

COURSE STRUCTURE AND SYLLABUS

FOR

Pre-Ph.D. Course Work



Department of Mechanical Engineering

Faculty of Engineering & Technology

Veer Bahadur Singh Purvanchal University, Jaunpur, U.P., INDIA

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C PROF. SATYA
EXTERNAL
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EXPERT

Syllabus of Ph. D. Course Work
w.ef. session 2023-2024

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10/10/2023
Prof. S.K. Singh
Convener, B.O.C (Mech)

EVALUATION SCHEME

For Ph.D. (Doctor of Philosophy) course work

S.No.	Course Code	Course Title	Theory/ Research	Credit	Max. Marks (100)	
					CIE	UE
1	FE03060XT	Core Course 1	Theory	6	25	75
2	FE03060XT	Core Course 2	Theory	6	25	75
3	FE030105T	Research Methodology, Research Publication Ethics and Computer Applications	Theory	4	25	75
4	FE030106P	Research Project	Project	-	25	75

Core Course 1

1. FE030601T: Nano Science And Nanomaterials
2. FE030602T: Machine Learning For Mechanical Engineering

Core Course 2

1. FE030603T – Solar thermal technologies and applications
2. FE030604T: Python Programming

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Chairman - B.O.S (Ment)

Credit system:

- A four (4) credit theory course/paper will have four Lectures/periods (of one hour) in a week. In one full semester the course will be covered in 60 Lectures.
- Similarly, a six (6) credit theory course/paper will have six Lectures/periods (of one hour) in a week. In one full semester the course will be covered in 90 Lectures.

Continuous Internal Evaluation (CIE) of 25 marks:

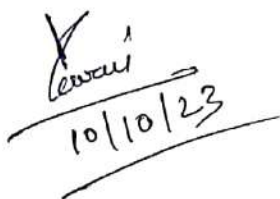
- Continuous internal evaluation will be performed by the teacher/ course coordinator concerned.
- CIE shall be 25% of total assessment in a Theory paper and research project.
- 25 marks shall be distributed as 5 marks for attendance, 5 marks for presentation and assignment and remaining 15 marks for class test.

Marking system:

- All papers will have a total maximum mark of 100, including both CIE and University Examination (UE). Maximum marks of 25 will be allotted to CIE and 75 to UE in a theory paper/ research project.
- The CIE of the research project shall be evaluated by the research supervisor and co-supervisor (if any).
- 75 marks of **research project** shall be distributed as 50 marks (project work and presentation) and a viva voce of 25 marks.
- The evaluation (Max Marks 75 UE) of the research project shall be done by internal examiner/s (Supervisor and Co-supervisor (if any)) and one external examiner appointed by the University.

Research Project Submission:

- The evaluated research project report in two sets of hard copy (spiral binding) must be prepared. One copy of it shall be submitted to the university if it demands. A second copy of the evaluated research project report must be in the records of the college/research centre.
- The format of university Ph.D. thesis writing guidelines can be used as format of Research project writing guidelines.


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Course Code: FE030105T	Course Title: Research Methodology, Research Publication Ethics and Computer Applications		
Course Outcomes (COs) The research scholar shall be able to CO1: decide the research field, topic, design, and pros and cons of research, sampling, and data collection techniques. CO2: understand the research process and acquire the skill of writing research articles. CO3: execute the best practices, morals, and ethical values in scientific conduct and avoid publication misconduct. CO4: learn about the standards of journals for good-quality publications of their research work. CO5: learn how to use computers and different application software for manuscript writing, reference management and the maintenance of academic integrity using scientific tools.			
Credits: 4	Core Compulsory		
Max. Marks: 25 (CIE) + 75(UE)	Min. Passing marks: 55		
Total number of lectures: Lectures-Tutorial-Practical (4 hours in a week) L-T-P: 4-0-0 (60 hr)			
Unit	Topics	No. of Lecture Hrs.	
I	Research Methodology Definition, and Objectives, Motivation and Significance of Research, Types of Research, Truth and Facts of Research, Similarity and Contrast in Literary Research and Scientific Research, Research and Criticism, Research Problem and Research Design, Sampling Design and Methods of Data Collection.	12	
II	Research standards: Layout of the Research Report, Research Process: subject Selection, Outline of the Research, Review of Literature, Material Collection;	12	
	Testing and Classification, Analysis, Discussion and Conclusions, Precautions in Writing Synopsis/Research Paper/Thesis/Research Report.		

