**
5. **www.ijsdr.org.paper.IJSDR1765093**
6. **www.yourarticlelibrary.com.costaccounting.timerecording**
7. **www.researchgate.net.publication.271588974**
8. **www.ergonomics.org.uk.public.resources**
9. **www.inestopedia.com/terms/twobinsystem.inventrotycontrol**

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	2	1	1	2	3	1
CO2	2	3	2	1	1	1	2	2	2
CO3	3	2	2	2	1	1	2	1	1
CO4	3	2	2	1	2	1	2	3	3
CO5	2	2	2	3	2	1	3	3	2
CO6	2	2	2	2	2	2	2	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Hiremath Prashant	Engineer	Reliance Industries Ltd. Navi Mumbai
2	Mr. Rao Virbhadra	Assistant Professor	Fr. C.R. College of Engg., Mumbai
3	Mr. Puralkar Mohanish	Manager R & D	Miles Ahead Tech Pvt. Ltd. Mumbai
4	Mr. E.C.Dhembare	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
5	Mr. Ansari N N	Rtd. Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Rubber Technology

Co-Ordinator
Department of Rubber Technology

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Rubber Technology (Sandwich Pattern)**										
Course Code: **RT22403**				**Course Title**: **Basic Machine Tools & Operations**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				**Examination Scheme**						
L	P	TU	Total	TH (2 Hrs 30 minutes)	TS1 (1 Hr)	TS2 (1 Hr)	PR	OR	TW	Total
03	**02**	**-**	**05**	**60**	**20**	**20**	**25**		**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examinerelse internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Manufacturing is the concept which converts raw material into finished product. The technician should be exposed to basic manufacturing processes. Various machines are required to perform the operations on raw materials to convert it into finished product. This course will help the student to get familiarized with working principle of basic machine tools and operations performed on it. Basic knowledge of these machine tools, and processes will help the technician to select most appropriate process for getting raw material converted in to finish product as per the requirement.

Course Outcomes:

Student should be able to:

CO1	Describe construction and various operations carried out on lathe machine.
CO2	Describe construction and various operations carried on drilling machine
CO3	Describe construction and various operations carried on milling machine
CO4	Describe construction and various operations carried on grinding machine
CO5	Describe construction and various operations carried on boring machine
CO6	Describe working principle of various welding processes

Course Content Details:

Unit No	Topics / Sub-topics
1	**Lathe Machines:** Working principle of lathe, Classification of lathe, Parts and their functions of centre lathe, specifications of lathe. Lathe operations- different operations performed on lathe machine turning, facing, chamfering, parting off, knurling, drilling, taper turning, taper turning methods, Safety precautions to be followed while working on lathe machine **Course Outcome: CO1 Teaching Hours :08 hrs Marks: 10 (R-4, U-4, A-2)**
2	**Drilling machines:** Working principle, Classification of drilling machines, parts and their functions of radial drilling machine, specification of drilling machine, Drilling machine operations- different operations performed on drilling machine drilling, boring, reaming, counter boring, Safety precautions to be followed while working on drilling machine **Course Outcome: CO2 Teaching Hours :07 hrs Marks: 10 (R-4, U-4, A-2)**
3	**Milling machine:** Working principle, classification of Milling machines, different parts and their functions of Column and Knee type milling machine, specification of milling machine Milling machine operations - different operations performed on milling machine milling, slab milling, straddle milling, gang milling, end milling, side milling Indexing, principle of indexing, simple dividing head, gear cutting with simple indexing, Safety precautions while working on milling machines **Course Outcome: CO3 Teaching Hours :08 hrs Marks: 10 (R- 2, U-4, A-4)**
4	**Grinding Machines** Working principle, Types of Grinding machines, parts and their functions of bench grinding machine, Specification of grinding machine Grinding operations- , Grinding wheel, abrasives, bonds, grit, grade, structure, Standard marking system for grinding wheel, Safety precautions to be followed while working on grinding machines **Course Outcome: CO4 Teaching Hours :08 hrs Marks: 10 (R-4, U-4, A-2)**
5	**Boring Machines** Working principle, Classification of boring machines, Different parts and their functions of horizontal boring machine, specification of boring machine. Operations of boring machine- Safety precautions while working on boring machine **Course Outcome: CO5 Teaching Hours :07 hrs Marks: 10 (R- 4, U-4, A-2)**

6	**Welding Processes** Principle of welding processes, Classification of welding processes, Arc welding process- working and applications Gas welding (Oxyacetylene welding)- types of flames, working and applications. Resistance (Spot) welding – principle, working and applications. Defects in welding, their causes and remedies Safety precautions to be followed in welding processes **Course Outcome: CO6 Teaching Hours :08 hrs Marks: 10 (R- 2, U-4, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Lathe machines	4	4	2	10
2	Drilling machines	4	4	2	10
3	Milling machines	2	4	4	10
4	Grinding machines	4	4	2	10
5	Boring Machines	4	4	2	10
6	Welding Processes	2	4	4	10
	Total	**20**	**24**	**16**	**60**

List of Experiments:

Sr. No.	Unit No	COs	Title of the Experiments/Assignment	Hours
1	1	1	Performing Plain turning and facing operation on lathe machine	4
2	1	1	Performing step turning and taper turning operation on lathe machine.	4
3	1	1	Performing Thread cutting, grooving, and chamfering operations on lathe machine.	4
4	2	2	Performing drilling and tapping operation on drilling machine	4
5	3	3	Performing gear cutting operation on a blank using milling machine	4
6	4	4	Performing surface grinding of given job on belt /bench grinding machine.	4
7	5	5	Industrial Visit/video demonstration to observe boring operation	2
8	6	6	Preparation of a ‘T’ joint/Lap joint/butt joint using arc welding process	4
			Total	**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Elements of Workshop Technology Vol. I (Manufacturing Processes)	Hajra Chawdhury, Media Promotors and Publications Pvt. Ltd. 15th Ed, 2008	ISBN-978-8185099149
2	Elements of Workshop Technology Vol. II (Machine Tools)	Hajra Chawdhury, Media Promotors and Publications Pvt. Ltd. 15th Ed, 2008	ISBN-9788185099156
3	Production Engineering	P. C. Sharma S. Chand Publications	ISBN-8121901111, ISBN-9788121901116
4	A course in of Workshop Technology Volume.	B S Raghuwanshi, Dhanpatrai & Sons, 2017	ISBN-978-1020092015
5	Introduction to Manufacturing Processes	Jhon Schey, Mcgraw Hills, 2012	ISBN-978-0071-169110

