B.Tech Computer Science and Engineering (Artificial Intelligence and Data Science)
Scheme of Studies/Examination(w.e.f. Session 2022-23)

Semester V

SNo.	Course No.	Subject	L:T:P	Hours /Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIDS-301A	Theory of Computation	3:0:0	3	3	75	25	0	100	3
2	PC-CS-AIDS-303A	Design and Analysis of Algorithms	3:0:0	3	3	75	25	0	100	3
3	ES-CS-AIDS-305A	Computer Network	3:0:0	3	3	75	25	0	100	3
4	PC-CS-AIDS-307A	Machine Learning with using Python	3:0:0	3	3	75	25	0	100	3
5	ES-CS-AIDS-309A	Computer Architecture	3:0:0	3	3	75	25	0	100	3
6	PC-CS-AIDS-311A	Artificial Neural Networks	3:0:0	3	3	75	25	0	100	3
7	PC-CS-AIDS-313LA	Artificial Neural Networks Lab	0:0:2	2	1	0	40	60	100	3
8	PC-CS-AIDS-317LA	Design and Analysis of Algorithms Lab	0:0:2	2	1	0	40	60	100	3
9	PC-CS-AIDS-315LA	Python Lab	0:0:2	2	1	0	40	60	100	3
		Total		**24**	**21**	**450**	**270**	**180**	**900**	
10	MC-904A	Energy Resources & Management	3:0:0	3	0	0	100	0	100	3
11	SIM-301A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	-

***Note: SIM-301A is a mandatory credit less course in which the students will be evaluated for the summer internship undergone after fourth semester and students will be required to get passing marks to qualify.**

PC-CS-AIDS-301A	Theory of Computation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To understand the challenges for Theoretical Computer Science and its contribution to other sciences						
Course Outcomes							
CO1	Students are able to explain and manipulate the different fundamental concepts in automata theory and formal languages.						
CO2	Simplify automata and context-free grammars; Prove properties of languages, grammars and automata with rigorously formal mathematical methods, minimization.						
CO3	Differentiate and manipulate formal descriptions of push down automata, its applications and transducer machines.						
CO4	To understand basic properties of Turing machines and computing with Turing machine, the concepts of tractability and decidability.						

Unit-I

Introduction to Automata: Study and Central Concepts of Automata Theory, Applications of Finite Automata, An Introduction of Deterministic Finite Automata (DFA) and Non-Deterministic Finite Automata (NFA), Finite Automata with Epsilon (€) Transitions.

Regular Expression and Languages: Regular Expressions (RE), Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws of Regular Expressions, Closure Properties of Regular Languages, RE to NFA, DFA Conversion and DFA to RE, Equivalence and Minimization of NFA and DFA automata.

Unit-II

Context free Grammars and Languages: Parse Trees, Context Sensitive Grammar, Context Free Grammar, Regular Grammar, Applications of Context Free Grammars, Ambiguity in Grammars and Languages. Closure Properties of CFL, Chomsky Theorem, Chomsky Hierarchy, Normal forms of context free grammars: Chomsky Normal Form, Greibach Normal Form.

Pumping Lemma: Introduction to Pumping Lemma, pumping lemma for context free languages, Applications of Pumping Lemma, Minimization of Finite Automata, and Recursive Language.

Unit-III

Mealey and Moore Machines: Definitions, Representation, Equivalence of Moore and Mealey Machines and its Designing.

Push Down Automata: Introduction of Push Down Automata (PDA), Language of PDA, Equivalence of PDA's and CFG's, Deterministic Push Down Automata, Designing of PDA,

Applications of PDA.

Unit-IV

Introduction to Turing Machine: The Turing Machine, Programming Techniques for Turing Machine, Extensions of Turing Machine, Restricted Turing Machines, Universal Turing Machines and Designing of Turing Machines, Time and Tape Complexity Measures of Turing machines

Decidability: Post's Correspondence Problem (PCP), Rice's Theorem, Decidability and Undecidability properties, P-NP class and completeness.

Suggested Books:

1. J.E.Hopcroft, R.Motwani and J.D.Ullman,"Introduction to Automata Theory Languages and computation", Pearson Education Asia,2001.
2. K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education, 2009.
3. Peter Linz," An Introduction to Formal Language and Automata",4th Edition, Narosa Publishing house, 2006.
4. M.Sipser;Introduction to the Theory of Computation; Singapore: Brooks/ Cole, Thomson Learning,1997.
5. John.C. Martin,"Introduction to the Languages and the Theory of Computation", Third edition, Tata Mc Graw Hill, 2003.

