

COURSE TEMPLATE

1.	Department / Centre proposing the course	PHYSICS
2.	Course Title (<i>< 45 characters</i>)	PHYSICS OF NANOMATERIALS
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	PHL 113
6.	Status (<i>category for program</i>)	PROGRAM LINKED

7.	Pre-requisites (<i>course no./title</i>)	PHL 101
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	NO
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NA

9.	Not allowed for (<i>indicate program names</i>)	Engineering Physics
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10.	Frequency of offering	☒ Every sem ☐ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Prof. B. R. Mehta, Prof. D. K. Pandya, Prof. R. K. Soni, Dr. J. P. Singh, Dr. Rajendra Singh, Dr. G. Vijay Prakash, Dr. P. K. Muduli	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): Exposing the students to the fascinating nano-world and the basic concepts that govern their functioning. Introduction to electronic, optical and magnetic properties of nano-structures & some common tools for their synthesis, size selection and characterization. Some nano-devices of current interest will be discussed.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Basics semiconductor concepts; Quantum dot, nanoparticle and clusters; critical size for low dimensional effects and magic numbers; Size induced modifications in band gap; Tight binding and effective mass approximations; Density of states of 0-D, 1-D, 2-D, superlattice and monolayer structures; Quantum Hall effect; Thermoelectrical properties of nanostructured materials. Optical properties of bulk, metal nanoparticles, Core-shell nanoparticles; Size, shape and matrix effects; surface plasmon resonance; intrinsic and extrinsic	
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	effects; Applications of surface plasmon resonance in sensor devices; Magnetic properties of bulk and nanostructured materials; Single domain and multiple domain super paramagnetic phases; ZFC and FC measurements; Giant magnetoresistance effect. Chemical and Physical methods of synthesis of nano-particles and nano-structures, size selection methods; Measurements of size and its distribution; Characterization by AFM, STM and STS; Applications - Single electron effect and resonant tunneling devices. QW lasers, CNT and Graphene, GMR magnetic sensor, Nanostructured solar cell, Thermoelectric devices.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	SEMICONDUCTOR NANOMATERIALS: Basic concepts for bulk, Basics semiconductor concepts, Quantum dot, nanoparticle and clusters, critical size for low dimensional effects and magic numbers. Size induced modifications in band gap, Tight binding and effective mass approximations. Density of states of quantum dot, quantum wire, quantum well, superlattice and monolayer structures. Quantum Hall effect, Thermoelectrical properties of nanostructured materials.	12 hr lecture + 2 hr problem solving sessions
2	METAL and MAGNETIC NANOMATERIALS: Basic concepts for bulk, Optical properties of metal nanoparticles, Core-shell nanoparticles. Size, shape and matrix effects, surface plasmon resonance, intrinsic and extrinsic effects. Applications of surface plasmon resonance in sensor devices. Magnetic properties of bulk and nanostructured materials. Single domain and multiple domain super paramagnetic phases, ZFC and FC measurements. Giant magnetoresistance effect.	12 hr lecture + 2 hr problem solving sessions
3	SYNTHESIS and APPLICATIONS: Chemical and Physical methods of synthesis of nano-particles and nano-structures, size selection methods; Measurements of size and its distribution, Characterization by AFM, STM and STS; Applications - Single electron effect and resonant tunneling devices. QW lasers, CNT and Graphene, GMR magnetic sensor, Nanostructured solar cell, Thermoelectric devices.	12 hr lecture + 2 hr problem solving sessions
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COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Includes 6 hr of problem solving sessions.
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17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
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COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

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| 1. | The Physics of Low dimensional semiconductors by John H. Davis, Cambridge University Press. |
| 2. | Intorduction to Nanotechnology by Charles P. Poole and Frank J Owens, Wiley Interscience |

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	Videos
19.4	Laboratory	
19.5	Equipment	Laptop
19.6	Classroom infrastructure	LCD projector
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	yes
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	Lab visit

Date: 28 January 2013

(Signature of the Head of the Department)