E-References:

www.mechanicalbooster.com
www.britannica.com>technology>modificationofbasicmacinetool
www.nptel.ac.in/content/storage/courses/112105127
www.pds.gov.in>downloads>plastic_processing_techniques
www.blog.robotiq.com>whatarediffferentypesofindustrilarobots
www.nptel.ac.in/content/storage2>courses>pdf
www.easyengineering.nt>maintenenceengineering
www.forgottenbooks.com>downloads>machinefoundationerection

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	2	1	1	2	3	1
CO2	2	3	2	1	1	1	2	2	2
CO3	3	2	2	2	1	1	2	1	1
CO4	3	2	2	1	2	1	2	3	3
CO5	2	2	2	3	2	1	3	3	2
CO6	2	2	2	2	2	2	2	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Dr. V U Rathod	Lecturer in Mech. Dept. , I/C Workshop Supdt.	Govt. Polytechnic, Mumbai
2	Mr. E C Dhembare	Lecturer in Mech. Dept.Co-ordinator Rubber Tech.	Govt. Polytechnic, Mumbai
3	Mr. Sunil Kumar Shrivastav	Senior Lecturer,,in Rubber Technology Dept.	Arizona Techzeal
4	Mr. Sahil Ranoliya	Lecturer, Rubber Technology	Member AIRIA
5	Mr. Sahil Soliya	Lecturer, Rubber Technology	Member AIRIA

Coordinator,
Curriculum Development,
Department of Rubber Technology

Co-ordinator
Department of Rubber Technology

I/C, Curriculum Development Cell

Principal

-

Program: Diploma in Mechanical Engineering /Rubber Technology										
Course Code: **ME22502**				Course Title: Entrepreneurship Development						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				**Examination Scheme**						
L	P	TU	Total	TH (2.30 Hrs.)	TS1 (1 Hr.)	TS2 (1Hr)	PR	OR	TW	Total
1		2	3					25*	25	50

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Globalization, liberalization & privatization along with revolution in Information Technology, have thrown up new opportunities that are transforming lives of the masses. Talented and enterprising personalities are exploring such opportunities & translating opportunities into business ventures such as- BPO, Contract Manufacturing, Trading, Service sectors etc. The student community also needs to explore the emerging opportunities. It is therefore necessary to inculcate the entrepreneurial "values during their educational tenure. This will help the younger generation in changing their attitude and take the challenging growth-oriented tasks instead of waiting for white- collar jobs. The educational institutions should also demonstrate their uniqueness in the creation of enterprising personalities in their colleges. This subject will help in developing the awareness and interest in entrepreneurship and create employment for others.

Course Outcomes: Student should be able to

CO1	Appreciate the concept of Entrepreneurship
CO2	Identify entrepreneurship opportunity
CO3	Understand the Marketing Strategy.
CO4	Collect and use the information to prepare project report for business venture.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction:** 1.1 Definition of Entrepreneur. 1.2 Characteristics of Entrepreneur. 1.3 Functions of an Entrepreneur. 1.4 Barriers to Entrepreneur. 1.5 Distinction between Entrepreneur, Manager and Intrapreneur 1.6 Women Entrepreneur-problems and developing trends 1.7 Entrepreneurship-definition, need **Course Outcome:CO1 Teaching Hours: 3 Hr.**
2	**FROM BUSINESS IDEA TO OPPORTUNITY:** 2.1 Identifying trends, opportunities and ideas. 2.2 Creativity techniques for idea generation. 2.3 Evaluate business opportunities 2.4 Use of SWOT analysis. **Course Outcome: CO2 Teaching Hours: 2 Hr.**
3	**MARKET ASSESSMENT AND PRODUCT FEASIBILITY:** 3.1 Marketing -Concept and Importance 3.2 Market Identification, 3.3 Customer need assessmen, Market Survey 3.4 Meaning and definition of product feasibility 3.5 technical, Market, Financial feasibility including break even analysis. **Course Outcome: CO3 Teaching Hours: 3 Hr.**
4	**SUPPORT SYSTEMS:** 4.1 Information Sources 4.2 Information related to project, procedures and formalities 4.3 Support Systems 4.4 Business Planning & Requirements for setting up an SSI 4.5 Govt. & Institutional Agencies (Like MSFC, DIC, MSME, MCED, MSSIDC, MIDC, LEAD BANKS), Statutory requirements and 4.6 Agencies. 4.7 **Course Outcome: CO4 Teaching Hours: 2 Hr.**
5	**PROJECT/BUSINESS PLAN:** 5.1 Meaning and Importance 5.2 Concept of vision and mission 5.3 Components of project report/profile

	Course Outcome: CO5 Teaching Hours: 3 Hr.
6	**ENTERPRISE MANAGEMENT AND MODERN TRENDS** 6.1 Essential roles of Entreprenem in managing enterprise 6.2 E-Commerce: Concept and process 6.3 Global trends and opportunities. 6.4 Steps in starting small scale industry 6.5 Causes Of Sickness **Course Outcome: CO6 Teaching Hours: Hours: 2Hr.**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction**	-	-	-	-
2	**FROM BUSINESS IDEA TO OPPORTUNITY:**	-	-	-	-
3	**FROM BUSINESS IDEA TO OPPORTUNITY:**	-	-	-	-
4	**SUPPORT SYSTEMS:**	-	-	-	-
5	**PROJECT/BUSINESS PLAN:**	-	-	-	-
6	**ENTERPRISE MANAGEMENT AND MODERN TRENDS:**	-	-	-	-
	Total	-	-	-	-

Legends: R- Remember, U-Understand; A- Apply and above levels (Bloom's revised Taxonomy).

