B.Tech. (Computer Science & Engineering) Credit Scheme – Semester V & VI

Semester	Basic Sciences' Courses BSC (BSC/X-T/P)		Engineering Sciences' Core/ Elective/ Open Courses ESC (PC/CSE/X-T/P)/ (PE/CSE/X-T/P)/ (OE/CSE/X-T/P)		Humanities, Social Sciences, Management Courses HSMC (HSMC/X-T/P)		Mandatory Courses (MC/X-T/P)		Industrial Training (EEC/CSE/ xx-P)		Grand Total Credit
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
V	00	00	07	18	01	02	01	00	01	04	24
VI	00	00	09	21	01	03	00	00	00	00	24

Courses codes, titles, and credits (Semester V)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CSE/11-T	Computer Graphics	3/3	-/-	-	3/3
2.	PC/CSE/12-T	Python Programming	3/3	-/-	-	3/3
3.	PC/CSE/13-T	High Speed Network Technologies	3/3	-/-	-	3/3
4.	PC/CSE/14-T	Cryptography and Network Security	3/3	-/-	-	3/3
5.	OE-I	Open Elective Course be opted by Students from another branch	3/3	-/-	-	3/3
6.	HSMC/4-T	Economics for Engineers	2/2	-/-	-	2/2
7.	**MC/4-T	Essence of Indian Traditional Knowledge	3/-	-/-	-	3/-
8.	PC/CSE/11-P	Computer Graphics Lab.	-/-	-/-	2/1	2/1
9.	PC/CSE/12-P	Python Programming Lab.	-/-	-/-	4/2	4/2
10.	***EEC/CSE/1-P	Industrial Training/ Internship	-/-	-/-	-/4	-/4
Total Credit			20/17	-/-	6/7	26/24

***The students will have to prepare and submit a Micro Project report of the Industrial Training/ Internship of 6-8 weeks done during summer vacations after the examination of IV semester under the supervision of faculty during V semester.

Courses codes, titles, and credits (Semester VI)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CSE/15-T	Operating Systems	3/3	-/-	-	3/3
2.	PC/CSE/16-T	Formal Language and Automata Theory	3/3	-/-	-	3/3
3.	PC/CSE/17-T	Data Analytics using R	3/3	-/-	-	3/3
4.	PC/CSE/18-T	Machine Learning	3/3	-/-	-	3/3
5.	PE/CSE/1-T to PE/CSE/6-T	Professional/ Programme Elective Course -I to be opted by students	3/3	-/-	-	3/3
6.	HSMC/3-T	Fundamentals of Management	3/3	-/-	-	3/3
7.	OE-II	Open Elective Course be opted by Students from another branch	3/3	-/-	-	3/3
8.	PC/CSE/15-P	Operating Systems Lab. (UNIX/LINUX)	-/-	-/-	2/1	2/1
9.	PC/CSE/17-P	Data Analytics using R Lab.	-/-	-/-	2/1	2/1
10.	PC/CSE/18-P	Machine Learning Lab.	-/-	-/-	2/1	2/1
Total Credit			21/21	-/-	6/3	27/24
***A Mini-Project/Training based on open source tools/.NET						

*******The students will have to undergo Industrial Training/ Internship for 6-8 weeks during summer vacations after the examination of VI semester which will be evaluated in VII semester.

Professional/ Programme Elective Course -I

1. PE/CSE/1-T: Embedded System Design
2. PE/CSE/2-T: Wireless and Mobile Communications
3. PE/CSE/3-T: Graph Theory
4. PE/CSE/4-T: Bioinformatics
5. PE/CSE/5-T: Component based software Engineering
6. PE/CSE/6-T: PHP Programming

Detailed Syllabus of B.Tech. (CSE) Vth and VIth Semester

Computer Graphics

General Course Information

Course Code: PC/CSE/11-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration:3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Programming skills in C/C++ and Data Structures.

About the Course:
This course involves studying graphic techniques, algorithms and imaging models. Moreover, students learn about the techniques for clipping, cropping, representing 2-D and 3-D objects.

Course Outcomes: By the end of the course students will be able to:

CO1. **state** basic concepts related to graphics. (LOTS: Level 1: Remember)
CO2. **describe** the principles of creating graphical objects and graphical user interface applications. (LOTS: Level 2: Understand)
CO3. **apply** 2-D and 3-D transformations (rotation, scaling, translation, shearing) on geometric objects. (LOTS: Level 3: Apply)
CO4. **use** different techniques for clipping and filling geometric objects. (LOTS: Level 3: Apply)
CO5. **compare** different graphics algorithms for different geometric objects. (LOTS: Level 4: Analyse)
CO6. **create** user-friendly interfaces for computer applications. (LOTS: Level 6: Create)

Course Content

Unit I

Introduction to Computer Graphics: What is Computer Graphics, Computer Graphics Applications, Computer Graphics Hardware and software, Two dimensional Graphics Primitives: Points and Lines, Line drawing algorithms: DDA, Bresenham's; Circle drawing algorithms: Using polar coordinates, Bresenham's circle drawing, mid-point circle drawing algorithm; Filled area algorithms: Scan-line: Polygon filling algorithm, boundary filled algorithm.

