Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 6 – EXAMINATION – SUMMER 2026

Subject Code: 3162603 **Date: 08/06/2026**

Subject Name: Rubber Equipment Design

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	State the function of the ram in a Banbury internal mixer.	**03**
	(b)	Compare the mixing mill and internal mixer with respect to mixing efficiency, batch size, and dust emission.	**04**
	(c)	Discuss in detail the historical design development of the internal mixer from Banbury,original tangential rotor to the latest variable-clearance intermeshing rotor designs,highlighting at least four key technological improvements.	**07**
Q.2	**(a)**	Define calendaring and state its purpose in rubber processing.	**03**
	(b)	Describe any two industrial methods (roll-bending, roll-crossing, roll-crowning) used to control product thickness in calendaring.	**04**
	(c)	Explain in detail the constructional features and operating principle of a modern computer-controlled four-roll Z-calender used for tyre inner-liner production.	**07**
		OR	
Q.2	**(c)**	A calendared sheet shows continuous thickness variation of ±0.15 mm across the width. As the shift engineer, analyze the possible mechanical and rheological causes, and recommend remedies	**07**
Q.3	**(a)**	Define daylight, stroke, and platen size for a vulcanizing press.	**03**
	(b)	Compare upstroke and downstroke hydraulic presses for rubber vulcanization, listing two advantages of each.	**04**
	(c)	Evaluate the advantages of a pin-barrel cold-feed extruder over a conventional cold-feed extruder for tread-strip production.	**07**
		OR	
Q.3	**(a)**	State Pascal's law and its relevance to hydraulic-press operation.	**03**
	(b)	A hydraulic accumulator uses a nitrogen-filled rubber bladder to maintain system pressure. If the rubber bladder has a surface area of 0.12m2 and the hydraulic fluid exerts a constant pressure of 2 X106 Pa (N/m2) against it: Calculate the total force being exerted on the surface of the rubber bladder.	**04**
	(c)	Explain in detail the construction and function of extruder hardware: liner, feed roller, extension barrel, screw, and breaker plate, with a labelled sketch.	**07**
Q.4	**(a)**	Define bolster and state its purpose in an injection mould assembly.	**03**
	(b)	Compare two-plate, three-plate, and runner-less moulds with respect to runner handling, ejection requirement, and complexity.	**04**

	(c)	A screw-type injection-moulding machine has a swept volume of 100 cm^3 and is used to mould an amorphous compound (ρ = 1.45 g/cm^3, C = 0.95). Each component weighs 30 g. Using 85 % of rated shot capacity, calculate (i) shot capacity W, and (ii) number of cavities Ns.	**07**

OR

Q.4	**(a)**	Classify injection moulds based on their construction	**03**
	(b)	Describe the two disadvantages of a leader pin and explain how a standard guide pillar–bush arrangement overcomes them.	**04**
	(c)	Compare cold-runner and hot-runner mould systems on at least six parameters (cost, maintenance, waste, cycle time, polymer compatibility, colour change). Recommend the suitable system for (a) heat-sensitive rubber compounds and (b) large-volume automotive sealing parts.	**07**
Q.5	**(a)**	List the three principal factors on which the number of cavities depends.	**03**
	(b)	Differentiate between a disk (diaphragm) gate, a ring gate, and a spoke (spider) gate for cylindrical / tubular parts, noting one merit and one demerit of each.	**04**
	(c)	Compare compression, transfer, and injection moulding for the manufacture of a small rubber bushing in terms of cycle time, scrap, capital cost, and product quality. Recommend the best for a 100 000-piece-per-year requirement.	**07**

OR

Q.5	**(a)**	Define Internal Cavity Pressure (ICP) and write its expression in terms of clamping force and projected area.	**03**
	(b)	Discuss the pros and cons of large runners versus small runners in terms of pressure, cooling time, material consumption, scrap and clamping force.	**04**
	(c)	Discuss the fundamentals of transfer moulding with a temperature–pressure–time diagram of one complete cycle. Identify the rate-controlling steps.	**07**

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