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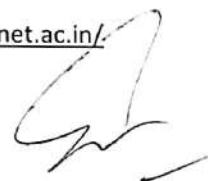


III	Philosophy, Ethics, Scientific Conducts and misconduct Moral Philosophy, Nature of Moral Judgments and Reactions, Publication Ethics, Best Practices/Standards Setting Initiatives and Guidelines: Committee on Publication Ethics (COPE), World Association of Medical Editors (WAME) etc., Intellectual Honesty and Research Integrity: Falsification, Fabrication and Plagiarism (FFP), Open Access Publishing, and Publication Misconduct.	08
IV	Databases and Research Metrics Databases: Indexing Databases, Citation Databases: Web of Science, Scopus etc., Research Metrics: Impact Factor of Journal as Per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-Index, g-Index, i-10 Index, and Altmetric.	08
V	Fundamentals of Computers and application Softwares Types Of Computers, Computer Peripherals and internal component, Types of Operating Systems, Web Browser, Web Search Engine, Spreadsheet Processing, Presentation (MS PowerPoints Preparation or Beamer or Libre Office (Optional), Project/Thesis/Report writing, Using MS-Word or LaTeX or LibreOffice documentation style Labelling, References Style, Footnotes etc.	12
VI	Scientific Softwares Use of Reference Management Software Like Mendeley, Zotero, Reference Manager, Endnote, Authorea Etc. Anti-Plagiarism Software Like Turnitin, iAuthenticate, Urkund, Ebooks and Virtual Library, UGC-Infonet, Computer Hazards and Security	08

Suggested Readings:

1. C.R. Kothari, *Research methodology Methods and Techniques*, 4th Edition, New Age International (P) Ltd. Publisher, 2014.
2. W. Creswell, *Research Design, Qualitative, Quantitative and mixed method approaches*, 3rd Edition, Sage Publications, Inc.
3. D.B. Resnik, (2011) What is ethics in research & Why is it important. National institute of Environmental Health Science, 1-10 Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
4. Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance* (2019), ISBN:978-81-939482-1-7. https://www.insaindia.res.in/pdf/Ethics_Book.pdf
5. Reema Thareja (2019) *Fundamentals Of Computers* (2nd Edition), Oxford University Press
6. Microsoft Office 365 : A complete Guide to Master Word, Excel, and PowerPoint 365 for Beginners, Matt Vic
7. Leslie Lamport, *LaTeX, A Document Preparation System*, 2nd Edition, Addison-Wesley Professional Publisher, July, 1994.
8. Latex tutorials <https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf>
9. Libre Office tutorial: www.documentation.libreoffice.org/en/english-documentation Suggested equivalent online courses: <https://epgp.inflibnet.ac.in/>

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The format of the question paper and evaluation will be as follows

The duration of each question paper is 3 hours

Types of Question	Total No of Questions	Questions to be Attempted	Maximum Marks = 75 (UE) (Questions x marks)
Very Short Answer Type Questions (50 words)	10	10	10 x 2 = 20
Short Answer Type (200 words)	8	5	5 x 7 = 35
Longs Answer Type (500 words)	4	2	2 x 10 = 20
			= 75 (Maximum Marks)

10-point grading system for evaluation of the Pre-Ph.D. course work

As per the UP GOs 1567/ -3-2021-16 (26)/2011 TC dated 13 July 2021, 401/ 3-3-2022, dated 09 Feb. 2022, and 1032/ 3-03-2022-08(35)/2020, dated 20 April 2022 regarding NEP-2020, the grading system for the Pre-Ph.D. course work shall be followed as given in table -1

Table-1

Letter Grade	Details	Limit of Marks	Grade Point
O	Outstanding	91-100	10
A+	Excellent	81-90	9
A	Very Good	71-80	8
B+	Good	61-70	7
B	Above Average	55-60	6
F	Fail	<55	0
AB	Absent	Absent	0
Q	Qualified		
NQ	Not Qualified		

In pre-Ph.D. course work, there is a mandatory research project that is qualifying in nature. This research project shall be a **non-credit course**. The letter grade for the research project will be Q or NQ. The grade of research project will not be included in the computations of the CGPA.

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Computation of CGPA:

Calculations for SGPA and CGPA shall be followed as given table 2:

Table 2

For j^{th} Sem. $\text{SGPA } (S_j) = \frac{\sum C_i G_i}{\sum C_i}$	Here: C_i = number of credits of the i^{th} course in the j^{th} semester G_i = grade point scored by the student in the i^{th} course in j^{th} semester
$\text{CGPA} = \frac{\sum C_j S_j}{\sum C_j}$	Here: S_j = SGPA of the j^{th} semester C_j = total number of credits in the j^{th} semester

Allocation of CGPA Into Division:

The allocation of CGPA into division in pre-Ph.D. course work follows as given in Table 3:

Table 3

Division	CGPA
First	Greater than or equal to 6.5 and less than or equal to 10
Second	Greater than or equal to 5.5 and less than 6.5

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Core Course

FE030601T: Non Science and Non martial

Course Objectives:- Students will be able to:

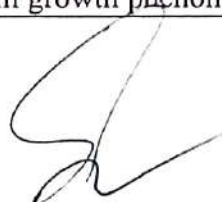
1. Students will be able to understand the importance of nanoscience and nanomaterials in industrial applications.
2. Understanding the basic properties and designs of nano structures.
3. Understanding the phase transition process.

