ARYABHATTA KNOWLEDGE UNIVERSITY

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Notification

The Syllabus of M.Tech. Course of Centre for Nanoscience & Technology (CNN) of Aryabhatta Knowledge University, Patna effective from session 2015-17 has been Post-facto approved by the Academic Council of the University in its 17th meeting held on 09.11.2019 is hereby notified.

By order of the Vice-Chancellor

Sd./-
Registrar (I/c)
Aryabhatta Knowledge University, Patna

Memo no. : 012/Acad/01-09/AKU/2020- 714 Date: 13.02.2020

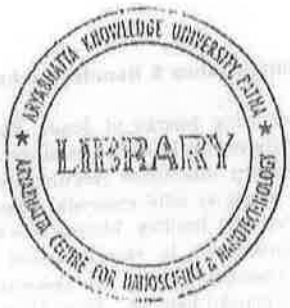
Copy to:

(i)PA to the Vice-Chancellor, (ii) Pro Vice-Chancellor's Office, (iii) Registrar's Office, (iv) Controller of Examinations, AKU, Patna with copy of Syllabus for information and (v) Shri Vishal Ratan Kumar, Web Programmer with copy of Syllabus for uploading the information on University website.

Registrar (I/c)
Aryabhatta Knowledge University, Patna

Aryabhatta Knowledge University, Patna

Aryabhatta Centre for Nanoscience & Nanotechnology



Syllabus for M.Tech. Coursework
Session: 2015 - '17

M.Tech. (Nano Science & Technology)

Course Structure for M.Tech. programme in Nano Science & Technology

L – Lecture, T- Tutorial, P – Practical (Lab), Cr – Credits

I[st] Semester

S. No.	Course Code	Course Title	L	T	P	Cr
		Theory				
1	601101	Introduction to Nanoscience & Nanotechnology	3	0	0	3
2	601102	Synthesis of Nanomaterials	3	0	0	3
3	601103	Experimental Techniques - I	3	0	0	3
4	601104	Nanobiotechnology & Nanomedicine	3	0	0	3
5	601105	Computational Methods, Research Methodology & Ethics	3	0	0	3
		Total Credits				15
		Practical				
1	601111	Laboratory work – I	0	0	4	2
2	601112	Laboratory work - II	0	0	4	2
		Total Credits				4

601101: Introduction to Nanoscience & Nanotechnology (3-0-0)

Introductory remarks, Understanding Science of Small, Wave function, Surface effect, Surface energy, Surface reactivity and catalysis, The Quantization of Energy, Particle in Well and box, Fermi energy and energy distribution function, density of state, Molecule and Molecular interactions, From atoms to solid materials, Bonding in Materials, Metallic bonding, Ionic bonding and covalent bonding, Molecular orbital theory, Dipole moment, Dipole-Dipole interaction, Introduction to Nanostructured materials, Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots, Nano clusters and Nanocrystals, Nanoparticles, Colloidal particles, Wire, Films, Layers and coating, Porous materials, Molecules - Fullerenes, Dendrimers, Micelles, superlattices, Introduction to crystal structure, Thermodynamics of small systems: Nucleation growth theory, Gibbs energy, Chemical potential, Enthalpy.

601102: Synthesis of Nanomaterials (3-0-0)

Synthetic procedures and their significance, Types of nanomaterials synthesis processes; ROHS and WEEE guidelines; Physical method: Advanced Ceramics (Solid-state reaction method), Ball milling method; Chemical method: Co-precipitation technique, Sol-gel method, Soft chemical technique (citrate, tertarate, *etc.*); Hydrothermal method; Bio-chemical method; Thin film Technology: Thermal Evaporation method, Sputtering (RF and DC), Spray pyrolysis method, Spin coating method, Pulsed laser deposition method, vacuum arc discharge, Chemical vapor deposition method (CVD), MOCVD, MBE, Ion beam deposition, Electron-beam lithography,

601103: Experimental Techniques - I (3-0-0)

Introductory remarks. Structural: X-ray and neutron diffraction. XPS. Electron beam techniques: Scanning Electron Microscope, Transmission Electron Microscope, Scanning Tunneling Microscope, Atomic Force Microscope; Photo-luminescence, Cathodo-luminescence, Electro-luminescence; UV-visible and Fourier transformed infrared spectrophotometry; Thermal analysis: Thermogravimetry analysis, Differential Scanning Calorimeter.

601104: Nanobiotechnology and Nanomedicine (3-0-0)

Introduction to living system: Cell (Prokaryotes and eukaryotes), Tissue, Organ, Organisms, a brief introduction to plant and animal physiology, plant and animal metabolism, Primary and secondary metabolites in plants and their significance. DNA, RNA, Proteins, Enzymes, Hormones, Growth factors and their importance in living systems.