PC-CS-AIDS-303A	Design and Analysis of Algorithms						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To introduce advanced data structures and algorithms concepts involving their implementation for solving complex applications.						
Course Outcomes (CO)							
CO1	To introduce the basic concepts of Data Structures and their analysis.						
CO2	To study the concept of Dynamic Programming and various advanced Data Structures.						
CO3	To introduce various Graph algorithms and concepts of Computational complexities.						
CO4	To study various Flow and Sorting Networks						

Unit 1: Introduction

Review: Elementary Data Structures, Algorithms and its complexity (Time and Space), Analyzing Algorithms, Asymptotic Notations, Priority Queue, Quick Sort.

Recurrence relation: Methods for solving recurrence (Substitution, Recursion tree, Master theorem), Strassen multiplication.

Unit 2: Advanced Design and analysis Techniques

Dynamic programming: Elements, Matrix-chain multiplication, longest common subsequence,

Greedy algorithms: Elements, Activity- Selection problem, Huffman codes, Task scheduling problem, Travelling Salesman Problem.

Advanced data Structures: Binomial heaps, Fibonacci heaps, Splay Trees, Red-Black Trees.

Unit 3: Graph Algorithms

Review of graph algorithms: Traversal Methods (Depth first and Breadth first search), Topological sort, strongly connected components, Minimum spanning trees- Kruskal and Prims, Single source shortest paths, Relaxation, Dijkstras Algorithm, Bellman- Ford algorithm, Single source shortest paths for directed acyclic graphs, All pairs shortest paths- shortest paths and matrix multiplication, Floyd-Warshall algorithm.

Computational Complexity: Basic Concepts, Polynomial Vs Non-Polynomial Complexity, NP-hard and NP-complete classes.

Unit 4: Network and Sorting Algorithms

Flow and Sorting Networks Flow networks, Ford- Fulkerson method, Maximum Bipartite matching, Sorting Networks, Comparison network, the zero- One principle, Bitonic sorting network, Merging networks

Suggested Books:

1. Corman, Leiserson and Rivest: Introduction toAlgorithms,2/e,PHI.
2. Das Gupta: Algorithms, TMH.
3. Horowitz, Ellis and Sahni, Sartaj: Fundamentals of Computer Algorithms. Galgotia Publications.
4. Aho, Hopcroft and Ullman: The Design and Analyses of Computer Algorithms. Addison Wesley.
5. R. B. Patel: Expert Data Structures with C, Khanna Publications, Delhi, India, 2nd Edition

2004, ISBN 81-87325-07-0.
6. R. B. Patel and M.M.S Rauthan: Expert Data Structures with C++, Khana Publications, Delhi ,India,2nd Edition 2004,ISBN 87522-03-8.

ES-CS-AIDS-305A	Computer Network						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To introduce the architecture and layers of computer network, protocols used at different layers.						
Course Outcomes (CO)							
CO1	To understand the basic concept of networking, types, networking topologies and layered architecture.						
CO2	To understand datalink layer and MAC sub-layer`						
CO3	To understand the network Layer functioning						
CO4	To understand the transport layer and application layer operation						

Unit-I

Introduction to Computer Networks: Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and Wired networks, broadcast and point-to-point networks, Network topologies, protocols, interfaces and services, ISO-OSI reference model, TCP/IP architecture.

Physical Layer: Concept of Analog & Digital Signal, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Multiplexing: Frequency Division, Time Division, Wavelength Division, Transmission Media: Twisted pair, Coaxial cable, Fiber optics, Wireless transmission (radio, microwave, infrared), Switching: Circuit Switching, Message Switching, Packet Switching & comparisons, narrowband ISDN, broadband ISDN.

Unit-II

Datalink layer: Error Control, Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, sliding window protocols, Selective repeat ARQ, HDLC;

Medium access sub layer: Point to point protocol, FDDI, token bus, token ring; Reservation, polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA, LLC, Traditional Ethernet, fast Ethernet, Network devices-repeaters, hubs, switches, Bridges, Router, Gateway.