Syllabus

Unit s	Content	Hours
1	Introduction, Importance of Nano-technology, Emergence of Nano-Technology, Bottom-up and Top-down approaches, challenges in Nano Technology. Zero-dimensional nano-structures, One-Dimensional Nano-structures, Two-dimensional nano-structures, Chemical Vapor Deposition (CVD), Atomic layer deposition (ALD), Sol-Gel films. Nanostructures and Nanomaterials, Nanostructures: Carbon Nanotubes, Fullerenes, Nanowires, Graphene, Quantum Dots, Thermodynamics of Nanomaterials, Surfaces and interfaces in nanostructures, Nano-biomaterials, Nano-ionics/electronics and nanophotonics, Nanomagnetic, Nanomechanics.	8
2	Classification of materials, metals, ceramics, polymers and composites, Nature of bonding in materials, metallic, ionic, covalent and mixed bonding; structure of materials: fundamentals of crystallography, symmetry operations, crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions; structures of metals, ceramics, polymers, amorphous materials and glasses.	8
3	Defects in crystalline materials: 0-D, 1-D and 2-D defects; vacancies, interstitials, solid solutions in metals and ceramics, Frenkel and Schottky defects; dislocations; grain boundaries, twins, stacking faults; surfaces and interfaces.	6
4	Thermodynamics, Kinetics and Phase Transformations Extensive and intensive thermodynamic properties, laws of thermodynamics, phase equilibria, phase rule, phase diagrams (unary and binary), basic electrochemistry. Reaction kinetics, fundamentals of diffusion, Fick's laws, their solutions and applications. Solidification of pure metals and alloys, nucleation and growth, diffusional solid-state phase	8
5	Mechanical properties of metals, ceramics, polymers and composites at room temperature; stress-strain response (elastic, anelastic and plastic deformation). Electronic properties: free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo- and ferro-electric behaviour. Magnetic properties: Origin of magnetism in materials, para-, dia-, ferro- and ferri-magnetism. Thermal properties: Specific heat, heat conduction, thermal diffusivity, thermal expansion, and thermoelectricity.	8
6	X-ray diffraction; spectroscopic techniques such as UV-Vis, IR and Raman; optical microscopy, electron microscopy, SEM, TEM, composition analysis in electron microscopes. Tensile test, hardness measurement. Electrical conductivity, carrier mobility and concentrations. Thermal analysis techniques: thermogravimetry and calorimetry. Processing of Materials Heat treatment of ferrous and aluminium alloys; preparation of ceramic powders, sintering; thin film deposition: evaporation and sputtering techniques, and chemical vapour deposition, thin film growth phenomena.	6

Suggested reading

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1. Nanophysics and Nanotechnology" – An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, 2nd Edition, John Wiley & Sons, 2006.
2. Surface Science Foundation of Catalysis and Nano science, K.W. Kolasinski, Wiley, 2002
3. Nano chemistry:- A chemical approach to Nano materials, G.A. Ozin and A.C. Arsenault 2005.
4. Nano structures & Nano materials Synthesis, Properties & applications, G. Cao Imperial Collage 2004.
5. Nanomaterials and Nanotechnologies and design on introduction for engineers and architects, Micheal F. Ashby, P.J.Ferreria, D.L. Schodek

FE030602T: Machine Learning For Mechanical Engineering

Course outcomes:

At the end of the course the student will be able to:

CO1. Choose the learning techniques with this basic knowledge

CO2. Apply effectively genetic algorithms for appropriate applications.

CO3. Apply bayesian techniques and derive effectively learning rules.

CO4. Choose and differentiate Clustering & Unsupervised Learning and Language Learning

Syllabus

Units	Content	Hours
1	Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses.	8
2	Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias - Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Over fitting, noisy data, and pruning.	8
3	Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles - Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing - Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. PAC results for learning conjunctions, kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis dimension.	8
4	Clustering and Unsupervised Learning: Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. K-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabeled data - Language	8

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Recommended in BOS meeting held on 10/10/2023

	Learning: Classification problems in language: word- sense disambiguation, sequence labeling.	
5	Hidden Markov models (HMM's). Viterbi algorithm for determining most-probable state sequences. Forward-backward EM algorithm for training the parameters of HMM's. Use of HMM's for speech recognition, part-of-speech tagging, and information extraction. Conditional random fields (CRF's). Probabilistic context-free grammars (PCFG). Parsing and learning with PCFGs. Lexicalized PCFGs.	6
6	. Conditional random fields (CRF's). Probabilistic context-free grammars (PCFG). Parsing and learning with PCFGs. Lexicalized PCFGs.	6

