BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC / MSC/ PHD **SEMESTER : X/IV/NA**
BRANCH: PHYSICS **SESSION : SP/2025**

SUBJECT: PH519: PHYSICS OF THIN FILM

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. **The question paper contains 5 questions each of 10 marks and total 50 marks.**
2. **Attempt all questions.**
3. **The missing data, if any, may be assumed suitably.**
4. **Before attempting the question paper, be sure that you have got the correct question paper.**
5. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

			CO	**BL**
Q.1(a)	Define pumping speed, throughput and conductance in vacuum systems. Air at room temperature (20°C) is flowing under molecular flow conditions, through a series connection of two tubes having diameters 12 cm and 6 cm, and lengths 10 cm and 14 cm, respectively. What is the overall conductance of this arrangement?	[5]	01	
Q.1(b)	Explain the pumping mechanism of a diffusion pump with the help of a schematic diagram. What is the importance of the baffle and cold trap in a diffusion pump system?	[5]	01	
Q.2(a)	State the working principle of the Zero Creep Method for surface energy measurement. How is the condition of "zero creep" related to surface energy in case of amorphous solids?	[5]	02	
Q.2(b)	Differentiate between steady state and non-steady state diffusion. A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a decarburizing (carbon-deficient) atmosphere on the other side at 700°C. If a condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 5 mm and 10 mm beneath the carburizing surface are 1.2 and 0.8 kg/m^3, respectively. Assume a diffusion coefficient of 3×10^{-11} m^2/s at this temperature.	[5]	02	
Q.3(a)	State the different stages involved in thin film formation during physical vapor deposition (PVD). How does adatom mobility influence this process?	[5]	03	
Q.3(b)	Explain the classical growth modes in thin film formation. What determines the selection of each mode?	[5]	03	
Q.4(a)	Compare DC and RF sputtering in terms of working principle, applications, and suitability for different types of target materials. A researcher needs to deposit a thin film of SiO_2 (an insulating material). Which sputtering technique would be most appropriate and why?	[5]	04	
Q.4(b)	Explain the working principle of Thermal CVD. How is plasma used in PECVD to enhance the deposition process? What are the advantages of PECVD over Thermal CVD?	[5]	04	
Q.5(a)	Explain the four-point probe method for measuring sheet resistance of thin films. Why is it preferred over the two-point method?	[5]	05	
Q.5(b)	State the Scherrer formula and explain each term. Under what conditions is this method valid for estimating crystallite size?	[5]	05	

:::::28/04/2025 E:::::