BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 18.01.2021

In addition to part I (General Handout for all courses appended to the Timetable) this portion gives further specific details regarding the course.

Course No : **PHY F416**
Course Title : **SOFT CONDENSED MATTER PHYSICS**
Instructor-in-Charge : **NAVIN SINGH**
Instructor(s) :
Tutorial/Practical Instructors:

1. Course Description:
Soft matter or soft condensed matter is a subfield of condensed matter comprising a variety of physical systems that are deformed or structurally altered by thermal or mechanical stress of the magnitude of thermal fluctuations. They include liquids, colloids, polymers, foams, gels, granular materials, liquid crystals, and biomolecules. These materials share an essential characteristic feature in that predominant physical behaviors occur at an energy scale comparable with room temperature thermal energy. At these temperatures, quantum aspects are less significant.

In this course, our aim would be to understand the structure, properties, and dynamics of the soft matter. What is the order of forces and times scales that affect the overall behaviour of this class of matter?

2. Scope and Objective of the Course:
- Develop familiarity with the basics of soft condensed matter.
- To develop an understanding about the forces and order of thermal fluctuations in soft matter.
- Why some part of matter is classified as soft matter?

3. Textbooks:
1. Soft Matter Physics, Masao Doi, Oxford University Press, I edition (2013)
2. Soft Condensed Matter, R.A.L. Jones, Oxford University Press, I edition (2002)

4. Reference Books:

1. Essentials of Soft Matter Science, Linda S. Hirst, CRC Press (Taylor & Francis), II edition (2020).

5. Course Plan:

Module Number	Lecture session/Tutorial Session.	Reference	Learning Outcome
Soft Matter: Introduction (Number of lectures: 1) L: 1	• Why it is called as soft matter? • Concept of thermal energies. • How it is different than condensed matter? • Three states of matter: solid, liquid & gas • Inter-molecular forces	TB1: 1.1-1.5	The students shall be able to identify the concept of soft matter (or soft condensed matter).
Phase transitions in soft matter (Number of lectures: 6) L: 2-7	• Thermodynamics of solutions • Concept of phase transition. • Phase separation. • Kinetics of the transition.	TB: 2.1-3.6	Students will be able to understand the concept of phase transition.
Theory of Polymers (Number of lectures: 9) L: 8-16	• Elasticity of Polymers • Random Walk model of polymers • Rubber elasticity	TB1: 3.1-3.5 TB2: 5.1-5.5	Students will develop an understanding of the polymers and their elastic response.
Theory of Colloids (Number of lectures: 7) L: 17-23	• What are Colloids? • Flow of colloids: Stokes' law • Brownian motion & Einstein equation • Forces between colloids	TB2: 4.1-4.4	Student will be able to know about this class of matter. They will learn about the forces and motions in colloids.
Theory of Liquid crystals (Number of lectures: 7) L: 24-30	• Phases in liquid crystals • The nematic to isotropic transition • Topological defects in liquid crystals • Polymer liquid crystals	TB1: 5.1-5.3 TB2: 7.1-7.7	Students will develop an understanding about the liquid crystals. During discussion student will be able to understand the defects in liquid crystals and their importance.
Theory of Gels (Number of lectures: 4) L: 31-34	• Introduction of Gels • Classes of gels • Theory of gelation	TB2: 6.1-6.3	Students will develop an understanding about the different class of gels.
Brownian Motion and thermal fluctuations (Number of lectures: 6) L: 35-40	• Brownian motion of a free particle • Brownian motion in a potential field • Fluctuation-Dissipation theorem	TB1: 7.1-7.5	Students will develop an understanding about the diffusion of soft matter in solutions.

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test	90 Min.	30	To be announced latter	Open book.
Comprehensive Examination	120 Min.	40	05/05/2020 (FN)	Open book
Tutorial		20	To be announced in the class	Open book.
Assignments	-	10	To be announced in the class	Open source.

7. Chamber Consultation Hour: Saturday (10:00-11:00 AM)

8. Notices: To be announced on NALANDA or by email.

9. Make-up Policy: No make-up for Tutorial tests. For other components, depending on the merit of the reason for missing the evaluative component.

10. Note (if any): It is a four units' course. The discussion related to the mentioned topics won't be confined to the books only. More readings from research papers and review articles will be expected from the students.

NAVIN SINGH
(Instructor-in-charge)
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