MHRD Scheme on GlobalInitiativeonAcademic Network(GIAN)

Course Title: **Composite And Nanocomposite Materials - Metal, Ceramic,Polymer Matrix, As New Engineering And Structural Materials**

Overview

Composites are scientific and researched combinations of two or more different materials to adopt the better properties of the conjugate components and perform in a far better away than the individual components when used alone.structured combinations of continuous and discrete phases in which the stronger and stiffer discrete phase (reinforcement) is held in the weaker and softer continuous phase (the matrix) by interfacial bonding. Significant use in modern aircraft structural and non-structural applications such as in automotive, marine vessels, utility industry, sports, chemical industry, printed circuit board base and elsewhere.

Objectives

The primary objectives of the course are as follows:

- Exposing participants to the fundamentals of composites and nanocomposites aspects.
- Building in confidence and capability amongst the participants in the application of composite and nanocomposites materials, tools, and mapping the composites fabrication organizational activities and problems in terms of structural engineering framework.
- Providing exposure to practical problems and their solutions, through case studies in composite materials application in engineering products.
- Enhancing the capability of the participants to identify, control and specialize incomposites technology related applications / problems in engineering systems.

Course details

This course deals with Philosophy of a Composite. Fibre and matrix materials. Role of the interface. Polymer matrix, metal matrix and ceramic matrix composites, Nanocomposites. Physico-chemical characteristion. Strengthening and toughening mechanisms. Fabrication techniques. Design with composites. Infrastructural Applications.

Lecture Module:

July 11 MONDAY

Lecture 1 : 9:30 to 11:00 AM
Philosophy of a composite: composite materials/structures, kinds of components

Lecture 2 : 11.15 to 12.45 AM
process synthesis approaches and hierarchical / systematic generation

Lecture 3 : 2.30 to 4.00 PM
Role of the interfaces: Fibre reinforced composites – Types of fibres used extensively & their characteristics-Types of matrices used over the years and being developed as new systems to meet various applications

July 12 TUESDAY

Lecture 4 : 9:30 to 11:00 AM
Physico-chemical characteristion: Scheme synthesis of composites and generation/ analysis of preformance curves

Lecture 5 : 11.15 to 12.45 AM
Effect of reinforcement volume fraction. Size and size distribution:Use of various types of fibres and phenomenon of stress transfer through the matrix – depending on the fibre-matrix networks

Lecture 6 : 2.30 to 4.00 PM
Properties of composites: Mechanical, Electrical and magnetic, thermal, chemical and optical

July 13 WEDNESDAY

Lecture 7 : 9:30 to 11:00 AM
Strengthening and toughening mechanisms : Adhesion the key.... Effect of bonding on fracture energy and fracture toughness of composites in mode I loading; Influence of debonding and pull-out, theoretical models

Lecture 8 : 11.15 to 12.45 AM
Metal matrix composites – Types of Metal Matrix Composites- Important Metallic Matrices-Aluminum-Titanium-Copper- Processing: Liquid-State Processes, Solid State Processes, In Situ Processes- Interface- Applications

Lecture 9 : 2.30 to 4.00 PM
Ceramic matrix composites: Types of ceramics matrices -Processing **-**. Cold Pressing and Sintering -.Hot Pressing- Reaction Bonding Processes - Infiltration - In Situ Chemical Reaction Techniques-Sol–Gel- Interface -Applications

July 14 THURSDAY

Lecture 10 : 9:30 to 11:00 AM
Polymer matrix composites- Types of polymers- Processing of PMCs -Processing of Thermoset Matrix Composites- Thermoplastic Matrix Composites - Sheet Molding Compound - Carbon Fiber Reinforced Polymer Composites

Lecture 11 : 11.15 to 12.45 AM
Interface in PMCs - Glass Fiber/Polymer - Carbon Fiber/Polymer Interface - Polyethylene Fiber/Polymer Interface
Structure and Properties of PMCs- Structural Defects in PMCs-Mechanical Properties - Applications

Lecture 12 : 2.30 to 4.00 PM
Carbon Fiber/Carbon Matrix Composites: Processing of Carbon/Carbon Composites - High Pressure Processing

Oxidation Protection of Carbon/Carbon Composites - Properties of Carbon/Carbon Composites -Applications

July 15 FRIDAY
Lecture 13 : 09.30 to 11.00 AM
Types of Bonding at the Interface- Mechanical Bonding - Physical Bonding - Chemical Bonding - Optimum Interfacial Bond Strength

