

## **ELECTIVE COURSES OFFERED BY THE DEPARTMENT**

### **SEMESTER-I**

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<b>OE/GE Courses offered by the Department of Nanotechnology for PG students enrolled in other Departments/Faculties</b>			
<b>COURSE CODE</b>	<b>PAPER</b>	<b>CREDITS</b>	<b>INSTRUCTORS</b>
<b>NTE18001OE</b>	<b>NANOSCIENCE &amp; NANOTECHNOLOGY: AN INTRODUCTION</b>	<b>2</b>	<b>DR. SHAFQUAT MAJEED</b>
<b>NTE18002OE</b>	<b>INTRODUCTION TO NANOBIO TECHNOLOGY: CONCEPTS AND APPLICATIONS IN HEALTH AND MEDICINE</b>	<b>2</b>	<b>DR. TARIQ MAQBOOL</b>

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<b>SYLLABUS</b>			
<b>COURSE CODE</b>	<b>PAPER</b>	<b>CREDITS</b>	<b>INSTRUCTORS</b>
<b>NTE18001OE</b>	<b>NANOSCIENCE &amp; NANOTECHNOLOGY: AN INTRODUCTION</b>	<b>2</b>	<b>DR. SHAFQUAT MAJEED</b>

#### **Unit-I**

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Nanoscience and Nanotechnology: History, definitions, nano scale and nano effects. Simple introduction and definition with suitable examples.

Nanomaterials, classification and properties: One-dimensional, Two-dimensional and Three-dimensional nanomaterials with examples from each class.

#### **Unit-II**

Nanomaterial Synthesis Strategies. Fundamentals of growth and nucleation. Top Down and Bottom up approaches for nanomaterial synthesis.

Photolithography, Chemical Etching, Laser Ablation, Ball milling, Solvothermal/Hydrothermal, Sol-gel route, chemical vapour deposition, Sonochemical and Microwave-irradiation assisted synthesis.

#### **Books/Reference Recommended:**

1. Charles P. Poole. Jr. & Frank J. ownes, Introduction to Nanotechnology - John Wiley & sons Inc. Publishers-2006
  2. Guozhong Cao, Nanostructures and Nanomaterials: Synthesis, properties and applications-Imperial College press.
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<b>SYLLABUS</b>			
<b>COURSE CODE</b>	<b>PAPER</b>	<b>CREDITS</b>	<b>INSTRUCTORS</b>
<b>NTE18002OE</b>	<b>INTRODUCTION TO NANOBIO TECHNOLOGY: CONCEPTS AND APPLICATIONS IN HEALTH AND MEDICINE</b>	<b>2</b>	<b>DR. TARIQ MAQBOOL</b>

**Course Description:**

Nanobiotechnology is a new frontier for biology with important applications in healthcare and medicine. It bridges areas in physics, chemistry, and biology and is a testament to the new areas of interdisciplinary science that are becoming dominant in the twenty-first century. This course will provide perspective for students who are interested

**Unit I**

**Introduction to Nano-Sciences and Technology:**

- Concepts and processes in Nanotechnology
- Properties of matter at Nanoscale
- Examples of Nanostructures in nature
- Commercial Nanomaterials

**Unit II**

**Application of Nanotechnology in Healthcare and Medicine:**

- Biological systems at nanoscale.
- Medical Innovation.
- Nanomedicine; Convergence of Nanoscience and systems biology.
- Applications of Nanotechnology in Healthcare and Medicine:
- Role of biosensors in diagnostics and Drug discovery.
- Targeted therapeutics and molecular imaging.
- Novel therapeutics and Drug delivery systems.
- Safety and Toxicological issues.

**Books/Reference Recommended:**

1. Hornyak, Dutta, Tibbals and Rao, *Introduction to Nanoscience and Nanotechnology*, New York, CRC press, 2008.
2. *Nanobiotechnology: Concepts, Applications and Perspectives* by Christof M.
3. Niemeyer and Chad A. Mirkin.
4. *Targeted Drug Delivery concepts* by P. V. Devarajan, S. Jain.
5. *Nanobiotechnology and nanobiosciences* by Claidio Nicolini.

## SEMESTER-II

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### OE/GE Courses offered by the Department of Nanotechnology for PG students enrolled in other Departments/Faculties

COURSE CODE	PAPER	CREDITS	INSTRUCTORS
NTE18003OE	TARGETED DRUG DELIVERY	2	DR MUGHTAQ A BEIGH
NTE18004OE	TISSUE ENGINEERING	2	DR. FAHEEM A SHEIKH

### SYLLABUS

COURSE CODE	PAPER	CREDITS	INSTRUCTORS
NTE18003OE	TARGETED DRUG DELIVERY	2	DR MUGHTAQ A BEIGH

#### Unit I

Nano-medicine: Nanoparticle delivery systems, characteristics, applications and advantages. Targeted drug delivery: (e.g., DNA, RNA, protein, drug) in therapeutic applications, Use different nanomaterials as drug carriers and imaging agents. Novel Therapeutic Delivery Systems. Liposome and Microsphere Transport and Delivery.