Unit II

Two/Three Dimensional Viewing: The 2-D viewing pipeline, windows, viewports, window to view port mapping; Clipping: point, clipping line (algorithms):- 4 bit code algorithm, Sutherland-Cohen algorithm, parametric line clipping algorithm (Cyrus Beck). Polygon clipping algorithm: Sutherland-Hodgeman polygon clipping algorithm.

Two dimensional transformations: transformations, translation, scaling, rotation, reflection, composite transformation.

Three dimensional transformations: Three-dimensional graphics concept, Matrix representation of 3-D Transformations, Composition of 3-D transformation.

Unit III

Viewing in 3D: Projections, types of projections, the mathematics of planner geometric projections, coordinate systems.

Hidden surface removal: Introduction to hidden surface removal, Z- buffer algorithm, scan line algorithm, area sub-division algorithm.

Unit IV

Representing Curves and Surfaces: Parametric representation of curves: Bezier curves, B- Spline curves. Parametric representation of surfaces; Interpolation method.

Illumination, shading, image manipulation: Illumination models, shading models for polygons, shadows, transparency. What is an image? Filtering, image processing, geometric transformation of images.

Text and reference books:

- James D. Foley, Andeies van Dam, Stevan K. Feiner and Johb F. Hughes, *Computer GraphicsPrinciples and Practices*, second edition, Addision Wesley, 2000.
- Pradeep K Bhatia, *Computer Graphics*, 3rd edition, I K International Pub, New Delhi,2013.
- Donald Hearn and M. Pauline Baker, *Computer Graphics* 2nd Edition, PHI, 1999.
- David F. Rogers, *Procedural Elements for Computer Graphics* Second Edition, T.M.H,2001.
- Alan Watt, *Fundamentals of 3Dimensional Computer Graphics*, Addision Wesley, 1999.
- Corrign John, *Computer Graphics: Secrets and Solutions*, BPB, 1994.
- Pilania & Mahendra, *Graphics, GUI, Games & Multimedia Projects in C*, StandardPub., 2002.
- N. Krishanmurthy, *Introduction to Computer Graphics*, T.M.H, 2002.

CO-PO Articulation Matrix Computer Graphics Course (PC/CSE/11-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **State** basic concepts related to graphics. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2. **Describe** the principles of creating graphical objects and graphical user interface applications. (LOTS: Level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3. **Apply** 2-D and 3-D transformations (rotation, scaling, translation, shearing) on geometric objects. (LOTS: Level 3: Apply)	2	1	_	_	2	_	_	_	_	_	_	_	3	_	_
CO4. **Use** different techniques for clipping and filling geometric objects. (LOTS: Level3: Apply)	2	1	_	_	2	_	_	_	_	_	_	_	3	_	_
CO5. **Compare** different graphics algorithms for different geometric objects. (LOTS: Level4: Analyse)	-	2	2	2	1	_	_	_	_	_	_	_	3	_	_
CO6. **Create** user-friendly interfaces for computer applications. (LOTS: Level 6: Create)	1	2	2	_	3	_	_	_	_	_	-	_	3	_	_
Level of Attainments PC/CSE/11-T			_	_	_	_	_	_	_	_	_	_	_	_	_

Python Programming

General Course Information

Course Code: PC/CSE/12-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode:Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisite: Exposure to programming languages

About the Course:
Python is a popular open-source programming language used for both standalone programs and scripting applications in a wide variety of domains. It is free, portable, and powerful and is both relatively easy and remarkably fun to use. In today's era Python has found great applicability in machine learning, data analytics and many other data science applications. This is introductory course and covers most of the basic concepts required for basic python programming. Some of the contents are advanced may be useful for data analytics purpose.

Course Outcomes: By the end of the course students will be able to:
CO1. **outline** various basic programming constructs including operators, character sets, basic data types and control statements. (LOTS: level 1: Understand)
CO2. **explain** Python packages and their functionalities for data analysis. (LOTS: level 2: Understand)
CO3. **solve** problems using python programming. (LOTS: level 3: Apply)
CO4. **analyses** the results of data analysis or machine learning programs (LOTS: level 4: Analyze)
CO5. **evaluate** solutions according to the problem definition. (LOTS: level 5: Evaluate)
CO6. **develop** database applications in Python. (LOTS: level 6: Create)

Course Content

Unit I

Introduction to Python, History of Python, Features of Python, Python Identifiers, Python Character Set, Keywords and Indentation, Comments, Command Line Arguments, Assignment Operator, Operators and Expressions, *print()* Function, *input()* Function, *eval()* Function, Python Data Types: *int, float, complex*, Variables, Mutable vs Immutable variables, Namespaces, Decision Statements: Boolean Type, Boolean Operators, *if* statement, *else* statement, Nested Conditionals Statements, Multi-way Decision Statements (*elif* statement).