Lecture 14 : 11.15 to 12.45 AM
Tests for Measuring Interfacial Strength: Flexural Tests- Single Fiber Pullout Tests-Curved Neck Specimen Test-Instrumented Indentation Tests- Fragmentation Test –Laser Spallation Technique

Lecture 15 : 2.30 to 4.00 PM
Fatigue and Creep of composites
Fabrication of Glass fibre reinforced composites&/or CFRP plates / CFRP strips
Design of composites for various Engineering

July 18 MONDAY

Lecture 16 : 9:30 to 11.00 AM
Nano compistes past and future – Features of nano composites -

Lecture 17: 11.15 to 12:45 AM
Polymer Nano composites: Preparation and Synthesis- Solution Dispersion- *In-Situ* -Polymerization- Melt Intercalation - Effect of Mixing

Lecture 18 : 2.30 to 4.00 PM
Rheology of Nano composites: Steady Shear Rheology-Dynamic Rheology- Non Linear Viscoelastic Properties

July 19 TUESDAY

Lecture 19 : 9:30 to 11.00 AM
Processing of Nanocomposites: Extrusion-Injection moulding-Blow moulding –Rotational moulding

Lecture 20: 11.15 to 12:45 AM
Structure and Properties Characterization of Nano composites:
Scattering Techniques- WAXS-SAXS-SALS-SANS
Microscopic Techniques- Electron Microscopy-TEM-SEM-AFM

Lecture 21 : 2.30 to 4.30 PM
Visiting labs : Ball Mill - Spray Pyrolysis- Mini CVD- Autoclave- Particle Size Analyser

July 20 WEDNESSDAY

Lecture 22 : 9:30 to 11.00 AM
Spectroscopic Techniques- FTIR-NMR-UV

Lecture 23: 11.15 to 12:45 AM
Solid-State Characterization: Mechanical Testing- DMA
Thermal Characterization: DSC-TGA-HDT

Lecture 24 : 2.30 to 4.30 PM
Visiting Labs: X-Ray Diffraction - TD/DTA- Raman Spectroscopy - Atomic Force Microscopy-UV- Visible Spectroscopy

July 21 THURSDAY

Lecture 25 : 9:30 to 11.00 AM
Micromechanics of Composites I: Mechanics of Load Transfer from Matrix to Fiber-Fiber Elastic–Matrix Elastic- Fiber Elastic–Matrix Plastic - Load Transfer in Particulate Composites

Lecture 26: 11.15 to 12:45 AM
Macromechanics of Composites II: Analysis of Laminated Composites- Stresses and Strains in Laminate Composites- Interlaminar Stresses and Edge Effects

Lecture 27 : 2.30 to 4.00 PM
Monotonic Strength and Fracture: Fracture Modes in Composites- Strength of an Orthotropic Lamina- Maximum Stress Theory - Maximum Strain Criterion - Maximum Work (or the Tsai–Hill) Criterion- Quadratic Interaction Criterion

July 22 FRIDAY

Lecture 28 : 9:30 to 11.00 AM
Recycling of Composites: Composite Ratio in Products and Re-melting - Separation of Fibers or Particles - State of Composites -Separation of Reinforcements- Using Fluxes - Entropy of Mixing by the Addition of Reinforcement Particles

Lecture 29: 11.15 to 12:45 AM
Infrastructural Applications : Latest ecomomic and structural developments
Challenges of CFRP woven products in enhancing safety of concrete structure under earthquake situations
Biomedical and Electonic applications of composite materials
2.30 to 4.30 PM
Examination, Evaluation and Certificate distribution

Teaching Faculty

Foreign Expert

Name of Faculty:**Prof Sri Bandyopadhyay**

Affiliation: UNSW Australia, Sydney, School of Materials Science & Engineering

Address: Room – 401, Bldg E-10, Materials Sci Eng, UNSW, Sydney 2052, Australia

Contact No: +61 414 751 755

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Prof Sri Bandyopadhyay is confidentially CATEI ranked by UNSW Australia relevant students as the Best Teaching Performer in UNSW Australia's a) School of Materials Science & Engineeerinng, b) Faculty of Science, and c) the entire UNSW Australaia. Professor Sri Bandyopadhyay is also a high class researcher in the fields of composites and nanocomposites. In 2013 August, Australia's Campus Review management selected him as 1 of Top 5 Autralian Innovators for his re-invention of coal power fly ash **http://www.materials.unsw.edu.au/news/archive/2013-10.**

Sri Bandyopadhyay is also the originator / chair of the world's one of the best brand of Composites conferences known as **ACUN** Conferences (Australia, Canad, USA, NZ) which happened on 6 occiasions between 1999 and 2012 in UNSW and Monash Universities Australia. These **ACUN** conferences have been ranked by attending delegates from over 20 countries as among the 5 to 10 world conferences.