Notes: This specification table shall be treated as a general Guideline and actual distribution of marks may slightly vary from table. Bet the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.

Term Work

Tern work consist of following interactive type assignments. Faculty acts as a facilitator in providing conducive, dynamic environment, exposing students to various aspects of entrepreneurship. Assignments are aimed at compelling the students to critically think and apply the concepts learnt, leading to better insight development.

Sr. No	Assignments	Hours
1	**Assimilation Of Profile Of A Successful Entrepreneurs** Every student will study the biography of a successful entrepreneur and make a write up of two pages, indicating milestone achievements. Summarize the important traits and share their understanding in the peer group.	4
2	**Assess yourself as an-entrepreneur?** Several skills and traits are essential in an entrepreneur. to achieve success What is your potential in this regard? Assess yourself and reflect upon the findings. Faculty will provide you a suitable instrument.	4
3	**Brain Storm To Generate Business Ideas.** Brain storming is a group creativity exercise designed to come out with a number of solutions to a problem. Follow the steps. ✓ State the problem (Ex. What business would you start if you are given Rs Lacs?) ✓ Select the participants ✓ Select a leader ✓ Set the stage Rules to be followed are, ➢ Focus on quantity ➢ Postpone criticism ➢ Build on others ideas ➢ Encourage crazy ideas your aptitude ❖ Make a matrix of advantages and disadvantages of remaining ideas, find which one is oi maximum advantage ❖ Use internet or library and find out at least one source of information for each idea. ❖ Choose one of the business opportunities that suit your life style requirements. ❖ Write vision and mission statement. Set personal financial and non-financial geals you hope to achieve your five years perspective.	4

	Be realistic and be sure to include specific activities for each plan	
4	**Begin To Develop Your Business Plan** ➢ Write a vision and mission statement for the business enterprise ➢ Describe one page report that fully describes your product or service and how it differs from what is currently available. ➢ List your short-, medium- and long-term goals. What steps do you need to achieve each of these goals? Do you foresee any obstacles in attaining them? What are they? ➢ What are the economic, technological or growth trends in this industry? Is the location of your business is a critical factor in its success? Why or why not?	4
5	**Design A Market Strategy:** ❖ Identify the market for your business. Use the secondary data source that could help you assess den and for your product or service. ❖ Based on secondary data, develop a customer profile. Figure out which market segment of your industry you are targeting. Be specific. ❖ Develop a questionnaire to conduct primary data research Coduct a inock survey and analyze the results. Determine what course of action you will take? ❖ Determine who your competitor are, both direct and indirect. Analyse each competitor in terms of price, location, facility, strength and weakness. Determine strategy to deal with each ❖ Write down your strategies for maintaining customer loyalty, and describe why you think each one will work.	4
6	**Find Out Break Even Point for Your Business** ✓ Perform a break-even analysis for your business. ✓ How many units you are required to sell to break even? Is this a feasible number? Why or Why not? Can you think of ways to lower the breakeven point?	2
7	**Feasibility Study Reports** ➢ Make a feasibility study analysis of sample reports provided and discuss your observations in the class. (Group work each consisting 4 students)	2
8	**Interactive Session with An Entrepreneur**	2

	➢ In live conversation with an entrepreneur raise the issues of your Interest pertaining to various aspects of entrepreneurship and make a report on it	
9	**Mini project:** Develop a mini project on a business opportunity incorporating various aspects as per the standard format provided. This activity should be carried out on continual basis, under the guidance of the concerned faculty Components of Project Report: 1. Project Summary (One page summary of entire project) 2. Introduction (Promoters, Market Scope/ requirement) 3. Project Concept & Product (Details of product) 4. Promoters (Details of ali Promoters- Qualifications. Experience. Financial strength) 5. Manufacturing Process & Technology 6. Plant & Machinery Required 7. Location & Infrastructure required 8. Manpower (Skilled, unskilled) 9. Raw materials, Consumables & Utilities 10. Working Capital Requirement (Assumptions, requirements) 11. Market (Survey, Demand & Supply) 12. Cost of Project. Source of Finance 13. Projected Profitability & Break-Even Analysis 14. Conclusion.	4

Notes: If possible am industrial visit should be arranged or videos should be shown of different die and operations

References/ Books:

Sr. No.	**Title**	**Author, Edition and Year Of publication**	**Publisher,**
1	Entrepreneurship Development	Preferred by Colombo plan staff college for technical education	Tata Mc Graw Hill Publishing co. Itd. New Delhi.
2	A Manual on How to Prepare a Project Report	J.B.Patel D.G.Allampally	EDI STUDY MATERIAL Ahmadabad (Near Village Bhat, Via Ahmadabad Airport & Indira Bridge), P.O. Bhat 382428, Gujrat,
3	A Manual on Business Opportunity Identification & Selection	J.B.Patel S.S.Modi	

4	National Directory of Entrepreneur Motivator & Resource Persons.	S.B.Sareen H. Anil Kumar	India P.H. (079) 3969163, 3969153 E-mail: ediindia@sancharnet.in /olpe@ ediindia.org Website http:/www.ediindia.org
5	New Initiatives in Entrepreneurship Education & Training	Gautam Jain Debmuni Gupta	
6	A Handbook of New Entrepreneurs	P.C.Jain	
7.	Evaluation of Entrepreneurship Development Programmes	D N Awastin Jose Sebeastian	
8	The Seven Business Crisis & How to Beat Them.	V.G.Patel	
9	Entrepreneurship Development	Special Edition for MSBTE	McGraw Hill Publications
10	Entrepreneurship Development	-	TTTI, Bhopal/ Chandigarh

2) VIDEO CASSETTES

NO	SUBJECT	SOURSE
1	Five success Stories of First Generation Entrepreneurs	EDI STUDY MATERIAL Ahmedabad (Near Village Bhat. Via Ahmadabad Airport & Indira Bridge). P.C. Bhat 382428, Gujrat, India P.L. (079) 3969163, 3969153 Email : edindiafesancharnet.in/olpe@ediindia.org Website: http://www.ediindia.org
2	Assessing Entrepreneurial Competencies	
3	Business Opportunity Selection and Guidance	
4	Planning for completion & Growth	
5	Problem solving-An Entrepreneur skill	