Unit II

Loop Control Statements: *While* loop, *range()* Function, *For* Loop, Nested Loops, Infinite Loop, *Break* Statement, *Continue* Statement, *Pass* Statement, Introduction to Strings, String Operations: Indexing and Slicing, Lists: Operations on List: Slicing, Inbuilt Functions for Lists, List Processing: Searching and Sorting, Dictionaries: Need of Dictionary, Operations on Directories: Creation, Addition, Retrieving Values, Deletion; Tuples, operations on Tuples, Inbuilt Functions for Tuples, Introduction to Sets, operations on sets.

Python Functions, Inbuilt functions, *Main* function, User Defined functions, Defining and Calling Function, Parameter Passing, Actual and Formal Parameters, Default Parameters, Global and Local Variables, Recursion, Passing Functions as Data, *Lamda* Function, Modules, Importing Own Module, Packages.

Unit III

Operations on File: Reading text files, read functions, *read (), readline()* and *readlines(),* writing Text Files, write functions, *write()* and *writelines(),*Manipulating file pointer using seek, Appending to Files.

Python Object Oriented: Overview of OOP, Classes and objects, accessing attributes, Built-In Class Attributes, Methods, Class and Instance Variables, Destroying Objects, Polymorphism, Overlapping and Overloading of Operators, Class Inheritance: *super ()*, Method Overriding, Exception Handling, *Try-except-else* clause, Python Standard Exceptions, User-Defined Exceptions

Unit IV

Databases in Python: Create Database Connection, *create, insert, read, update* and *delete* Operation, DML and DDL Operation with Databases.

Python for Data Analysis: *NumPy*: Creating arrays, Using arrays and Scalars, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output

Pandas: Series, Data Frame, Panel, Index objects, Re-indexing, Iteration, Sorting. *Matplotlib*: Python for Data Visualization, Visualization Section, *Skle arn*: loading of dataset, learning and predicting, Model Persistence.

Text and Reference Books:

- Ashok Namdev Kamthane, *Programming and Problem Solving with Python,* Mc Graw Hill Education Publication, 2018.
- John Guttag, *Introduction to Computation and Programming using Python*, Springer,Revised and Expanded version (Referred by MIT), 2013.
- Lutz, M., *Learning Python: Powerful Object-Oriented Programming*. O'Reilly Media,Inc., 2013.
- Michael T Goodrich and Robertto. Thamassia, Micheal S Goldwasser, *Data Structures and Algorithms in Python*, Wiley, 2016.
- Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2013.
- Reema Thareja, *Python Programming Using Problem Solving Approach,* Oxford Publications, 2017.
- Dr. R. Nageswara Rao, Allen B. Downey, *Core Python Programming, Think Python,* O'Reilly Media,2012.
- Kenneth A. Lambert, *The Fundamentals of Python: First Programs*, Cengage Learning,2011.

CO-PO Articulation Matrix Python Programming Course (PC/CSE/12-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Outline** various basic programming constructs including operators, character sets, basic data types and control statements. (LOTS: level 1: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	_	_	2
CO2. **Explain** Python packages and their functionalitiesfor data analysis. (LOTS: level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3. **Solve** problems using python programming. (LOTS:level 3: Apply)	3	2		2	_	3	_	_	_	_	_	_	_	_	3
CO4. **Analyze** the results of data analysis or machine learning programs (LOTS: level 4: Analyze)	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO5. **Evaluate** solutions according to the problem definition. (LOTS: level 5: Evaluate)	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO6. **Develop** database applications in Python. (LOTS:level 6: Create)	3	3	2	3		3	_	_	_	_	_	_	3		3
Level of Attainments PC/CSE/12-T															

High Speed Network Technologies

General Course Information

Course Code: PC/CSE/13-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours /week Mode:Lecture(L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of computer networks, layers of OSI reference model, protocols at different layers of OSI reference model.

About the course:
High Speed Network Technologies is a professional core course based around Network Architectures, protocols used across the layers, techniques used in communication and modes of data transfer. The course deals with creating High Speed Networks for any organization/institute with its various phases/life cycles.

Course Outcomes: By the end of the course students will be able to:
CO1. **define** different high speed network technologies. (LOTS: Level 1: Remember)
CO2. **explain** working of different wired / wireless technologies suitable for LAN and WAN communication. (LOTS: Level 2: Understand)
CO3. **illustrate** the mapping of OSI reference model to different high-speed technologies and Internet Suite of Protocols. (LOTS: Level 3: Apply)
CO4. **analyze** the performance of different high-speed technologies in different scenarios / situations. (LOTS: Level 4: Analyze)
CO5. **design** a network for any organization using high speed technologies along with Internet connectivity. (LOTS: Level 6: Create)

Course Content

Unit I

(High Speed LAN)
Gigabit Ethernet: Overview of fast Ethernet, Gigabit Ethernet – overview, specifications, layered protocol architecture, frame format, network design using Gigabit Ethernet, applications,10GB Ethernet – overview, layered protocol architecture, frame format.
Fiber Channel: Fiber channel – overview, topologies, ports, layered protocol architecture, frame structure, class of service.

UNIT II

(High Speed WAN)
Frame Relay: Protocol architecture and frame format.
ISDN & B-ISDN: Channels, interfaces, addressing, protocol architecture, services.
ATM: Virtual circuits, cell switching, reference model, traffic management.