Sri Bandyopadhyay is, by invittaion, Editor-in-Chief of International Journal of Energy Engineering, by World Academic Publishing Company, ISSN:2225-6563(Print), ISSN:2225-6571(Online)
http://www.ij-ee.org/

Sri Bandyoadhyay was earlier employed at Australian Defence Science & Technology Organisation (DSTO) Materials Research Laboratort Melbourne, where he was given the Best Scientist Award for his innovative research on In-situ SEM deformation and fracure studies of polymers and polumer-matrix composites.

Sri Bandyopadhyay has over 130 refereed research publications and 4 provisional patents/Intellectual Properties on new composite materials including metal matrix composites, polymer matrix composites and carbon nano tube composites.In Nov 2015, he is

included as Inventor & Technical Advisor Enhanced Nanocomposites Inc. USA : http://www.enhancednanocomposites.com/team/

Finally, Prof Sri Bandyopadhyay was the initiator of today's Australia –India Science Research Funded scheme AISRF over $60M projects that started after Sri Bandyopadhyay approached India's 11 th President Dr APJ Abdul Kalam in 2004, and Dr Kalam was pleased to follow it through DST / Govt of India and Australia's then Prime Minister Mr John Howard through DIISR, Govt of Australia.

Who can Attend

- Executives, engineers and researchers from manufacturing, service and government organizations includingR&D laboratories.
- Student students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions.

Host Faculty

Dr. P.Prasanna
Assistant Professor
Mechanical Engineering Dept
JNTUH College of Engineering
Kukatpally
Hyderabad-500085
Telangana

Dr.B.Ramesh Chandra
Assistant Professor
Metallurgical Engineering Dept
JNTUH College of Engineering
Kukatpally
Hyderabad-500085
Telangana

Dr.B.Ramesh Chandra has a Masters and Ph.D in Metallurgy from IIT Kharagpur. He is presently working as Assistant Professor in the department of Metallurgical Engineering, JNTUH College of Engineering, Hyderabad. His area of specialization is Composite materials, Surface Engineering and Material Characterization. He has a teaching expereince of 10 years and also published more than 15 research papers in reputed National and International journals.

Dr.P.Prasanna has a Masters and Ph.D in Mechanical from JNTU Kakinada. He is presently working as Assistant Professor in the department of Mechanical Engineering, JNTUH College of Engineering, Hyderabad.His area of specialization is Composite materials,

Manufacturing and Machine Design. He has a teaching expereince of 10 years and also published more than 10 research papers in reputed National and International journals.

Registration Fees

Participants from abroad	: US $500
Industry/ Research Organizations	**:** Rs.15000/-
Teaching faculty from Academic Institutions	**:** Rs.10000/-
Students	: Rs.2000/-
	Rs.1000/-(SC/ST)

The above fee include all instructional materials, computer use for tutorials, 24 hr free internet facility. The participants will be provided with shared accommodation and lunch on payment basis.

PROPOSED BUDGET FOR TWO Weeks Course (Tentative)

Sl No	Description of budgetary head per Course	Amount (Rs.)
1	International Expert Air Fare(Economy class by Shortest Route)	2,00,000
2.	Honorarium to Expert (Item 1 + Item 2 should not exceed 8000 or 12000 USD) (@USD250 per Lecture/Tutorial) (Accommodation charges are to be borne by the Expert)(Comfortable accommodation can be obtained @USD50 per day max)	4,50,000
3	Lecture Notes/video-learning material preparation	50,000
4	Contingency	50,000
5	Video recording expenses	25,000
6	Miscellaneous expenditure	25,000
7.	Host Faculty Honorarium	30,000
8.	Local Coordinator Honorarium	20,000
	GRAND TOTAL	**8,50,000**

Honorarium to host faculty and local coordinator should be paid from the earnings for the subject through fee collection.