E-References:

https://en.wikipedia.org/wiki/entrepreneurshipdevelpment

CO Vs PO and CO Vs PSO Mapping (Rubber Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	3	2	2	2	2	2	3	2
CO2	1	3	2	2	3	2	2	3	3
CO3	1	3	2	2	2	2	2	3	2
CO4	1	2	2	2	3	2	2	2	2
CO5	1	3	2	2	2	2	2	3	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mrs. Ashwini Naik	Lecturer in Mech. Dept	Govt. Polytechnic, Mumbai
2	Mr. E C Dhembare	Lecturer in Mech. Dept.Co-ordinator Rubber Tech.	Govt. Polytechnic, Mumbai
3	Mr. Sunil Kumar Shrivastav	Senior Lecturer,,in Rubber Technology Dept.	Arizona Techzeal
4	Mr. Sahil Ranoliya	Lecturer, Rubber Technology	Member AIRIA
5	Mr. Sahil Soliya	Lecturer, Rubber Technology	Member AIRIA

Coordinator, Co-ordinator

Curriculum Development, Department of Rubber Technology

Department of Rubber Technology

I/C, Curriculum Development Cell Principal

Program: Diploma in Rubber Technology (Sandwich Pattern)										
Course Code: RT22404				Course Title: Vulcanization Systems						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2.30 Hrs.)	TS1 (1 Hr.)	TS2 (1Hr)	PR	OR	TW	Total
3	4	--	7	60	20	20		25	25	150

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Vulcanization is the most important step in manufacture of rubber products. Design of vulcanization system for a compound influences its processing characteristics and product properties. A judicious selection of the vulcanization system is therefore required for the processing, curing technique and product property requirements. A student of rubber technology must therefore understand the chemistry and physics of vulcanization. He should also understand the various vulcanization techniques.

Course Outcomes: Student should be able to

CO1	Understand about the importance of vulcanization in Rubber.
CO2	Understand about the Types of Vulcanizing agents & their effects
CO3	To know about Different - different types of accelerators.
CO4	Analyze of state of vulcanization.
CO5	Relate structure and properties of Vulcanizate.
CO6	Classify different vulcanization systems and techniques.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction:** 1.1 Characteristics of Raw Rubber, 1.2 Definition of Vulcanization, 1.3 Properties of Unvulcanised Compound, 1.4 Difference between Vulcanized Rubber and Unvulcanised Rubber, 1.5 Structural Changes observed in Rubber After Vulcanization, 1.6 Structure of Rubber Vulcanizate. 1.7 Vulcanizing agent : 1.7.1 Cross linking agents 1.7.2 Activators 1.7.3 Accelerators 1.7.4 Sulphur donors **Course Outcome:CO1 Teaching Hours: 6 hrs Marks: 8 (R- 4, U-2 , A-2)**
2	**Types of Vulcanizing agents & their effects:** 2.1 Classification of sulphur 2.1.1 Insoluble Sulphur 2.1.2 Soluble Sulphur 2.2 Theory of Sulphur 2.2.1 Conventional cure system 2.2.2 Efficient cure system 2.2.3 Semi Efficient cure system 2.2.4 Accelerator system selection & adjustment, 2.2.5 Sulphur donors 2.3 Peroxides : 2.3.1 Classification of Peroxides and their Structures & Examples of Peroxides, 2.3.2 Half life period & Decomposition temp. 2.3.3 Chemistry of peroxide cure & Reaction mechanism 2.3.4 Compounding Aspects of peroxide Cure, 2.3.5 Advantages & Disadvantages of Peroxides cure over sulphur vulcanization, 2.3.6 Peroxide cure of saturated and unsaturated Elastomers 2.4 Theory of metal oxide vulcanization with reaction mechanism 2.5 Theory of resing curing in butyl rubber 2.6 Theory of diamine cure system in Fluoroelastomers 2.7 Theory of Diisocynate cure system in polyurethane. **Course Outcome: CO2 Teaching Hours: 12 hrs Marks: 14 (R- 4, U-6 , A-4)**
3	**Accelerators:** 3.1 Classification of Accelerators 3.1.1Aldehyde amine 3.1.2 Guanidine 3.1.3 Thiazole 3.1.4 Thiophosphate, 3.1.5 Sulfenamides 3.1.6 Thiourea 3.1.7 Thiuram

	3.1.8 Dithiocarbamate 3.1.9 Xanthates 3.2 Selection of Accelerators for Rubber Compounds **Course Outcome: CO3 Teaching Hours: 8 hrs Marks: 10 (R- 4, U-4 , A-2)**
4	**The assessment of state of vulcanization:** 3.1 Concept of Cross link density 3.2 evaluation of cross link density by the sewlling techniques. 3.3 Discussion of methods of measuring cure, Calculation of cure in thick articles, 3.4 The relation between curing system type & properties 3.5 Vulcanization process analysis by Rheometers curve & the product Properties 3.6 Mooney Scorch time & Its practical significance **Course Outcome: CO4 Teaching Hours: 10 hrs Marks: 8 (R- 4, U-2 , A-2)**
5	**Relations between Structure and Properties of Vulcanizates:** 4.1 Modulus and Strength, 4.2 Hardness, 4.3 Resilience and Heat Build-up, 4.4 Fatigue Properties, 4.5 Heat Stability, 4.6 Swelling, 4.7 Low Temperature Properties, 4.8 Abrasion, 4.9 Compression Set, 4.10 Aging, 4.11 Dynamic Properties and Rolling Friction. **Course Outcome: CO5 Teaching Hours: 12 hrs Marks: 10 (R- 4, U-2 , A-4)**
6	**Vulcanisation techniques:** 5.1 Classification of Vulcanization Techniques. 5.2 Batch Vulcanization Techniques 5.2.1 Moulding 5.2.2 Autoclave 5.2.3 Hot Air Oven Curing, 5.2.4 Lead Curing, 5.2.5 Free Heating. 5.3 Continuous vulcanization 5.3.1 Liquid Curing Method 5.3.2 Fluidized Bed Vulcanization 5.3.3 Continuous Vulcanization in Stem Pipes 5.3.4 Rotocure, 5.3.5 Hot Air Tunnel **Course Outcome: CO6 Teaching Hours: 16 hrs Marks: 10 (R-4, U-2 , A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction	04	02	02	08
2	Types of Vulcanizing agents & their effects	04	06	04	14
3	Accelerators	04	04	02	10
4	The assessment of state of vulcanization	04	02	02	08
5	Relations between Structure and Properties of Vulcanizates	04	02	04	10
6	Vulcanisation techniques	04	02	04	10
	Total	24	18	18	60