Use of different living organisms (Bacteria, Fungi, Plants, Lower animals) for synthesizing different nanomaterials. Use of different nanomaterials like: Gold, Silver, Platinum, Carbon nanotubes in treatment of different diseases. Use of nanomaterials in drug delivery system and their potential promises. Nanotechnology in Healthcare: Future Nanomedicine, Nanorobots.

601105: Computational Methods & Research Methodology (3-0-0)

Overview of computer organization, hardware, software, scientific programming in FORTRAN 77. Sorting, interpolation, extrapolation, regression, numerical integration, quadrature, differentiation, Newton-Raphson method, matrix manipulations, eigenvectors and eigenvalues, initial-value problems, Euler, Runge-Kutta, idea of Monte Carlo method.

Research methodology: Introduction to research, Topic Selection, Addressing a problem, Review of literature, Objectives, Scientific method of Research, Work Plan Budget, Research reporting.

Introduction to Graphics and graphical analysis, modeling

Statistical methods: Standard deviation, Chi-square test, Significance in statistical analysis.

601111: Laboratory work – I (0-0-4)

Synthesis of different nanomaterials using soft-chemical and bio-chemical routes.

601112: Laboratory work – II (0-0-4)

Problem solving through computer
Statistical analysis of data
Graphics and analysis including modeling
Idea of Circuit Simulation.

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2nd Semester

S. No.	Course Code	Course Title	L	T	P	Cr
Theory						
1	601201	Properties of Nanomaterials	3	0	0	3
2	601202	Experimental Techniques – II	3	0	0	3
3	601203	Intellectual Properties Rights & Entrepreneurship Development Programme	3	0	0	3
4		Elective - I	3	0	0	3
5		Elective - II	3	0	0	3
		Total Credits				15
Practical						
1	601211	Laboratory work – III	0	0	4	2
2	601212	Laboratory work - IV	0	0	4	2
		Total Credits				4

601201: Properties of Nanomaterials **(3-0-0)**

General Shape and Size dependent properties,

Electrical properties - Resistivity, Dielectric & ferroelectric properties, Conductivity behavior.

Magnetic Properties - Magnetic parameters variation, susceptibility, permeability eddy current loss, Superparamagnetic effect, *etc*,

Optical properties - Photoconductivity. Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence,

601202: Experimental Techniques - II **(3-0-0)**

Vibrating Sample Magnetometer, Superconducting Quantum Interface devices, pH and Conductivity meter, UV-Visible-NIR Spectrophotometer, Digital refractometer, Nanoparticles tracking analysis system, Digital Viscomter, Multiferroic system, Raman spectroscopy, Atomic Absorption Spectrometer, Photoconductivity measurement, Mossbauer Spectroscopy, Positron annihilation Spectroscopy. Electrochemical Impedance Spectroscopy, Brunnauer-Emmett Teller surface areas, Zeta potential.

601203: Intellectual Property Rights & Entrepreneurship Development Programme **(3-0-0)**

Intellectual Property Rights: Introductory remarks, Nature and types of Intellectual Property, How to acquire rights, What is a Patent?, Types of Patents, Life and duration of Patents, Patentable Invention/items, Industrial Design, Trade & Service Marks, Trade Secrets, Copyright, Geographical Indications of Goods.

Entrepreneurship Development: Introductory remarks, Characteristics, Team building and Motivation, Leadership, Communication and interpersonal skills, Managing R&D and Innovations, Entrepreneurship, Analyzing business environment, Decision Making techniques, Project Management (PERT / CPM analysis).

Elective – I: 601221: Nanoceramics & Nanocomposites

Elective – II: 601226: Nanotechnology in Energy & Environment

601211

601111: Laboratory work – III (0-0-4)

General electricity based practical.

601112: Laboratory work – IV (0-0-4)

Hands on practice on some research level equipment/data analysis.

Course structure for M.Tech. programme in Nano Science & Technology
L – Lecture, T- Tutorial, P – Practical (Lab), Cr – Credits
3rd Semester

S. No.	Course Code	Course Title	L	T	P	Cr
		Theory				
1	601331	Seminar & Presentations	-	-	-	5
2	601341	Project work (to be continued to 4th Sem.)	-	-	-	12
		Total Credits				17

Course structure for M.Tech. programme in Nano Science & Technology
L – Lecture, T- Tutorial, P – Practical (Lab), Cr – Credits
4th Semester

S. No.	Course Code	Course Title	L	T	P	Cr
		Theory				
1	601431	Seminar & Presentations	-	-	-	4
2	601441	Project work (continued)	-	-	-	16
		Total Credits				20

Total Number of Credits: 75