#### Unit II

Recent advancement in Nano-biointerface: Interactions of cells with nanomaterials in-vivo and in vitro: Dependence of interaction on physiochemical properties of nanomaterials, biocompatibility, surface functionalization as a means to enhance biocompatibility. Drug targeting to tumours. Targeting the Vasculature of Solid Tumours. Drug Delivery to the Brain.

#### Books/Reference Recommended:

1. *Targeted drug delivery: Concepts and design: by Padma V. Devrajan, Springer Press*
  2. *Drug delivery systems: Ranade-Cannon-Third edition, CRC press*
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<b>SYLLABUS</b>			
<b>COURSE CODE</b>	<b>PAPER</b>	<b>CREDITS</b>	<b>INSTRUCTORS</b>
<b>NTE180040E</b>	<b>TISSUE ENGINEERING</b>	<b>2</b>	<b>DR. FAHEEM A SHEIKH</b>

### Unit I

History and fundamentals of tissue engineering. Different biomaterials for tissue engineering. Different routes for synthesis of tissue engineered materials (e.g., Nanofiber self-assembly, Textile technologies, Solvent casting and particulate leaching, Gas foaming, Emulsification freeze-drying, Thermally induced phase separation, Electrospinning, Laser-assisted bioprinting and 3D printing). Bone healing around implants (e.g., biomimetic coatings, nano titanium based implants). Scaffolding, Tissue culture, Bioreactors and Bioartificial organs

### Unit II

Nanofiber production using specialized technique. Controlling morphologies of nanofibers. Polymer nanofibers and ceramic nanofibers for tissue engineering application. Bionics (Swim-suits with shark-skin-effect, soil repellence, lotus effect). Nano finishing in textiles (UV resistant, antibacterial, hydrophilic, self-cleaning, flame retardant finishes, fragrance releasing cloths). Modern textiles (Lightweight bulletproof vests and shirts, color changing property, Waterproof and Germ proof, Cleaner kids clothes).

#### Books/Reference Recommended:

1. *Tissue Engineering*, John P. Fisher , Joseph D. Bronzino , Antonios G. Mikos, Taylor & Francis Inc, ISBN10: 0849390265
  2. *Electrospinning: Materials, Processing, and Applications*, Joachim H. Wendorff, Seema Agarwal, Andreas Greiner , Wiley ISBN: 978-3-527-32080-6
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## SEMESTER-III

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### OE/GE Courses offered by the Department of Nanotechnology for PG students enrolled in other Departments/Faculties

COURSE CODE	PAPER	CREDITS	INSTRUCTORS
NTE18005OE	CANCER NANOTECHNOLOGY		DR MUSHTAQ A BEIGH
NTE18006OE	APPLICATIONS OF NANOTECHNOLOGY IN FOOD SCIENCES		DR. FAHEEM A SHEIKH

### SYLLABUS

COURSE CODE	TITLE	CREDITS	INSTRUCTOR
NTE17005OE	CANCER NANOTECHNOLOGY	2	DR. MUSHTAQ A BEIGH

#### Unit I

**Cancer and classical therapeutics:** Cancer- General description, cancer cells and effector mechanisms, Tumor Dissemination (metastasis), Types and localization.

Current therapies, chemotherapy, radiotherapy and other biologicals-based therapies, cancer diagnostics- elementary idea

Problems with current therapies-tumor relapse

#### Unit II

**Nanotechnology based cancer theranostics:** Benefits of Nanotechnology for cancer treatment, passive tumor accumulation, Active tumor targeting, transport across tissue barriers,

Early detection and diagnosis- imaging *in vivo*, Sensing *in vitro*

Treatment and therapy- delivering targeted chemotherapy, Nano-enabled immunotherapy, Augmenting radiotherapy

Current nanotechnology Treatments, Approved cancer drug therapies based on Nanotechnology, Nano based therapeutics in clinical trials

#### Books/Reference Recommended:

1. *Targeted drug delivery: Concepts and design:* by Padma V. Devrajan, Springer Press
  2. *Drug delivery systems: Ranade-Cannon-Third edition,* CRC press
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<b>SYLLABUS</b>			
<b>COURSE CODE</b>	<b>TITLE</b>	<b>CREDITS</b>	<b>INSTRUCTOR</b>
NTE17006OE	APPLICATIONS OF NANOTECHNOLOGY IN FOOD SCIENCES	2	DR. FAHEEM A SHEIKH

### Unit I

Introduction to nanoscale, Synthesis of different nanomaterials used in food (e.g., nanodispersions, nanocapsules, association colloids, nanoemulsions, biopolymeric nanoparticles, nanolaminates, nanofibers and nanotube) the enhanced material properties, method of processing and level of incorporation. Nano-sized additives used in food and nanomaterials for delivery of nutraceutical/functional ingredients. Nanosensors for pesticide, pathogen and toxin detection in food products. Nano-based food packaging materials, cleaning and disinfection, Safety issues and regulations for use of nanomaterials.