List of experiments/Assignments:

Sr. No.	Unit	CO	Experiments/Assignments	Approx. Hours
1	1	CO1	Perform of experiments on ODR & Do study of Rheometer graph, Calculate cure time & Scorch time.	8
2	2	C02	Prepare CV, EV & Semi EV Batch of Rubber compound and do comparison of Rheotest.	10
3	3	CO5	Prepare CV, EV & Semi EV Batch of Rubber compound and do comparison of tensile strength.	8
4	4	CO5	Prepare CV, EV & Semi EV Batch of Rubber compound and do comparison of compression test.	8
5	5	CO2	Prepare Rubber compound of peroxide cure in synthetic rubber.	8
6	6	CO2	Prepare Rubber compound of CR using proper curing systems..	8
7	7	CO5	Do study of effect of state of cure on swelling of rubber compound in fluids.	10
			Total	60

References/ Books:

Sr. No.	Title	Author, Edition and Year Of publication	Publisher,
1	Vulcanization of rubber	Hoffman	Hanser Publishers, Munich & Vienna
2	Rubber Technology	C.M. Blow	Butterworth Scientific, London.
3	Natural & Synthetic rubber	H.J. Stern	-------

4	Rubber Technology Hand Book	R.T. Vanderbilt	R.T. Vanderbilt Co. Inc.
5	Rubber Engineering	I.R.I	I.R.I

E-References:

http://www.ajer.org/papers/rase-2-2013/Volume-3/BV120130813.pdf
https://en.wikipedia.org/wiki/Vulcanization
https://www.ias.ac.in/public/Volumes/reso/002/04/0055-0059.pdf
https://www.nocil.com/Downloadfile/DTechnicalNote-Vulcanization-Dec10.pdf

CO Vs PO and CO Vs PSO Mapping (Rubber Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	3	2	1	3	3	2	3	2
CO2	2	2	1	2	2	3	2	3	3
CO3	2	3	3	3	2	2	3	3	2
CO4	3	2	3	2	3	3	2	2	2
CO5	2	3	1	2	3	2	2	3	3
CO6	3	2	1	2	2	3	2	2	2

Industry Consultation Committee:

Sr. No	**Name**	**Designation**	**Institute/Organization**
1	Mr. Ravindra Barde	Industry Expert	Sidhhi Elasto Pvt. LTD.
2	Mr. Dharmesh Dhanani	Industry Expert	Elphiepoly
3	Mr. Sahil Ranoliya	Lecturer in Rubber Technology	AIRIA
4	Mr. Sahil Soliya	Lecturer in Rubber Technology	AIRIA

Coordinator, Co-ordinator
Curriculum Development, Department of Rubber Technology
Department of Rubber Technology

I/C, Curriculum Development Cell Principal

Program: Diploma in Rubber Technology (Sandwich Pattern)										
Course Code: RT22402				**Course Title**: Rubber Compound & Product Testing						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				**Examination Scheme**						
L	**P**	**TU**	**Total**	**TH** (2.30 Hrs.)	**TS1** 1 Hr.	**TS2** 1 Hr.	**PR**	**OR**	**TW**	**Total**
3	4	--	7	60	20	20	25*	---	25	150

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

A Rubber technologist must understand fully testing of unvulgarized rubber compound for its processing & Curing characteristics Rubber products for various physical properties such as stress- strain properties, hardness, abrasion resistance, tear resistance etc. This will able him to determine whether the compound he has prepared is satisfactory and whether the product cured is according to specification. Understanding of various national & international standards will be required for day to day working in testing laboratory. Understanding of testing methods of incoming raw materials, raw rubbers, textiles etc. for various test will enable him to know if raw materials are received as per required quality.

Course Outcomes: Student should be able to

CO1	Summarize the importance of testing, calibration and need of standardization in Rubber industries.
CO2	To learn methods of testing of raw martial.
CO3	To learn methods of testing of compounded rubber.
CO4	To learn methods of testing of vulcanized rubber.
CO5	Identify suitable test for ageing properties
CO6	To learn about electrical test & permeability.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Importance of Testing in Rubber Industries:** 1.1 Introduction 1.2 Precision, Accuracy & Validity 1.3 Specimen Preparation 1.4 Standard Temperature 1.5 Organisations Producing Standards 1.5.1 SAE 1.5.2 DIN 1.5.3 JIS 1.5.4 ASTM 1.5.5 ISO 1.5.6 BIS 1.5.7 ITTAC 1.5.8 ETRTO 1.5.9 TRA 1.6 Preparation of Test Pieces **Course Outcome: CO1 Teaching Hours: 12 hrs Marks: 08 (R- 2, U-2 , A-4)**
2	**Raw material test :** 2.1 Burning test 2.2 Chemical test 2.2.1 Acetone extract test 2.2.2 Chloroform extract 2.2.3 ASTM solution 2.3 Ash content test 2.4 Moisture content test **Course Outcome: CO2 Teaching Hours: 12 hrs Marks: 08 (R- 4, U-2 , A-2)**
3	**Tests on Unvulcanised Rubbers**: 3.1 Viscoelastic Flow Behaviour 3.1.1 Compression Plastimeters 3.1.2 Plasticity Retention index 3.1.3 Mooney viscometers 3.1.4 Rheometers (ODR & MDR) 3.2 Scorch & Cure rate 3.3 Tack 3.4 Determination of Specific gravity 3.5 Green Strength 3.6 Shrinkage **Course Outcome: CO3 Teaching Hours: 12 hrs Marks: 12 (R- 4, U-4, A-4)**
4	**Testing for Physical Properties:** 4.1 Density 4.2 Hardness 4.2.1 Dead load tests