Unit-III

Network layer: Addressing: Internet address, sub-netting; Routing techniques, static vs. dynamic routing, routing table, DHCP, IEEE standards 802.x, Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IGMP, IPV6; Unicast and multicast routing protocols, ATM.

Unit-IV

Transport layer: Process to process delivery; UDP; TCP, RPC, Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Quality of service: techniques to improve QoS.

Application layer: DNS; SMTP, SNMP, FTP, HTTP&WWW; Firewalls, Bluetooth, Email, S/MIME, IMAP

Network Security: Cryptography, user authentication, security protocols in internet, public key encryption algorithm, digital signatures.

Suggested Books:

1. Behrouz A. Forouzan, “Data communication and Networking”, Tata Mc Graw Hill, Fourth Edition, 2011.
2. Computer Networks,4th Edition, Pearson Education by Andrew S. Tanenbaum.
3. Larry L. Peterson, Peter S. Davie, “Computer Networks”, Elsevier, Fifth Edition,2012.
4. William Stallings, “Data and Computer Communication”, Eighth Edition, Pearson Education, 2007.
5. James F. Kurose, Keith W. Ross, “Computer Networking: A Top–Down Approach Featuring the Internet”, Pearson Education, 2005.

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PC-CS-AIDS-307A	Machine Learning with using Python						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Introduction and implementation to Real-life examples of Machine learning using Python						
Course Outcomes-At the end of the course students will be able to:							
CO1	Understand basics of Python programming language.						
CO2	Explain the operation of different supervised and unsupervised algorithms and their implementation in Python.						
CO3	Implement several clustering, classification and regression algorithms, and apply a suitable learning algorithm to a range of basic problems.						
CO4	Work on Recommender Systems: Content-Based and Collaborative Filtering						
CO5	Use and Analyze Popular models: Train/Test Split, Gradient Descent, and Mean Squared Error and perform custom analysis						
CO6	Apply predictions and segmentation on real-world datasets. Interpret the output and validity of a learning algorithm.						

Unit-I

Python Basics, Data Structures and Fundamentals - First program, Types, Expressions and Variables, String Operations, Lists and Tuples Sets, Dictionaries, Conditions and Branching, Loops, Functions, Objects and Classes

Unit-II

Working with Data in Python and Introduction to Machine Learning - Reading files with open, writing files with open, loading data with Pandas, working with and Saving data with Pandas, Applications of Machine Learning, Supervised vs Unsupervised Learning, Python libraries suitable for Machine Learning

Unit-III

Regression, Classification and Unsupervised Learning- Linear Regression, Non-linear Regression, Model evaluation methods, K-Nearest Neighbor, Decision Trees, Logistic Regression, Support Vector Machines, Unsupervised Learning, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering, Content-based recommender systems, Collaborative Filtering

Unit-IV

What is System ML? And Spark ML Context - Explain the purpose and the origin of System ML, List the alternatives to System ML**,** compare performances of System ML with the alternatives, Use ML Context to interact with System ML (in Scala), Describe and use a number of System ML algorithms.

Suggested Books

1. Ethem Alpaydin, Introduction to Machine Learning, Second Edition.
2. Introduction to Machine Learning with Python: A Guide for Data Scientists 1st Edition by Andreas C.
3. Hands-On Machine Learning with Scikit- Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems 1st Edition by Aurélien Géron.

4. Stephen Marsland, Machine Learning: An Algorithmic Perspective.
5. Christopher M. Bishop, Pattern Recognition and Machine Learning.
6. Tom Mitchell, Machine Learning.

ES-CS-AIDS-309A	Computer Architecture						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Student will be able to understand the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems.						
Course Outcomes (CO)							
CO1	Be familiar with the internal organization and operations of a computer.						
CO2	Be familiar with the design trade-offs in designing and constructing a computer processor.						
CO3	Be aware with the CPU design including the RISC/CISC architectures.						
CO4	Be acquainted with the basic knowledge of I/O devices and select the appropriate interfacing standards for I/O devices.						

Unit-I

Data representation and Computer arithmetic: Introduction to Computer Systems, Organization and architecture, Von Neumann Architecture, evolution and computer generations; Fixed point representation of numbers, digital arithmetic algorithms for Addition, Subtraction, Multiplication using Booth's algorithm and Division using restoring and non-restoring algorithms. Floating point representation with IEEE standards and its arithmetic operations.