Suggested reading

1. Tom M. Mitchell, "Machine learning", McGraw Hill 1997
2. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3. Rajan Shinghal, "Pattern Recognition", Oxford Press, 2006.
4. 1. Ethem Alpaydin, "Introduction to machine learning", PHI learning, 2008.
5. 2. Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning", Springer 2001.
6. 3. R.O. Duda, P.E. Hart and D.G. Stork, Pattern Classification, Wiley-Interscience, 2nd Edition, 2000. 3. T. Hastie,
7. R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction, Springer, 2nd Edition, 2009

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FE030603T – SOLAR THERMAL TECHNOLOGIES AND APPLICATIONS

Course Objectives:-Students will be able to:

- CO 1 Analyse the energy concepts on solar devices for various thermal properties.
- CO 2 Analyse the solar thermal devices for various tracking modes.
- CO 3 Evaluate the performance of various solar thermal technologies.

Syllabus		
Units	Content	Hours
1	Solar Radiation: Location on earth, celestial sphere, horizon and equatorial system, Instruments for measuring solar radiation and sunshine, description of the various angles depicting the relation between sun and earth, coordinates transformation, solar time, obliquity and declination of the sun, apparent motion of the sun, sun rise and sun set time, east west time, analysis of the direct daily solar radiation on any arbitrarily located surface.	8
2	Flat Plate Collectors: Performance analysis, transmissivity of the cover system, overall loss coefficient and heat transfer correlations, collector efficiency factor, collector heat removal factor, effects of various parameters on the performance. Evacuated Tube Collectors Principle of working, advantages of ETC over FPC, Types of evacuated tubes. Design aspects of solar plate collectors	8
3	Concentrating Collectors: Types, description of cylindrical parabolic collector, orientation and tracking modes, performance analysis, parametric study of collector performance in different modes of operation, compound parabolic collector geometry, tracking requirements, parabolic dish collector.	8
4	Thermal Energy Storage: Introduction, sensible heat storage: liquids, solids, analysis of liquid storage tank in well mixed condition and thermal stratification, analysis of packed-bed storage, latent heat storage, thermo chemical storage.	6
5	Applications: Water heating systems (Natural and Forced), Industrial process heating system, Active and passive space heating, Solar absorption refrigeration, Power generation (Low Temperature, Medium Temperature, High Temperature),	8
6	Distillation, Drying, Cooking, Solar Pond. Recent advancement in materials and systems for thermal energy storage systems.	6

Suggested reading

1. S.P. Sukhatme, J K Nayak "Solar Energy- Principles of Thermal Collection and Storage", Tata McGraw Hill Company.
2. G. D. Rai., "Non- Conventional Energy Sources", Khanna Publishers, NewDelhi
3. G.N. Tiwari and S. Suneja, Solar Thermal Engineering Systems, Narosa Publishers.
4. Khan, B.H., "Non-Conventional Energy Resources", Tata McGraw Hill, 2nd Edition, New Delhi.
5. Recent Advancements in Materials and Systems for Thermal Energy Storage, Dott. Andrea Frazzica,

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Recommended in BOS meeting held on 10/10/2023

FE030604T: Python Programming

Course Objectives:-Students will be able to:

1. To read and write simple Python programs.
2. To develop Python programs with conditionals and loops.
3. To define Python functions and to use Python data structures - lists, tuples, dictionaries
4. To do input/output with files in Python
5. To do searching, sorting and merging in Python

Syllabus

Units	Content	Hours
1	Introduction: The Programming Cycle for Python , Python IDE, Interacting with Python Programs , Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.	8
2	Conditionals: Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation.	8
3	Loops: Purpose and working of loops , While loop including its working, For Loop , Nested Loops , Break and Continue.	8
4	Function: Parts of A Function , Execution of A Function , Keyword and Default Arguments , Scope Rules. Strings : Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. Python Data Structure : Tuples , Unpacking Sequences , Lists , Mutable Sequences , List Comprehension , Sets , Dictionaries Higher Order Functions: Treat functions as first class Objects , Lambda Expressions	6
5	Sieve of Eratosthenes: generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. File I/O : File input and output operations in Python Programming Exceptions and Assertions Modules : Introduction , Importing Modules , Abstract Data Types : Abstract data types and ADT interface in Python Programming. Classes : Class definition and other operations in the classes , Special Methods (such as <code>_init_</code> , <code>_str_</code> , comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.	8
6	Iterators & Recursion: Recursive Fibonacci , Tower Of Hanoi Search : Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time Sorting & Merging: Selection Sort , Merge List , Merge Sort , Higher Order Sort	6

Suggested reading


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Recommended in BOS meeting held on 10/10/2023

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/thinkpython/>)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
1. 3. John V Guttag, —Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. 4. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. 5. Timothy A. Budd, —Exploring Python||, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

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