SEMESTER: S5

TYRE TECHNOLOGY

Course Code	PBPOT504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic Knowledge in Rubbers	Course Type	Theory

Course Objectives:

1. To explain the Industrial manufacturing of tyres along with its research and development

2. To introduce students about the machineries used to manufacture various types of tyres and also the formulation for various tyre components, its processing, building and curing process.

3. After this course the student will be able to explain the tyre grip mechanism, tyre design features and tyre testing methods

KTU SPECIAL

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to tyres**: Tyre functions, History on the design and development of tyres, current status of tyre industry in India and its future prospects, tyre sizing, different components of a tyre, its geometry, basic functions, functions of a pneumatic tyre, load carrying, vibration and noise reduction, the tyre function as a spring, contribution to road adhesion, tyre friction contribution to driving control, steering control and self-aligning torque. Solid tyres, concave tyres, winter tyres, OTR tyre, bicycle tyre, different types of tyres, bias, bias belted, radial, relative merits and demerits, their components, tube and tubeless tyres basic features.	11
2	**Manufacturing techniques of various tyres -** two-wheeler, car tyres, truck tyres, cycle tyres, cycle tubes, OTR tyres, aircraft tyres, automotive tubes, manufacture of tyre treads, beads, sidewalls, compounding techniques, principles of designing formulations for various rubber components, tyre	11

	reinforcement materials (textile, steel, glass, aramid), criteria of selection, different styles and construction, textile treatment (RFL dip).	
3	**Tyre mould design**- green tyre design principles, methods of building green tyres for bias, bias belted, radial and tubeless tyres, green tyre treatments, tyre curing methods, curing bags, bladders, diaphragms, autoclave, airbag, bagomatic, autoform, post cure inflation, different types of tyre building machines, bead winding machine, bias cutters, curing presses.	**11**
4	**Tyre Testing and Quality Control-** Measurement of tyre properties, dimension and size-static and loaded, tyre construction analysis, endurance test, wheel and plunger tests, traction, cornering coefficient aligning torque coefficient, rolling resistance, non-uniformity dimensional variations, force variations, radial force variation, lateral force variation concentricity and ply steer, tyre balance, mileage, X-ray holography, foot print pressure distribution, BIS standards for tyres, tubes and flaps, quality control tests, failure mechanism of cord reinforced rubber, tyre forces on dry and wet road surface, traction forces on dry, wet, ice, snow and irregular pavements, tyre noise, mechanism of noise generation, flatspotting, fatigue resistance, pantographing, pneumatic resilience effect.	**11**

KTU SPECIAL

Suggestion on Project Topics

- After teaching the students the fundamentals of Tyre Technology (Module 1)
- Faculty can direct the students to design a tyre according to a particular need.
- Ensure that it is suitable for the course.
- Students should prepare the plan which includes the appropriate compounding ingredients and formulations for various tyre components in the due time of Module II.
- Students can refer the appropriate code of practices.
- Students can fabricate different components of tyre with the help of suitable machineries.
- Assembling of tyres and curing of tyres should also be done according to the tyre type in the due period of Module III.
- Any tyre testing methods can also be performed by the student on the tyre he/she has designed during the time of Module IV.

- Students should submit the report to the faculty.

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

KTU SPECIAL

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the parts and functions of tyre.	**K2**
CO2	Define tyre sizing, tyre design and tyre grip mechanisms	**K1**
CO3	Design formulations of tyre with the property required from each part of the tyre	**K6**
CO4	Evaluate the industrial manufacture of tyre including building, curing and post cure treatments	**K5**
CO5	Discover various raw material, in process and product tests performed in tyre companies for quality control	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

KTU SPECIAL

CO-PO Mapping Table:

1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										
CO2	3	1										
CO3	3	2	2				1					
CO4	3	2			1							
CO5	3	2			1							

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Rubber technologist's handbook. Vol. 1.,	De, Sadhan K., and Jim R. White, eds.	iSmithersRapra Publishing	2001.
2	"The little book of tire pavement friction." Pavement Surface Properties Consortium 1	Flintsch, Gerardo W., Kevin K. McGhee, Edgar de León Izeppi, and ShahriarNajafi		2012.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechanics of Pneumatic Tires	Clark, S. K. (Ed.).	US Government Printing Office	1981
2	Tyre technology	French, T.		1989
3	Tyre technology	Kovac, F. J		1973
4	Tire engineering. In Science and Technology of Rubber	Rodgers, B., & Waddell, W		3rd Edition 2005

KTU SPECIAL

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=fVmBXtSKDw8&t=33s NPTEL-NOC IITM mod 11 lec73- Tyres Part 1
2	https://www.youtube.com/watch?v=RJ0Ck736qrw NPTEL-NOC IITM mod 12 lec74- Tyres Part 2
3	https://www.youtube.com/watch?v=CX7_6mL7ksA
4	https://www.youtube.com/watch?v=oqtZRLUDDtQnptelhrd MOD-01 LEC-09

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

KTU SPECIAL

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

- Active participation and individual contribution
- Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

KTU SPECIAL

5. **Final Presentation (5 Marks)**

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches