**Lesson Plan**

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Class and Section: M.Sc. Physics 4th Sem.

Subject: Physics of Nano material Paper code: 19PHY24HC2

| Week | Date | Topics |
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| 1 | 1st March-7th March | **Unit I:** |
| | | Free electron theory and its features. Idea of band structure metals,insulater and semiconductors |
| | | Concept of effective mass, Density of states in bands |
| | | Variation of density of states and band gap with size of crystal |
| | | Electronic structure from bulk to quantum dot. |
| | | Electronic states in direct and indirect semiconductor nano-crystals. |
| | | Excitions in direct and indirect band gap semiconductors. |
| 2 | 7th March-14th March | **Unit:2** Physics of reduced dimensional systems and devices, |
| | | Quantum confinement, electron confinement in one,two and three dimensional infinitely deep square well potentials |
| | | Various low dimensional systems:Quantum well st. Idea of quantum well st. |
| | | Electron wave function and energy in quantum well st. |
| | | Density of ststes and optical absorption in quantum well. |
| | | Quantum wires electron wave function and energy, density of states. |
| 3 | 15th March-21th March | Quantum dots electron wave function and energy, density of states idea of hetrojunction LED |
| | | Quantum well laser and quantum dot laser |
| | | Coloumb blockade and single electron transistor |
| | | **Unit:3** Fabrication of nano material bottom up& top down approaches for synthesis of nano material |
| | | Synthesis of zero dimensional nano structure |
| | | Sol-Gel process |
| | | Synthesis inside micelles or using micro-emulsions and growth termination |
| | | Epitaxial core cell nano material |
| 4 | 29th March-4th April | Ball milling, one dimensional nano structure (nano wire ,nano rod, nano tubes ) |
| | | Vapour liquid solid growth and size control |

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| | | Electro chemical deposition , |
| | | lithography |
| | | Two dimensional nano structure (thin films and quantum well) |
| 5 | 5th April-11th April | Molecular beam epitaxy |
| | | MOCVD |
| | | Clustre beam vaporisation, |
| | | ion beam deposition |
| | | chemical bath deposition technique |
| 6 | | **Unit 4** characterisation of nano materials |
| | | Effect of particle size and strain on width of XRD peaks of nano material |
| | | Determination of particle size and strain in nano materials using Deby Scherrer,s formula and Williamson hot spot |
| | | Transmission electron microscopy |
| | 12th April-18th April | Basic princiople brief idea of set up sample prepration |
| 7 | | Imaging modes |
| | | Photoluminuscence spectroscopy |
| | | Basic principle and idea of ionstrumentation |
| | | Shift in PL peaks with particle size |
| | 19th April-25th April | Determination of alloy composition in thin films of compound semiconductor |
| 8 | | Estimation for width of quatum well |
| | | Ramman spectroscopy |
| | | Basic principle and idea of instrumentation |
| | | Variation in Ramman spectra of nano material |
| | 26th April-2nd May | Srudy of Ramman spectra of Carbon nano tube and graphene |
| 9 | | REVISION AND TEST |
| | | ASSIGNMENTS |
| | 3rd May-9th May | |

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| | | Effect of temperature on Fermi energy |
| | | Mechanism of beta decay |
| | | Energetics of beta decay |
| | | Heat capacity of the electron gas |
| | | Experimental heat capacity of metals |
| | | Thermal effective mass |
| | | Electrical conductivity and Ohm's law |
| 10 | | Hall effect |
| | | Failure of the free electron gas model |
| | | Band theory of solids: Periodic potential |
| | | Band theory of solids: Periodic potential (Continue) |
| | | Bloch's theorem |
| | | Kronig-Penney model |
| | | Wave equation of electron in a periodic potential, |
| | | Number of orbitals in an energy band, Classification into metals, semiconductors and insulators (Continue) |
| | $10^{th}$ May - $16^{th}$ May | Tight binding method and its application to sc and bcc structures |