Unit III

(Wireless LAN)
Wireless Networks: Existing and emerging standards, Wireless LAN (802.11), Broadband Wireless (802.16), Bluetooth (802.15) their layered protocol architecture and security. Mobile Networks – GSM, CDMA.

Unit IV

(Internet Suite of Protocols)
Internet Layer: IPV4 and IPV6, IP addressing, IP classes, CIDR.
Transport Layer: UDP/TCP protocols & architecture, TCP connection management.
Application Layer: DNS, E-Mail, Voice over IP.

Text and Reference Books:

- Jochen Schiller, *Mobile Communication*, 2nd Edition, Pearson,2009.
- Andrew S Tanenbaum, *Computer Networks*, 5th Edition, Pearson 2013.
- William C Y Lee, *Mobile Communication Engineering: Theory and Applications*, 2ndEdition, McGrawHill, 1997.

CO-PO Articulation Matrix High Speed Network Technologies Course (PC/CSE/13-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Define** different high speed network technologies. (LOTS: Level 1: Remember)	1	-	-	-	-	_	_	_	-	_	_	_	_	2	_
CO2. **Explain** working of different wired / wireless technologies suitable for LAN and WAN communication. (LOTS: Level 2: Understand)	1	-	-	-	-	_	_	_	-	_	_	_	_	3	_
CO3. **Illustrate** the mapping of OSI reference model todifferent highspeed technologies and Internet Suite of Protocols. (LOTS: Level 3: Apply)	_	2	-	-	-	_	_	_	-	_	_	_	_	3	_
CO4. **Analyze** the performance of different high-speed technologies in different scenarios / situations. (LOTS: Level 4: Analyse)	_	2	2	2	2	_	_	_	-	_	_	_	_	3	_
CO5. **Design** a network for any organization using highspeed technologies along with Internet connectivity. (LOTS: Level 6: Create)	_	3	3	2	3	_	_	_	2	_	_	2	_	3	_
Level of Attainments PC/CSE/13-T	_														

Cryptography and Network Security

General Course Information

Course Code: PC/CSE/14-T Course Credits: 3 Type: Professional Core Contact Hours: 3hours/week Mode:Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of Number systems, Complexity Theory, Computer Networks.

About the Course:
The increase in techniques to penetrate into systems has led to variety of information and Network attacks, to mitigate the exploitation of the vulnerabilities leading to these attacks we need to adopt robust security architecture into our premises. We have to choose between various security technologies such as cryptography, Digital Signatures, Key Management, Program Security, Database security, WIFI security. In the current scenario we require to secure end-to-end devices, Networks, Networking devices and clouds.

Course outcomes: By the end of the course students will be able to:
CO1. **recognize** need of cryptography and cryptographic Algorithms. (LOTS: Level 1: Remember)
CO2. **represent** security in terms of various techniques and algorithms. (LOTS: Level2: Understand)
CO3. **apply** mathematical techniques to cryptography for solving problems related to security issue. (LOTS: Level 3: Apply)
CO4. **identify** various types of attacks for their mitigation/proactive and reactive treatment. (LOTS: Level4: Analyze)
CO5. **judge** the security of an organization/institute by means of Network security devices/models/controls. (LOTS: Level 5: Evaluate)
CO6. **integrate** different types of securities under one environment and evaluate its performance. (LOTS: Level 6: Create)

Course Content

Unit I
Cryptography: Overview of classical cryptosystems, stream and block ciphers, ciphers & cipher modes, Substitution Ciphers: Mono-alphabetic Substitution and Poly-alphabetic Substitution, Transposition Ciphers: Rail Fence, ScyTale, Book cipher, Vernam cipher, Vigenere Tabluae, HillCipher. Cryptanalysis of Classical Cryptosystems.

Unit II

Mathematical Foundations: Elementary Number theory, Finite fields, Groups and Subgroups, Matrix representations, Symmetric matrices and diagonalization, Number theory: Divisibility, gcd, prime numbers, primality testing. Congruences, solution of congruences, Chinese remainder theorem, Fermat and Euler's theorem, Modular Arithmetic and its properties, Modular exponentiation.

Unit III

Cryptographic Algorithms and techniques: Private/Symmetric Key cryptography: DES and its variants, AES, Feistel networks, Modes of operation, Public/Asymmetric Key Cryptography: RSA Algorithm, Elliptic Curve Cryptography. Diffie Hellman Key Exchange Algorithm, Digital Signatures, Knapsack Algorithm, Public Key Infrastructure, Kerberos, secret sharing schemes, Digital Certificates, X.509 Certificates.

Unit IV

Network Security: Attacks: types, detection, mitigation. Network Security Foundations, Defense Models, Access Control: Authentication and Authorization Controls, Network Architecture, Network Device Security, Wireless Security, Firewalls, Intrusion Detection Systems, Network Role-Based Security: Email-PGP, PEM, S- MIME. Proxy servers. SSL, TLS. SET, SHTTP, IPSec. Virtual Private Networks security.