	4.2.2 Durometer Tests 4.3 Tensile Stress-strain 4.4 Compression stress- strain 4.5 Shear stress-strain 4.6 Flexural(Bending) Stress- strain 4.7 Tear test 4.8 Rebound Resilience, 4.9 Flex-cracking & Cut growth test 4.10 Heat Build-up 4.11 Abrasion test Note: BIS or ASTM to be used for explanation of above. **Course Outcome: CO4 Teaching Hours: 12 hrs Marks: 14 (R- 4, U-6, A-4)**
5	**Effect of Temperature & Environmental Resistance:** 5.1 Low temperature properties 5.2 Heat ageing 5.3 Effect of liquids(ASTM Oils) 5.4 Volume Swelling 5.5 Water absorption 5.6 Effect of gases 5.7 Effect of ozone 5.8 Flame resistance. **Course Outcome: CO5 Teaching Hours: 12 hrs Marks: 8 (R- 4, U-2 , A-2)**
6	**Electrical Tests & Permeability :** 6.1 Resistance or resistivity 6.1.1 Test on Insulating Rubbers 6.1.2 Test on Conducting and Anti-static Rubbers 6.2 Surface charge 6.3 Electric strength 6.4 Tracking resistance 6.5 Power factor and permittivity 6.6 Gas Permeability 6.6.1 Constant Volume Method 6.6.2 Constant Pressure Method 6.6.3 Carrier gas Methods 6.6.4 High pressure measurements 6.7 Vapour Permeability **Course Outcome: CO6 Teaching Hours: 12 hrs Marks: 10 (R- 4, U-4, A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Importance of Testing in Rubber Industries	02	02	04	08
2	Raw material test	04	02	02	08
3	Tests on Unvulgarized Rubbers	04	04	04	12
4	Testing for Physical Properties	04	06	04	14
5	Effect of Temperature & Environmental Resistance	04	02	02	08
6	Electrical Tests & Permeability	04	04	02	10
Total		22	20	18	60

List of experiments/Assignments:

Sr. No.	Unit	CO	Experiments/Assignments	Approx. Hours
1	2	CO2	Identification of rubbers by burning test.	4
2	2	C02	Determination of moisture content and ash content of rubber.	6
3	3	CO3	Determination of mooney viscosity of rubbers.	4
4	3	CO3	Analysis of rubber compound by Acetone extract test.	4
5	3	CO3	Determination of Mooney Viscosity, Mooney scorch and Rheomatric properties of rubber compound.	6
6	4	CO4	Determination of Specific gravity , tensile strength , Elongation at Break and modulus properties of vulcanized rubber compound.	8
7	4	CO4	Determination of compression set of vulcanized rubber.	6
8	4	CO4	Determinations of DeMattia flex resistance of compound.	8
9	5	CO5	Determination of volume swell and retention of physical properties of vulcanized rubber compound in fluids/solvents.	8
10	5	CO5	Determine retention of physical properties of rubber on accelerated ageing test.	6
			Total	**60**

References/ Books:

Sr. No.	Title	Author, Edition and Year Of publication	Publisher,
1	Physical Testing of Rubber	Roger Brown	Chapman & Half Publication
2	Rubber Technology Compounding & Testing	John S. Dick	Hanser Publication

E-References:

https://www.youtube.com/watch?v=9N5SS8f1auI
https://www.youtube.com/watch?v=P8u2s7s4N3c&t=10s
https://www.youtube.com/watch?v=j1ov7qWfJbM

CO Vs PO and CO Vs PSO Mapping (Rubber Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	3	3	3	2	2	3	2
CO2	3	2	1	2	2	2	2	3	3
CO3	3	2	3	3	2	2	3	3	2
CO4	3	2	3	2	3	3	2	2	2
CO5	3	2	1	2	3	2	2	3	3
CO6	3	2	1	2	2	2	1	2	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Ravindra Barde	Industry Expert	Sidhhi Elasto Pvt. LTD.
2	Mr. Dharmesh Dhanani	Industry Expert	Elphiepoly
3	Mr. Sahil Ranoliya	Lecturer in Rubber Technology	AIRIA
4	Mr. Sahil Soliya	Lecturer in Rubber Technology	AIRIA

Coordinator, Co-ordinator

Curriculum Development, Department of Rubber Technology

Department of Rubber Technology

I/C, Curriculum Development Cell Principal

Program: Diploma in Rubber Technology (Sandwich Pattern)										
Course Code: RT22405				**Course Title:** Rubber Compounding Materials						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				**Examination Scheme**						
L	**P**	**TU**	**Total**	**TH (2.30 Hrs.)**	**TS1 (1 Hr.)**	**TS2 (1Hr)**	**PR**	**OR**	**TW**	**Total**
3	4	--	7	60	20	20	25*	---	25	150

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale: A rubber technologist must have an understanding of various compounding ingredients used in making the rubber articles as raw rubber is seldom useful without compounding. The ingredients used in compounding plays a very important part in the properties of final products, its cost of manufacturing and performance quality etc. It will help him understand the fundamental principles of selecting ingredients for compounding.

