

COURSE TEMPLATE

1.	Department / Centre proposing the course	PHYSICS	
2.	Course Title (<i>< 45 characters</i>)	PRINCIPLES OF ELECTRONIC MATERIALS	
3.	L-T-P structure	3 - 0 - 0	
4.	Credits	3	
5.	Course number	PHL 111	
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. D. K. Pandya, Prof. Neeraj Khare, Prof. Pankaj Srivastava, Prof. Sujeet Chaudhary, Prof. Ratnamala Chatterjee, Dr. J. P. Singh, Dr. P. K. Muduli		
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12.	Will the course require any visiting faculty?	NO	
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13.	Course objective (<i>about 50 words</i>): To present the principles of behaviour of electrons in metals, semiconductors, dielectric and magnetic materials and thus develop understanding of the basis properties of electronic materials and generate understanding of their functioning. The course lays foundation for advanced courses in engineering aspects of materials and their applications.		
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Energy bands in solids(KP model), Classification of electronic materials:metals, semiconductors and insulators. Free electron model, Conductivity in metals and Concepts of Fermi level, effective mass and holes, Concept of phonons, Thermoelectricity, Intrinsic, extrinsic and degenerate semiconductors, Fermi level variation by carrier concentration and temperature, Metal-semiconductor junction, p-n junction, Diffusion and drift transport, carrier life time and diffusion length; Direct and indirect band gaps,		
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	Optical transitions, photon absorption, Exciton, photovoltaic effect, Dielectrics and electrical polarization, Depolarization field, Clausius-Mossotti relation; Drude model, Electronic polarization and its mechanisms, Dielectric breakdown; Piezoelectricity, Pyroelectricity and Ferroelectricity; Magnetism in materials – types of interactions, Magnetic susceptibility, Curie and Neel temperatures; Domains, Magnetic anisotropies, Spin-orbit interaction.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	METALS: Kronig Penney model and Energy bands in solids, Classification of metals, semiconductors and insulators; Density of states and Fermi-Dirac distribution; Free electron model, Conductivity in metals and alloys – classical and quantum mechanical models; Concepts of Fermi level, effective mass and holes, Brillouin zones; Hall-effect and concept of holes in metal; Concept of phonons, Thermoelectricity.	12 hr lecture + 2 hr problem solving sessions
2	SEMICONDUCTORS: Intrinsic, extrinsic and degenerate semiconductors, Fermi level variation by carrier concentration and temperature, charge carrier mobility; Metal-semiconductor junction - rectifying and ohmic, p-n junction, Diffusion and drift transport, carrier life time and diffusion length; Direct and indirect band gaps, Optical transitions, photon absorption, Excitons; Recombination, photoconductivity, photovoltaic effect.	12 hr lecture + 2 hr problem solving sessions
3	DIELECTRICS and MAGNETISM: Dielectrics and electrical polarization, Depolarization field, Clausius-Mossotti relation; Drude model, Electronic polarization and its mechanisms, Dielectric breakdown; Piezoelectricity, Pyroelectricity and Ferroelectricity; Magnetism in materials – types of interactions, Magnetic susceptibility, Curie and Neel temperatures; Domains and domain walls, Magnetic anisotropies, Spin-orbit interaction.	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')	
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18. Suggested texts and reference materials

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

1. Electronic Properties of Materials by R. E. Hummel
2. Principles of Electronic Materials and Devices by S. O. Kasap
3. Introduction to the Electronic Properties of Materials by D. Jiles

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

19.1	Software	
19.2	Hardware	Laptop/tablet
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	Electronic visualizer, remotes for quiz answers, mikes
19.7	Site visits	

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

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

Date: 28 January 2013

(Signature of the Head of the Department)