Text and Reference Books

- William Stallings, *Cryptography and Network security-Principles and Practices*, Pearson Education,Ninth Indian Reprint 2005.
- Charlie Kaufman , *Network Security : Private communication in Public World*, Prentice-HallInternational, Inc. April 2008.
- Roberta Bragg, Mark Rhodes-Ousley, Keith Strassberg, *The Complete Reference Network Security*,McGraw hill Education, 2004.
- Charles P. Fleeger, *Security in Computing*, 2nd Edition, Prentice Hall International Inc.,1996.

CO-PO Articulation Matrix Cryptography and Network Security (PC/CSE/14-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Recognize** need of cryptography and cryptographic Algorithms. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO2. **Represent** security in terms of various techniquesand algorithms. (LOTS: Level2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3. **Apply** mathematical techniques to cryptography for solving problems related to security issue. (LOTS: Level 3: Apply)	3	3	2	2	2	-	-	-	-	-	-	-	-	3	_
CO4. **Identify** various types of attacks for their mitigation/proactive and reactive treatment. (LOTS: Level 4: Analyze)	2	2	2	3	3	_	_	_	_	_	_	_	_	3	_
CO5. **Judge** the security of an organization/institute bymeans of Network security devices/models/controls. (LOTS: Level 5:Evaluate)	3	3	2	3	3	_	_	3	_	3	_	_	_	3	_
CO6. **Integrate** different types of securities under one Environment and evaluate its performance. (LOTS: Level 6: Create)	3	3	2	3	3	_	_	_	_	_	_	_	_	3	_
Level of Attainments PC/CSE/14-T															

Economics for Engineers

General Course Information

Course Code: HSMC/4-T Course Credits: 2 Type: Humanities and Social Sciences including Management courses Contact Hours: 2 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: None

About the Course: This course is designed to provide the elementary and essential knowledge of economics relevant to their profession as engineers. The graduating engineers will learn aboutthe basic principles of economics and cost benefit analysis for various economic alternatives.
The course also gives an initial exposure to issues and challenges for sustainable development.

Course Outcomes: By the end of the course students will be able to:
CO1. **outline** the principles of economics in general and economics in Indian context. (LOTS: Level 1: Remember)
CO2. **discuss** concepts related to economics in general and particularly relevant to Indian scenario. (LOTS: Level 2: Understand)
CO3. **apply** the principles of economics for solving problems related to Engineering sector. (LOTS: Level3: Apply)
CO4. **carry** out cost/benefit/, life cycle and breakeven analyses on one or more economic alternatives. (LOTS: Level 4: Analyse)
CO5. **judge** the issues and challenges of sustainable development. (LOTS: Level 5: Evaluate)

Course Content

Unit I
Definition of Economics- various definitions, Nature of economic problem, Production possibility curve, Economics laws and their nature. Relation between Science, Engineering, Technology and Economics. Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical applications and importance.

Unit II
Meaning of Demand, Individual and Market demand schedules, Law of demand, shape of demand curve, Elasticity of Demand, measurement of elasticity of demand, factors affecting elasticity of demand, practical importance and applications of the concept of elasticity of demand.
Meaning of production and factors of production; Law of variable proportions, Returns to scale,Internal and External economics and diseconomies of scale.

Unit III
Various concepts of cost- Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run both.
Meaning of Market, Types of Market - Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)
Issues, Strategies and challenges for sustainable development for developing economies

Unit VI

Elements of Business/Managerial Economics and forms of organizations, Cost & Cost Control Techniques, Types of Costs, Lifecycle Costs, Budgets, Break Even Analysis, Capital Budgeting, Application of linear Programming. Investment Analysis- NPV, ROI, IRR, Payback Period, Depreciation, Time Value of Money (present and future worth of cash flows).

Business Forecasting- Elementary techniques. Statements- Cash Flows, Financial. Case Study Method. Nature and Characteristics of Indian Economy (brief and elementary introduction). Privatization - meaning, merits, and demerits. Globalisation of Indian economy- merits and demerits.

WTO and TRIPs agreements.

Text and Reference Books:

- Alfred William Stonier, D. C. Hague, *A text book of Economic Theory*, 5th edition, Longman HigherEducation, 1980.
- K. K. Dewett, M. H. Navalur, *Modem EconornicTheory*, S. Chand, 2006.
- H. L. Ahuja, *Modern Microeconomic: Theory and Applications*, S. Chand, 2017.
- N. Gregory Mankiw, *Principles of Economics*, 7th edition, South-Western College Publishing, 2013.
- Ruddar Dutt & K. P. M. Sundhram, *Indian Economy*, S. Chand, 2004.
- V. Mote, S. Paul, G. Gupta, *Managerial, Economics*, McGraw Hill Education, 2017.
- Saroj Pareek, *Text book of Business Economics*, Neha Publishers and Distributors, 2013.
- William McDonough and Michael Braungart, *Cradle to Cradle Remaking the Way We Make Things*,North Point Press, New York, 2002.
- Sustainable Development Challenges, *World Economic and Social Survey*, United Nations Publication,2013.

