SEMESTER: S7

POLYMER REACTION ENGINEERING

Course Code	PEPOT745	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic Knowledge in Polymer Science	Course Type	Theory

Course Objectives:

1. To impart knowledge of application of reaction engineering for polymer production

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction To Reactor Design**: Design equation for single reaction system, parallel and series reactions, temperature dependant terms, interpretation of batch reactor data, conversion, concentration and mole balance, constant volume reaction system, rate of reaction, first and zero order reaction	9
2	**Reaction Engineering of Free Radical Polymerisation:** thermodynamics and kinetic aspects of free radical polymerisation MWD of free radical polymerisation: Standard free radical polymerisation; design of tubular reactors involving radical polymerisation, solution of equations describing isothermal radical polymerisation **Reaction Engineering of Ionic, Ziggler Natta:** Smith-Ewart and other models, average chain length estimation of stereoregular polymers, chain segment estimation and its distribution, classification of various ionic species, effect of solvent, ionophores and ionogens	9
3	**Reaction Engineering of Step Growth Polymerisation**: kinetics of step growth polymerisation, accessibility of functional groups, equilibrium	9

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	considerations: closed and open systems, cyclisation versus linear polymerisation, MWD in linear and non-linear polymerisations	
4	**Bulk, Solution and Precipitation Polymerisations:** Modelling of bulk and solution polymerisation reactor, precipitation polymerization: reactor modelling to interpret MWD of industrial polymers. **Suspension and Emulsion Polymerisation**: Suspension Polymerization: Principles, of reactor modelling and MWD estimation; Modelling of emulsion reactors, prediction of MWD and solution viscosity, examples	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

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Criteria for Evaluation (Evaluate and Analyse): 20 marks

1. **Problem Definition (2 points)**

- Check for clarity and completeness of the problem definition.
- Check for clear objectives and divide into sub objectives

2. **Problem Analysis (4 points)**

- Examine the problem and identify the variables and responses
- Divide the problem to manageable parts

3. **Implementation of software (2 points)**

- Use suitable software for getting the solution
- Check for the appropriateness of tools used

4. **Evaluate (4 points)**

- Evaluate the proposed solution.
- Assess the correctness of solution.

5. **Validation of the results (4 points)**

- Validate the results using available data.
- Do the error analysis of the results obtained.

6. **Conclusion and presentation (4 points)**

- Summarize the results obtained
- Do critical thinking of the results obtained and evaluate.
- Submit a technical report

End Semester Examination Marks (ESE)

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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 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the design of tubular reactors involving radical polymerisation	**K2**
CO2	Explain the mechanism of reaction engineering of ionic, Zeigler Natta & copolymerisation	**K2**
CO3	Interpret the mechanism of reaction engineering of step growth polymerisation	**K5**
CO4	To propose the modelling of bulk and solution polymerisation reactor	**K6**
CO5	To propose the modelling of suspension and emulsion polymerisation reactor	**K6**

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

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CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Principles of Polymerisation Engineering"	Beisenberger J. A. and Sebastian D.H.;	John Wiley& Sons.	1983
2	Text Book of Polymer Science	Billmayer, F. W	Willey Inter Science, New York	3rd Edition 1984

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Polymerization	Odian G.	John Wiley & Sons.	**2002**
2	Polymer reaction engineering	J M Asua	Blackwell publishing	2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1-4	https://archive.nptel.ac.in/courses/103/107/103107206/

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