NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Alt-Mid-Term Examination, 2023-24

Course Code: PHO541
Course Name: Thin Film Technology

Full Marks: 25
Time: 90 Minutes

Instructions: Answer **any five** questions.
Materials to be supplied: N/A

Question No.	Body of the Question	Marks	Mapped CO
1	Explain the mechanism of thin film growth. What is the typical range of thickness of thin film? Explain F-V, S-K and V-W growth process.	2+3	CO1
2	Explain the process of electron beam evaporation process for thin film growth. Write-down two advantages of e-beam evaporation over thermal evaporation process. Find the distance of the crucible and filament of the e-beam evaporation system, if the velocity of the electron is $3x10^7$m/s and applied magnetic flux density is B= 3 K gauss, mass of the electron is 9.11 x 10^{31} Kg.	2+1+2	CO1
3	Find the lattice mismatch between Si and GaAs. It is given that the lattice constant of Si = 4.189 A° and GaAs = 3.765 A°. Describe sliding technique of epilayer growth in LPE technique along with the temperature versus time curve.	2+3	CO1
4	Explain on the flux distribution inside the evaporation system if the source is (i) Point and (ii) extended. Find the thickness of the film at a distance 2 cm from the center of the substrate. Consider that the source substrate distance is 12 cm and evaporation is taking place at a base pressure of 10^{-5} mbar.	3 + 2	CO1 CO2
5	Describe the process of GaAs growth using MBE technique and utilization of RHEED to monitor the growth mechanism.	3+2	CO2
6	Describe the working principle of Magnetron sputtering. Also describe the advantages and disadvantages of different shapes electrodes in magnetron sputtering. An electron is moving with velocity v in the perpendicular magnetic field B = 105 Gauss. Find out the radius of the circular path that will be traced by the electron.	3 + 2	CO2
7	Describe laser ablation method for the thin film growth and explain why excimer laser is most suitable than infrared laser for this process. Explain the process of fabrication of polymer thin film.	3 + 2	CO2

Course Outcomes
CO1: To understand growth mechanism of thin film
CO2: To comprehend application of thin film in modern devices
CO3: To be familiar with characterization technique of thin film
CO4: To know about the industrial applications of thin film

NITDGP/BTECH/Reg/Odd/2023-24

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: PHO741 Full Marks: 25
Course Name: Nuclear Reactor Technology Time: 90 Minutes

Instructions: Answer *any five* questions.
Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
1.	a) Graphically show the variations of potential energy V(r) with interparticle radial distance (r) for the neutron-proton and proton-proton interaction within a nucleus. b) What are the different ways to express the mass of nucleons? c) What is the implication of the nonzero neutron magnetic moment? What is the unit of the nuclear magnetic moment?	2+ 1+ (1+1)	CO1,
2.	a) Show graphically the nature of variations of nuclear charge density (ρ) with radial distance (r) for the neutron and proton for a typical ^{208}Pb nucleus. b) What do you mean by mass defect? c) Carbon-16 has a mass defect of 0.11888 u. What is the nuclear binding energy of this isotope (in MeV/nucleon)?	2+ 1+ 2	CO1
3.	a) What is neutron capture? Explain how neutron capture by a U^{238} target nucleus can lead to plutonium production in a nuclear reactor. b) What do you mean by nuclear reaction cross-section? How is it related with the probability of a reaction to occur?	(1+1.5) + (1+1.5)	CO2

Course Outcomes
CO1: To understand basic properties of a nucleus and nuclear reaction.
CO2: To procure knowledge of the action of nuclear reactor.
CO3: To understand neutron physics and diffusion theory.
CO4: To learn the utility, protection and control of nuclear reactor.

4.	a) U^{233} captures a thermal neutron to become U^{234*} with an excitation energy of 6.84 MeV. From this information, can you comment on whether U^{233} is fissile or not? b) Plot and explain the distribution of the fission cross-section of ^{235}U, ^{238}U, and ^{239}Pu nuclei against various incident neutron energies.	1.5 + 3.5	CO2
5.	a) What are the different types of neutron sources? b) How can we define neutrons in terms of energy? (c) Write down a few properties of neutrons.	1.5 + 1.5 + 2	CO3
6.	a) Write down the neutron diffusion equation. b) What is neutron leakage? c) Calculate energy release in fission using the corresponding binding energies of the element. $_0{}^1n + {}_{92}{}^{235}U \rightarrow {}_{56}{}^{144}Ba + {}_{36}{}^{89}Kr + 3\,{}_0{}^1n$ Given: mass of $_0{}^1n$ = 1.00866 u, mass of $_{92}{}^{235}U$ = 235.04393 u, mass of $_{56}{}^{144}Ba$ = 143.92295 u, mass of $_{36}{}^{89}Kr$ = 89.00521 u, mass of $_1{}^1p$ = 1.00786 u.	1+ 2+ 2	CO3

Course Outcomes

CO1: To understand basic properties of a nucleus and nuclear reaction.

CO2: To procure knowledge of the action of nuclear reactor.

CO3: To understand neutron physics and diffusion theory.

CO4: To learn the utility, protection and control of nuclear reactor.