CO-PO Articulation Matrix Economics for Engineers (HSMC/4-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Outline** the principles of economics in general and economics in Indian context particularly for public sector agencies and private sector businesses. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2. **Discuss** concepts related to economics in general and particularly relevant to Indian scenario. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3. **Apply** the principles of economics for solving problems related to Engineering sector. (LOTS: Level 3: Apply)	2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO4. **Carry** out benefit/cost, life cycle and breakeven analyses on one or more economic alternatives. (LOTS:Level 4: Analyse)	3	2	2	3	3	-	-	-	2	-	-	3	-	-	-
CO5. **Judge** the issues and challenges of sustainable development. (LOTS: Level 4: Evaluate)	3	_	3	3	_	_	3	-		3	3	3	-	-	-
Level of Attainments HSMC/4-T															

Essence of Indian Traditional Knowledge

General Course Information

Course Code: MC/4-T Course Credits: 0 Type: Mandatory course Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: None

About the Course: This course is designed to acquaint students with Indian knowledge traditions. It introduces students to Vedic period, Post Vedic period, Sufi and Bhakti Movement in India, the ancient scientists of India and social reform movements of 19th century.

Course Outcomes: By the end of the course students will be able to:
CO1. **recognize** the forms and sources of Indian traditional knowledge. (LOTS: Level 1:Remember)
CO2. **identify** the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge. (LOTS: Level 2: Understand)
CO3. **apply** the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalent in Indian society. (LOTS: Level 3: Apply)
CO4. **differentiate** the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment. (LOTS: Level 4: Evaluate)
CO5. **suggest** means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures. (LOTS: Level 6: Create)

Course Content

Unit I
Introduction to Indian Tradition Knowledge: Defining traditional knowledge, forms, sources and dissemination of traditional knowledge.
Vedic Period: Vedas and Upanishads, Yogsutras of Patanjali
Post Vedic Period: Budhism, Janism and Indian Materialism: Charvak School of Thought

Unit II
Sufism and Sufi saints, Kabir, Nanak and Guru Jambheshwar ji Maharaj etc., Composite Culture of Indian sub-continent.

Unit III
Jyotirao Phule and Savitri Bai Phule and other 19th Century Social Reform Movements; India'scultural heritage.

Unit IV
India's Contribution to the world of knowledge, Astrology and Astronomy, Myths and Reality

Text and Reference Books:

1. L. Bhansam, The Wonder That was India, A Survey of the Culture of the, Indian Sub-Continent before, the Coming of the Muslims, Vol 1, Groove Press, New York, 1959.
2. S. A. A. Rizvi, Wonder That was India, A Survey of the History and Culture of the Indian Sub-Continent from the Coming of the Muslims to the British Conquest 1200-1700, Vol 2, Rupa and Co. 2001.
3. B. V. Subbarayappa, A Historical Perspective of Science in India, Rupa Publications, New Delhi,2013.
4. Thich Nhat Hanh, Nguyen Thi Hop, Mobi Ho , Old Path White Clouds: Walking in the Footstepsof the Buddha, Parallax Press, 1991.
5. Hermann Hesse, Siddhartha, Simon & Brown, 2017.
6. Rosalind O' Hanlon, Caste Conflict and Ideology, Mahatma Jyotirao Phule and low caste protesting nineteen century, Western India, Cambridge University Press, 2009.
7. Melanie P. Kumar, Savitribai Phule: Forgotten liberator, Infochange, 2009.
8. Leah Verghese, Ranjna, and Medha Sundar, Savitribai, Journey of a Trailblazer, Azim Prem University, 2014.

CO-PO Articulation Matrix Essence of Indian Traditional Knowledge (MC/4-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Recognize** the forms and sources of Indian traditional knowledge. (LOTS: Level 1: Remember)	-	1		-	-		-	-	-	-	-	1	-	-	-
CO2. **Identify** the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge. (LOTS: Level 2: Understand)	-	2	1	-	-	3	-	-	-	-	-	1	-	-	-
CO3. **Apply** the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalentin Indian society. (LOTS: Level 3: Apply)	-	3	3	2	-	3	-	-	-	-	-	3	-	-	-
CO4. **Differentiate** the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment. (LOTS: Level 4: Evaluate)	-	2	3	3	-	3	1	-	-	-	-	3	-	-	-
CO5. **Suggest** means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures. (LOTS: Level 6: Create)	-	3	3	3	-	3	-	-	-	-		3	-	-	-
Level of Attainments MC/4-T															

Computer Graphics Lab.

General Course Information

Course Code: PC/CSE/11-P Course Credits: 1 Type: Professional Core Lab. Course Mode: Lab practice andassignments Contact Hours: 2 hours / week	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA- VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Knowledge of C/C++ and Data Structures.

About the Course:
This lab course provides opportunity to students to implement various algorithms to do graphics. This includes drawing lines, circles and ellipses. In addition, students learn to rotate, move and transform graphical objects.