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Unit-II

Basic Computer organization and Design: Instruction codes, stored program organization, computer registers and common bus system, computer instructions, timing and control, instruction cycle: Fetch and Decode, Register reference instructions; Memory reference instructions. Input, output and Interrupt: configuration, instructions, Program interrupt, Interrupt cycle, Micro programmed Control organization, Control Memory, address sequencing, Microprogram Example, micro instruction format, Horizontal Vs Vertical micro-programming, design of control Unit, microprogram sequencer, Hardwired v/s Micro-programmed Control Unit.

Unit-III

Central Processing Unit: General register organization, stack organization, instruction formats (Zero, One, Two and Three Address Instruction), addressing modes, Data transfer and manipulation, Program control. CISC and RISC: features and comparison. Pipeline and vector Processing, Parallel Processing, Flynn's taxonomy, Pipelining, Instruction Pipeline, Basics of vector processing and Array Processors.

Unit-IV

Input-output organization: I/O interface. I/O Bus and interface modules, I/O versus Memory Bus. Asynchronous data transfer: Strobe control, Handshaking, Asynchronous serial transfer. Modes of Transfer: Programmed I/O, Interrupt driven I/O, Priority interrupt; Daisy chaining, Parallel Priority interrupt. Direct memory Access, DMA controller and transfer. Input output Processor, CPU-IOP communication, Serial communication.

Suggested Books:

1. William Stallings, "Computer Organization and Architecture–Designing for Performance", Sixth Edition, Pearson Education, 2003.
2. Morris Mano, M., "Computer System Architecture,"3/e, Pearson Education,2005.
3. John P. Hayes, "Computer Architecture and Organization,"3/e, TMH,1998.

4. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware / Software interface”, Third Edition, Elsevier,2005.
5. V.P.Heuring, H.F.Jordan,“Computer Systems Design and Architecture”,Second Edition, Pearson Education, 2004.
6. Carl Hamacher, Zvonko Vranesic and Safwat Zaky,“ Computer Organization”, 5th Edition, TMH, 2002.

PC-CS-AIDS-311A	Artificial Neural Networks						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	The objective of this course is to provide students with a basic understanding of the Fundamentals and applications of artificial neural networks.						
Course Outcomes-At the end of the course students will be able to:							
CO1	Understand basic principles of neuron structure.						
CO2	Understand and explain the mathematical foundations of neural network models						
CO3	Understand and apply the methods of training neural networks;						
CO4	Implement and analyze different algorithms for learning.						
CO5	Formalize the problem to solve it by using a neural network. Via implementation of these techniques in MATLAB.						

Unit-I

Introduction and ANN Structure: Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures. Mathematical Foundations and Learning mechanisms: Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error -correction learning. Memory-based learning. Hebbian learning. Competitive learning. Building a simple ANN in python.

Unit-II

Feedforward ANN: Structures of Multi-layer feedforward networks with implementation in Python. Back propagation algorithm. Back propagation–training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.

Radial Basis Function Networks: Pattern separability and interpolation. Regularization Theory. Regularization and RBF networks. RBF network design and training. Approximation properties of RBF.

Unit-III

Associative memories network-Linear Association, Pattern Association, Hebb and Delta rule for pattern association with its implementation in Python, Extended delta rule, Recurrent Auto associative memory: retrieval algorithm, storage algorithm; Bi-directional associative memory, Architecture, Association encoding & decoding, Stability.

Unit-IV

Self-organizing networks- unsupervised learning of clusters, winner-take-all learning, recall mode, Initialization of weights, separability limitations. Design SOM in python.

Perceptron Network- Perceptron neural algorithm with its implementation in Python, Multi-Layer perceptron, Adaline Network, Madaline network

Neural network projects with MATLAB: Brain maker to improve Hospital treatment using ADALINE, Breast cancer treatment using ART Network face recognition using BPN, data compression using BPN.

Suggested Books:

1. Simon Haykin; Neural Networks: A Comprehensive Foundation; Prentice Hall; ISBN-13:978-0131471399;2008.
2. Dan Simon; Evolutionary Optimization Algorithms; Wiley; ISBN-13:978-0470937419;2013.
3. Daniel Graupe; Principles of Artificial Neural Networks; World Scientific Publishing Company; ISBN-13: 978-9814522731; 2013.