### Unit II

Case studies based on: Delivery of nano-based antimicrobials. Packaging using edible coating, active packaging and intelligent packaging. Nanoencapsulation for bioactive delivery, flavor delivery and nutrient delivery. Enhancing physical properties for color additives, anticaking, improving the tensile strength, increasing the gas permeability, water resistance and flame resistance. Recent examples of nano additives (colors, flavoring agents, preservatives, antioxidants). Nano-starch, Nano-cellulose, Nano-salt, nano-mayonnaise, Ice-cream, Nanotea, Nano-SiO<sub>2</sub>, Se, TiO<sub>2</sub>, Fe, ZnO, Ag, Ca materials used in modern foods.

#### Books/Reference Recommended:

1. *Xiaojia He, Huey-MinHwang, Nanotechnology in food science: Functionality, applicability, and safety assessment, Journal of Food and Drug Analysis, 24, 2016, 671-681.*
  2. *Neha Pradhan, Facets of Nanotechnology as Seen in Food Processing, Packaging, and Preservation Industry, BioMed Research International, Volume 2015, Article ID 365672, 17 pages.*
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## SEMESTER-IV

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### OE/GE Courses offered by the Department of Nanotechnology for PG students enrolled in other Departments/Faculties

COURSE CODE	PAPER	CREDITS	INSTRUCTORS
NTE18001GE	SMART MATERIALS	2	DR. SHAFQUAT MAJEED
NTE18002GE	STEM CELLS & REGENERATIVE MEDICINE	2	DR. TARIQ MAQBOOL

### SYLLABUS

COURSE CODE	TITLE	CREDITS	INSTRUCTOR
NTE17001GE	SMART MATERIALS	2	DR. SHAFQUAT MAJEED

#### Unit-I

Introduction to materials, classification of materials, Historical perspective and time-line of major developmental efforts related to material science, Considerations in the design of new materials: critical thinking approach.

#### Unit-II

Definition of a smart material, different types of smart materials: shape-memory alloys (SMAs), piezoelectric materials, magnetostrictive materials, magneto- and electro rheological Materials, chromic materials: thermochromic and photochromic

#### Books/Reference Recommended:

1. *Material Chemistry* by Bradley D. Fahlman
  2. *Smart Materials* by Dr Daine Talbot (*Institute of Materials, Minerals and Mining*)
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<b>SYLLABUS</b>			
<b>COURSE CODE</b>	<b>TITLE</b>	<b>CREDITS</b>	<b>INSTRUCTOR</b>
<b>NTE17002GE</b>	<b>STEM CELLS &amp; REGENERATIVE MEDICINE</b>	<b>2</b>	<b>DR. TARIQ MAQBOOL</b>

### Course Description

Stem Cell and Regenerative Medicine course is designed as a generic elective course to give opportunity to students to learn about new, up to date technologies that are applicable to modern therapeutic approaches in biomedicine, such as: stem cell applications, nanomedicine, bioengineering-functionalized scaffolds, biomaterials.

#### **Unit-I**

- Current and Future Perspectives of Regenerative Medicine
- Biologic and Molecular Aspects of Regenerative Medicine
- Embryonic and Adult Stem Cells
- Induced Pluripotent Stem Cells

#### **Unit-II**

- Therapeutic applications of Stem cells
- Applications of Nanotechnology in stem cell research: tracking, delivery, scaffolds
- Nanoparticles as Nucleotide Delivery for Genetic Control in stem cells
- Biomaterials & bioprinting in Regenerative Medicine

#### **Books/Reference Recommended**

1. *R. Lanza, Gearhart et al (Eds), Essentials of Stem Cell Biology. 2009, Elsevier Academic press.*
  2. *Stem cells: a revolution in therapeutics-Recent advances in stem cell biology and the applications in regenerative medicine and cancer therapies, M Mimeault, R Hauke and S K Batra, Clinical Pharmacology & Therapeutics.*
  3. *Ferreira, L. et al. New opportunities:2008 The use of nanotechnologies to manipulate and track stem Cells.*
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