Course Outcomes: By the end of the course students will be able to:
CO1. **implement** various graphics algorithms for drawing and filling of geometric objects. (LOTS: Level 3: Apply)
CO2. **demonstrate** transformation of geometric objects. (LOTS: Level 3: Apply)
CO3. **compare** strengths and weakness of various graphics algorithms. (LOTS: Level 4:Analyse)
CO4. **design** algorithms for creating scenes like flying a kite and solar eclipse. (LOTS: Level 6:Create)
CO5. **create** lab assignment record that includes problem definitions, solutions and conclusions. (LOTS: Level: 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3:Apply)

List of experiments/assignments

- A program to draw a line using Digital Differential Analyzer (DDA) Algorithm
- A program to draw a line using Bresenham's Line Algorithm (BLA) for lines with slopes
- negative and less than 1.
- positive and less than 1.
- positive and greater than 1.
- negative and greater than 1.
- A program to draw a circle using Bresenham's Circle Algorithm.
- A program to draw a circle using Midpoint Circle Algorithm
- A program to draw an ellipse using Midpoint Ellipse Algorithm.
- A program to fill different types of geometric shapes using Flood Fill. Algorithm
- A program to fill different types of geometric shapes using Boundary Fill Algo.
- A program to demonstrate window to view-port mapping. A program to clip a line segment using 4-bit code algorithm.
- A program to draw a C-Curve of nth order.
- A program that shows a scene of flying kite.
- A program to rotate a line about its mid-point.
- A program that shows a scene of eclipse.
- A program that translates and rotate a circle along a horizontal line.
- A program to rotate an ellipse about its major axis and minor axis alternatively.

Note:
The actual experiments/assignments may vary and will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective ofthe course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Computer Graphics Lab. Course (Course Code: PC/CSE/11-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Implement** various graphics algorithms for drawingand filling of geometric objects. (LOTS: Level 3: Apply)	2	-	3	-	2	_	_	_	_	_	_	_	3	_	_
CO2. **Demonstrate** transformation of geometric objects. (LOTS: Level 3: Apply)	2	-	-	-	2	_	_	_	_	_	_	_	3	_	_
CO3. **Compare** strengths and weakness of variousgraphics algorithms. (LOTS: Level 4: Analyse)	2	2	-	-	-	_	_	_	_	_	_	_	3	_	_
CO4. **Design** algorithms for creating scenes like flying akite and solar eclipse. (LOTS: Level 6: Create)	2	2	-	2	-	_	_	_	_	_	_	_	3	_	_
CO5. **Create** lab assignment record that includes problem definitions, solutions and conclusions. (LOTS: Level: 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6. **Demonstrate** use of ethical practices, self-learningand team spirit. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
Level of Attainments PC/CSE/11-P															

Python Programming Lab.

General Course Information

Course Code: PC/CSE/12-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA- VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic programming skills

About the Course:
Python is a scripting programming language known for both its simplicity and wide breadth of applications. For this reason, it is considered one of the best languages for beginners. Used for everything from web development to scientific computing Python is referred to as a general-purpose language by the greater programming community. The major objective of Python language is to make the students solve real word problem efficiently using python library.

Course Outcomes: By the end of the course students will be able to:
CO1. **implement** solutions to the given assignments in Python. (LOTS: Level 3: Apply)
CO2. **use** various Python packages for solving different programming problems. (LOTS: Level 3: Apply) CO3. **devise** solutions for complex problems of data analysis and machine learning. (LOTS: Level 6:
Create)
CO4. **Evaluate** the output of data analysis and machine learning models. (LOTS: Level 5: Evaluate)
CO5. **create** lab records of the solutions for the given assignments. (LOTS: Level 6:Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit.. (LOTS: Level 3:Apply)

List of experiments/assignments

- Install Python and explore various popular IDE like IDLE, PyCharm, and Anaconda.
- Assignments to perform various number operations like
- Find maximum from a list of numbers
- GCD of two number
- Square root of a number
- Check number is prime or not.
- Print first N prime numbers
- Remove duplicate numbers from list
- Print the Fibonacci series.
- Assignments to perform various operations on Strings like creation, deletion, concatenation.
- Create a List L = [10, 20, 30]. Write programs to perform following operations:
- Insert new numbers to list L.
- Delete numbers from list L.
- Sum all numbers in list L.
- Sum all prime numbers in list L.
- Delete the list L.
- Create a Dictionary D= {‘Name’: ‘Allen’, ‘Age’: 27, 5:123456}. Write programs to perform following operations:
- Insert new entry in D.
- Delete an entry from D.

- Check whether a key present in D.
- Update the value of a key.
- Clear dictionary D.
- Two assignments on Sets to perform various operation like union, intersection, differenceetc.
- Two assignments related to searching operation like linear search, binary search.
- Three assignments related to sorting like selection sort, bubble sort, insertion sort.
- Demonstrate the use of dictionary for measuring student marks in five subjects and you haveto find the student having maximum and minimum average marks.
- Two assignments on usage of different available packages like random package to perform
- Print N random numbers ranging from 100 to 500.
- Print 10 random strings whose length between 3 and 5.
- Two assignments on usage of package such as NumPy, Pandas.
- Implement and demonstrate the functions of a simple calculator.
- One assignment on implementing object-oriented concept such as classes, inheritance,and polymorphism.
- One assignment on file handling that how data is read and written to a file.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet theobjective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Python Programming Lab. Course (PC/CSE/12-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Implement** solutions to the given assignments in Python. (LOTS: Level 3: Apply)	2	1	_	_	3	_	_	_	_	_	_	_	_	_	3
CO2. **Use** various Python packages for solving different programming problems. (LOTS: Level 3: Apply)	2	3	_	3	3	_	_	_	_	_	_	_	_	_	3
CO3. **Devise** solutions for complex problems of data analysis and machine learning. (LOTS: Level 6: Create)	3	3	1	3	3	_	_	_	_	_	_	_	_	_	3
CO4. **Evaluate** the output of data analysis and machine learning models. (LOTS: Level 5: Evaluate)	3	3		3	3	_	_	_	_	_	_	_	_	_	3
CO5. **Create** lab records of the solutions for the given assignments. (LOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6. **Demonstrate** use of ethical practices, self-learningand team spirit. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
Level of Attainments PC/CSE/12-P															