PC-CS-AIDS-313LA	Artificial Neural Networks Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To gain a broad understanding of implementing neural networks using MATLAB						
Course Outcomes -At the end of this course students will be able to:							
CO1	Implement cognitive tasks and processing of sensorial data such as vision, image- And speech recognition, control, robotics, expert systems.						
CO2	Design single and multi-layer feed-forward neural networks						
CO3	Understand and implement supervised and unsupervised learning concepts & Understand unsupervised learning using Kohonen networks						
CO4	Implement training of recurrent Hopfield networks and associative memory concepts.						

List of Practicals

1. Write a MATLAB program to plot a few activation functions that are being used in neural networks.
2. Generate AND NOT function using Mc Culloch-Pitts neural net by a MATLAB program.
3. Generate XOR function using Mc Culloch-Pitts neuron.
4. Write a MATLAB program for perceptron net for an AND function with bipolar inputs and targets.
5. With a suitable examples imulate the perceptron learning network and separate the boundaries. Plot the points assumed in the respective quadrants using different symbols for identification.
6. With a suitable example demonstrate the perceptron learning law with its decision regions using MATLAB. Give the output in graphical form.
7. Write a MATLAB program to show Back Propagation Network for XOR function with Binary Input and Output.
8. Write a MATLAB program to show Back Propagation Network for XOR function with Bipolar Input and Output.
9. Write a MATLAB program to recognize the number 0, 1, 2, 39. A 5 * 3 matrix forms the numbers. For any valid point it is taken as 1 and invalid point it is taken as 0. The net has to be trained to recognize all the numbers and when the test data is given, the network has to recognize the particular numbers.
10. Write a MATLAB program to illustrate ART neural network.

PC-CS-AIDS- 317LA	Design and Analysis of Algorithms Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	The student should be made to Learn the algorithm analysis techniques, become familiar with the different algorithm design techniques and understand the limitations of Algorithm power.						

Course Outcomes (CO)	
CO1	The student should be able to Design algorithms for various computing problems.
CO2	The student should be able to Analyse the time and space complexity of algorithms.
CO3	The student should be able to Critically analyse the different algorithm design techniques for a given problem.
CO4	The student should be able to Modify existing algorithms to improve efficiency.

LIST OF PRACTICALS

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2. Using Open, implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3. a. Obtain the Topological ordering of vertices in a given digraph.
   b. Compute the transitive closure of a given directed graph using Warshall's algorithm.
4. Implement 0/1 Knapsack problem using Dynamic Programming.
5. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
6. Find Minimum Cost Spanning Tree of a given undirected graph using Kristal's algorithm.
7. a. Print all the nodes reachable from a given starting node in a digraph using BFS method.
   b. Check whether a given graph is connected or not using DFS method.
8. Find a subset of a given set S = {sl,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions{1,2,6}and{1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.
9. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.
10. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
11. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this algorithm, implement it using Open and determine the speed-up achieved.
12. Implement N Queen's problem using Back Tracking.
13. Use divides and conquers method to recursively implement Binary Search.

PC-CS-AIDS-315LA	Python Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To implement the concepts of Python and its advanced functions.						
Course Outcomes-At the end of the course students will be able to:							
CO1	Implement Python programming basics and paradigm.						
CO2	Implement python looping, control statements, string manipulations and functions.						
CO3	Implement Data Analysis & visualization–using NumPy, panda, matplot lib etc.						
CO4	Implement Object Oriented Skills in Python.						

LIST OF PRACTICALS

1. Write and run a Python program that outputs the value of each of the following expressions:

5.0/9.0, 5.0/9, 5/9.0, 5/9,9.0/5.0, 9.0/5, 9/5.0, 9/5

Based on your results, what is the rule for arithmetic operators when integers and floating-point numbers are used?

2. Write and run a Python program that asks the user for a temperature in Celsius and converts and outputs the temperature in Fahrenheit. (Use the formula given in the example above and solve for temp F in terms of temp C.)

3.Here is an algorithm to print out n!(n factorial)from 0!to 19!:
1. Setf =1

2. Setn = 0

3. Repeat the following 20 times:

a. Output n, "! =", f

b. Add 1 to n

c. Multiply f by n

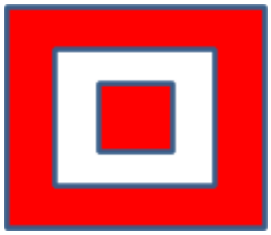
Using a for loop, write and run a Python program for this algorithm.