Course Outcomes: Student should be able to

CO1	To Understand the need of compounding.
CO2	To know about carbon black and its types and its role in rubber compounding.
CO3	Analyze the effects of different fillers on rubber compound
CO4	To Know about different-different compounding materials.
CO5	To understand role of antidegrantes
CO6	To understand art of compounding.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Compounding:** 1.1 Definition of Compounding 1.2 Characteristics of rubbers 1.3 General purpose and speciality rubber 1.4 Incorporation of fillers 1.5 Vulcanizing agents **1.6** Compounding ingredients **Course Outcome:CO1 Teaching Hours: 6 hrs Marks: 10 (R- 4, U-4 , A-2)**
2	**Carbon Black:** 2.1 Introduction 2.2 Properties 2.2.1 Physical Properties 2.2.2 Chemical Properties 2.2.3 Health & Safety 2.3 Manufacture 2.3.1 Lampblack 2.3.2 Channel Black 2.3.3 Thermal Black 2.3.4 Acetylene Black 2.3.5 Furnace Black 2.4 Characterization of Carbon Black 2.4.1 Particles size& Structure 2.4.2 Classification of carbon Black According to Particle size 2.4.2 DBP absorption 2.4.3 Acid value and PH 2.4.4 Ash content 2.4.5 Mesh size & Iodine Numbers 2.5 Effect of properties of carbon black on properties of rubber Vulcanizate. **Course Outcome: CO2 Teaching Hours: 12 hrs Marks: 10 (R- 4, U-4 , A-2)**
3	**Precipited Silica And Non- Black Fillers :** 3.1 Mineral Fillers 3.1.1 Calcium Carbonate 3.1.2 Baryte 3.1.3 Ground Crystalline Silica 3.1.4 Clay 3.1.5 Talc 3.1.6 Alumina Tyrihydrate 3.2 Synthetic Fillers 3.2.1 Precipitated Calcium carbonate 3.2.2 Metal Oxide 3.2.3 Precipitated Silica 3.2.4 Silicates **Course Outcome: CO3 Teaching Hours: 8 hrs Marks: 8 (R- 4, U-2 , A-2)**

4	**Compounding Materials:** 4.1 Plasticizers 4.1.1 Petroleum Oil Plasticizer 4.1.1.1 Aromatic Oil 4.1.1.2 Naphthenic Oil 4.1.1.3 Paraffinic Oil 4.1.2 Synthetic Plasticizer 4.1.3 Epoxydiesed vegetable oils 4.2 Process aids & Factices 4.2.1 Resins 4.2.2 Factices 4.3 Accelerators & Activator 4.3.1 Classification of accelerators 4.3.2 Zinc oxide And Stearic acids 4.4 Blowing Agents 4.4.1 Inorganic Blowing agents 4.4.2 Organic Blowing Agents 4.5 Bonding Agents 4.5.1 Resins 4.5.2 RF Resins 4.5.3 VP Latex 4.6 Peptisers, 4.7 Colors & Pigments 4.8 Coupling Agents **Course Outcome: CO4 Teaching Hours: 10 hrs Marks: 10 (R- 4, U-4 , A-2)**
5	**Antidegrants:** 5.1 Properties of Antidegradants 5.1.1 Discoloration and Staining 5.1.2 Volatility 5.1.3 Solubility and Migration 5.1.4 Chemical Stability 5.1.5 Physical Form 5.1.6 Antidegradants Concentration 5.2 Antidegradant Types 5.2.1 Non-Staining, Non-Discoloring Antioxidants 5.2.2 Staining/Discoloring Antioxidants 5.2.3Antiozonants **Course Outcome: CO5 Teaching Hours: 12 hrs Marks: 10 (R- 4, U-2 , A-4)**
6	**Principles of Compounding & Art of compounding** 6.1 Introduction, 6.2 The ingredients & formulation of a mix 6.3 Compounding to meet processing requirements, 6.4 Compounding of Vulcanizate properties, 6.5 Compounding for Bonding to non-rubber substrates 6.6 Calculation of compound cost of a recipe, 6.7 Calculation of compound volume of a recipe, 6.8 Calculation of compound specific gravity of a recipe, 6.9 Formulation of mix,

	6.10 Processing **Course Outcome: CO6 Teaching Hours: 16 hrs Marks: 12(R-4, U-4 , A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Tota Marks
1	Compounding	04	04	02	10
2	Carbon Black	04	04	02	10
3	Precipited Silica And Non- Black Fillers	04	02	02	08
4	Compounding Materials	04	04	02	10
5	Antidegrants	04	02	04	10
6	Principles of Compounding & Art of compounding	04	04	04	12
Total		24	20	16	60

List of experiments/Assignments:

Sr. No.	Unit	CO	Experiments/Assignments	Approx. Hours
1	2	CO2	Determination of Iodine Absorption no. Particle Size And DBP noof Carbon Black.	4
2	4	C04	Determination of Viscosity , Flash Point, Aniline Points ofProcessing Oil.	4
3	4	CO4	Determination of Melting Point and Solubility of RubberChemicals	4
4	3	CO3	Determination of Moisture Contents of Fillers , Accelerators	4
5	3	CO3	Determination of Ash Content , Moisture contents, pH of CalciumCarbonate , China Clay & Silica.	6
6	6	CO6	Mixing of Formulation as per given Mixing Sequence on a tworoll mixing mill. Determination of specific gravity of rubber compound and comparing it with theoretical specific gravity.	6
7	6	CO6	To Prepare Rubber compound to meet a given hardness	8
8	6	CO6	Blending Two Rubber and studying the changes in characteristicproperties of the compound.	8
9	6	CO6	Prepare rubber compound for “”O”” ring and determine itsphysical properties	8

10	6	CO6	Comparative Study of Tensile, Tear strength & Abrasion Resistance of Natural Rubber and Styrene Butadiene Rubber	8
			Total	60

References/ Books:

Sr. No.	Title	Author, Edition and Year Of publication	Publisher,
1	Handbook of Rubber Technology	Hoffman	Hanser Publishers,Munich & Vienna
2	Rubber Technology	C.M. Blow	Butterworth Scientific,London.
4	Rubber Technology Hand Book	R.T. Vanderbilt	R.T. Vanderbilt Co. Inc.

CO Vs PO and CO Vs PSO Mapping (Rubber Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	3	2	1	3	3	2	3	2
CO2	2	2	1	2	2	3	2	3	3
CO3	2	3	3	3	2	2	3	3	2
CO4	3	2	3	2	3	3	2	2	2
CO5	2	3	1	2	3	2	2	3	3
CO6	3	2	1	2	2	3	2	2	2

Industry Consultation Committee:

Sr.No	Name	Designation	Institute/Organization
1	Mr. Ravindra Barde	Industry Expert	Sidhhi Elasto Pvt. LTD.
2	Mr. Dharmesh Dhanani	Industry Expert	Elphiepoly
3	Mr. Sahil Ranoliya	Lecturer in Rubber Technology	AIRIA
4	Mr. Sahil Soliya	Lecturer in Rubber Technology	AIRIA

Coordinator, Co-ordinator

Curriculum Development, Department of Rubber Technology

Department of Rubber Technology

I/C, Curriculum Development Cell Principal

Program: Diploma in Rubber Technology (Sandwich Pattern)										
Course Code: RT22401				**Course Title**: Thermoplastic Elastomers						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				**Examination Scheme**						
L	**P**	**TU**	**Total**	**TH** (2.30 Hrs.)	**TS1** (1Hr.)	**TS2** (1Hr)	**PR**	**OR**	**TW**	**Total**
3	--	--	3	60	20	20	--	---		100

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests,
PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Thermoplastic Elastomers are a relatively new class of polymers which differ from conventional rubber in the sense that this products behaves like rubber at normal temperature but can be processed like plastic elevated temperature. There this are new engineering elasomers entering automobile and engineering sector as high performance material. Student must be familiar with these materials to understand modern elastomers used in the industry.

Course Outcomes: Student should be able to

CO1	Know about the importance of Thermoplastic Elastomers in rubber field.
CO2	Learn about Thermoplastic Styrene Block Copolymer.
CO3	To Understand about Polyester Thermoplastic Elastomers
CO4	Know & study about thermoplastic polyolefin rubbers
CO5	To Study about Manufacturing, Properties And Processing of Thermoplastic Polyurethane.
CO6	Learn the importance of thermoplastic polyamide Elastomer

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction of TPE :** 1.1 Definition and Characteristics of TPE. 1.2 Advantages of TPE 1.3 Disadvantages of TPE 1.4 Classification of TPE **Course Outcome:CO1 Teaching Hours: 6 hrs Marks: 10 (R- 4, U-4 , A-2)**
2	**Thermoplastic Styrene Block Copolymers:** 2.1 Structure and Composition 2.2 Synthesis and Manufacturing 2.3 Properties Composition relationship 2.4 Compounding 2.5 Mixing & Processing 2.6 Application **Course Outcome: CO2 Teaching Hours: 8 hrs Marks: 10 (R- 4, U-4 , A-2)**
3	**Polyester Thermoplastic Elastomers:** 3.1 Structure and chemistry 3.2 Synthesis and Manufacturing 3.3 Commercial Elastomer Grades 3.4 Dynamic Properties 3.5 Special Polyester Thermoplastic Elastomers (Hytrel) 3.6 Processing 3.7 Application **Course Outcome: CO3 Teaching Hours: 8 hrs Marks: 10 (R- 4, U-4 , A-2)**
4	**Thermoplastic Polyolefin Elastomers:** 4.1 Structure and chemistry 4.2 Synthesis and Manufacturing 4.3 Properties Composition relationship 4.4 Processing 4.5 Application **Course Outcome: CO4 Teaching Hours: 8 hrs Marks: 10 (R- 4, U-4 , A-2)**
5	**Thermoplastic Polyurethane Elastomers:** 5.1 Preparation & Structure 5.2 Synthesis and Manufacturing 5.3 Properties Composition relationship 5.3.1 Molecular Weight Effects 5.3.2 Chemical c/s Effects 5.3.3 Environmental Stability & Stabilization 5.4 Compounding

	5.5 Processing 5.6 Applications **Course Outcome: CO5 Teaching Hours: 8 hrs Marks: 8 (R- 4, U-2 , A-2)**
6	**Thermoplastic Polyamides:** 6.1Structure and Composition 6.2 Synthesis and Manufacturing 6.3 Properties Composition relationship 6.4 Compounding 6.5 Mixing & Processing 6.6 Application **Course Outcome: CO1 Teaching Hours: 6 hrs Marks: 12(R-4, U-6 , A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Introduction of TPE**	04	04	02	10
2	**Thermoplastic Styrene Block Copolymers**	04	04	02	10
3	**Polyester Thermoplastic Elastomers**	04	04	02	10
4	**Thermoplastic Polyolefin Elastomers**	04	04	02	10
5	**Thermoplastic Polyurethane Elastomers**	04	02	02	08
6	**Thermoplastic Polyamides**	04	06	02	12
	Total	24	24	12	60

References/ Books:

Sr. No.	Title	Author, Edition and Year Of publication	Publisher,
1	Handbook of Elastomers: New Development & Technology	Anil K. Bhowmick, Howard L. Stephens	----
2	Handbook of Thermoplastic Elastomer	Benjamin M. Walker	----
3	Thermoplastic Elastomers: A Comprehensive Review	N. R. Legge, G.Holden, H. E. Sehroeder	----

E-References:

https://youtu.be/GmHtt-OFNWc?si=jCSWjrLU4Lr-shSv
https://youtu.be/mE0dNmQ0Ihc?si=zxgGVXPWj_PowIlz
https://youtu.be/asNsbr2_xL8?si=2Wvc_tVqvnbl7--z

CO Vs PO and CO Vs PSO Mapping (Rubber Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	3	2	1	3	3	2	3	2
CO2	2	2	1	2	2	3	2	3	3
CO3	2	3	3	3	2	2	3	3	2
CO4	3	2	3	2	3	3	2	2	2
CO5	2	3	1	2	3	2	2	3	3
CO6	3	2	1	2	2	3	2	2	2

Industry Consultation Committee:

Sr. No	**Name**	**Designation**	**Institute/Organization**
1	Mr. Ravindra Barde	Industry Expert	Sidhhi Elasto Pvt. LTD.
2	Mr. Dharmesh Dhanani	Industry Expert	Elphiepoly
3	Mr. Sahil Ranoliya	Lecturer in Rubber Technology	AIRIA
4	Mr. Sahil Soliya	Lecturer in Rubber Technology	AIRIA

Coordinator,
Curriculum Development,
Department of Rubber Technology

Program Coordinator
Department of Rubber Technology

I/C, Curriculum Development Cell

Principal