3(a). Modify the program above using a while loop so it prints out all of the factorial values that are less than 1 billion.

3(b).Modify the first program so it finds the minimum in the array instead of the maximum.

3(c).(Harder)Modify the first program so that it finds the **index** of the maximum in the array rather than the maximum itself.

4. Draw the Target symbol (a set of concentric Squares, alternating red and white) in a graphics window that is 200 pixels wide by 200 pixels high. Hint: Draw the largest circle first in red, then draw the next smaller circle in white, then draw the next smaller circle in red. Graphical objects drawn later appear "on top of" graphical objects drawn earlier



5. Try entering the following literal values at the prompt.(Hit ENTER after each)
-5
-4.2
4.5
4.14
0.90

Some thing odd should occur. *Describe it on paper.*

- Reading from a CSV file of the given data using pandas library.

6. For the given data, plot the scatter matrix for males only, and for females only. Do you think that the2 sub-populations correspond to gender?

- For the given data, using python environment, apply,1-samplet-test: testing the value of a population mean.

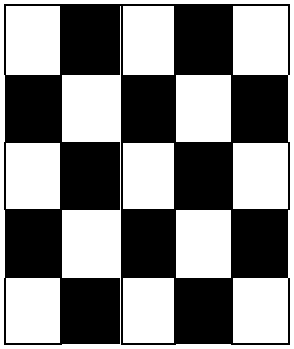
For the given data, using python environment, apply,2-samplet-test: testing for difference across populations.

7. Generate simulated data from python, apply simple linear and multiple linear regression analysis.
Retrieve the estimated parameters from the model above. Hint: use tab-completion to find the relevant attribute.

8. Going back to the brain size + IQ data, test if the VIQ of male and female are different after removing the effect of brain size, height and weight.

9. Using matplot lib,visualize the simulated data with suitable statistical measures.

10. Create a 5 X 5 rectangle whose top left corner is at (*row**5, *col**5). (Where is the bottom right corner?) If the sum of the *row* and *col* numbers is even, set the fill color of the rectangle to white, otherwise set it to black. Then draw the rectangle.



MC-904A	Energy Resources &Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**0**	**0**	**100**	**100**	**3 Hrs.**
Purpose	To make the students conversant with the basic concepts and conversion of various form of Energy						
COURSE OUTCOMES							
CO1	An overview about Energy Resources, Conventional and Non-conventional Sources.						
CO2	Understand the Layout and working of Conventional Power Plants.						
CO3	Understand the Layout and working of Non-Conventional Power Plants.						
CO4	To understand the Energy Management, Audit and tariffs, Role of Energy in Economic development and Energy Scenario in India.						

UNIT-I

Introduction: Types of energy, Conversion of various forms of energy, Conventional and Non-conventional sources, Need for Non-Conventional Energy based power generation.

UNIT-II

Conventional Energy sources: Types of Conventional Energy sources, Selection of site**,** working of Thermal, Hydro, Nuclear and Diesel power plants and their schematic diagrams & their comparative advantages/ disadvantages.

UNIT-III

Non-Conventional Energy sources: Types of Non-Conventional Energy sources, Basic principle, site selection of Solar energy power plant, photovoltaic technologies, PV Systems and their components, Wind energy power plant, Bio energy plants, Geothermal energy plants and Tidal energy plants.

UNIT-IV

Energy Management: General Principles of Energy Management, Energy Management Strategy, Modern trends and developments towards Computerizations of Power System.
Energy Audit: Need, Types, Methodology and Approach.
Energy Scenario: Lay out of power system, Role of Energy in Economic development, energy demand, availability and consumption, Indian energy scenario, long term energy scenario, energy sector reforms in India, energy strategy for the future.

Suggested Books:

1. Energy Studies-Wiley Dream Tech India.
2. Non-conventional energy resources-Shobhnath Singh,Pearson.
3. Electrical Power Systems: Soni, Gupta, Bhatnagar–Dhanpat Rai & Sons.
4. NEDCAP: Non-Conventional Energy GuideLines.
5. Non-conventional energy sources: G.D.Roy.
6. Non-Conventional energy resources: B H Khan– Mc Graw Hill.
7. Applied Solar Energy: Meinel AB-Addison Wesley Publications.
8. Direct Energy Conversion George: Sutton-McGraw.