Industrial Training/Internship

General Course Information

Course Code: EEC/CSE/1-P Course Credits: 4 Mode: Industrial Training /Internship	**Course Assessment Methods (100 Marks)** An internal evaluation is done by a faculty memberappointed by the Chairperson of the Department. Significance and originality of the problem addressed andthe solution provided: 20 Knowledge of the problem domain and tool used (VIVA-VOCE):25 Report Writing: 20 Judgment of the skill learnt and system developed: 20Level of ethics followed: 15

About the Industrial training:
Students do an Industrial Training of 4 to 6 weeks after fourth semester. They are expected to learn novel skills and develop some software application during the training period.

After doing training students will be able to:

CO1. **review** the existing systems for their strengths and weaknesses. (LOTS: Level 4: Analyze)
CO2. **address** novel problems in an original and innovative manner (LOTS: Level 6:Create)
CO3. **select and apply** modern engineering tools. (LOTS: Level 3: Apply)
CO4. **evaluate** the system developed critically with respect to the requirement analysis andother similar systems. (LOTS: Level 5: Evaluate)
CO5. **prepare** training report by organizing ideas in an effective manner.

CO-PO Articulation Matrix Industrial Training (EEC/CSE/1-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Address** novel problems in an original manner using latest skills (LOTS: Level 6: Create)	3	3	3	2		1	_	_	2	_	1	_	_	_	_
CO2. **Select and apply** modern engineering tools. (LOTS: Level 3: Apply)	2	_	_	_	3	_	_	_	3	_	_	_	_	_	_
CO3. **Prepare** training report by organizing ideas in an effective manner.	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO4. **Engage** in lifelong learning. (LOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	_	_	3	_	_	_
CO5. **Apply** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply	_	_	_	_	_	_	_	3	_	3	_	_	_	_	_
Level of Attainments EEC/CSE/1-P															

Operating Systems

General Course Information

Course Code: PC/CSE/15-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: programming in C and knowledge of computer fundamentals.

About the Course:
The objective of this course is to help students become familiar with the fundamental concepts of operating systems and provide them with enough understanding of operating system design.

Course Outcomes: By the end of the course students will be able to:
CO1. **list** various functions and design characteristics of operating systems (LOTS: Level 1:Remember)
CO2. **explain** fundamental concepts of operating systems. (LOTS: Level 2: Understand)
CO3. **apply** operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc. (LOTS: Level 3: Apply)
CO4. **analyze** the issues related to various operating systems. (LOTS: Level 4: Analyze)
CO5. **design** solutions for the memory and process management problems. (LOTS: Level 6:Create).

Course Content

Unit I
Introductory Concepts: Operating systems functions and characteristics, operating system services and systems calls, system programs, operating system structure. operating systems generation, operating system services and systems calls. Types of Operating systems: Batch operating system, Time-sharing OS, Distributed operating system, Realtime systems.
File Systems: Types of Files and their access methods, File allocation methods, Directory Systems: Structured Organizations, directory and file protection mechanisms, disk scheduling and its associated algorithms.

Unit II
Processes: Process concept, Process Control Block, Operations on processes, cooperating processes. CPU scheduling: Levels of Scheduling, scheduling criteria, Comparative study of scheduling algorithms, Algorithm evaluation, multiple processor scheduling. Critical-section problem, Semaphores.

Unit III
Storage Management: Storage allocation methods: Single contiguous allocation, non-contiguous memory allocation, Paging and Segmentation techniques, segmentation with paging, Virtual memory concepts, Demand Paging, Page replacement Algorithms, Thrashing.

Unit VI
Deadlock: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock
Case Studies: Comparative study of WINDOW, UNIX & LINUX system.

Text and Reference Books:

- Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, 8th Edition, Wiley Indian Edition, 2010.
- Andrew S Tanenbaum, *Modern Operating Systems*, Third Edition, Prentice Hall India, 2008.
- Naresh Chauhan, *Principles of Operating Systems*, Oxford Press, 2014.
- D.M. Dhamdhere, *Operating Systems*, 2nd edition, Tata McGraw Hill, 2010.
- William Stallings, *Operating Systems– Internals and Design Principles*, 5th Edition, Prentice Hall India, 2000.

CO-PO Articulation Matrix Operating System Course (PC/CSE/15-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **List** various functions and design characteristics of operating systems (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2. **Explain** fundamental concepts of operatingsystems. (LOTS: Level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3. **Apply** operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc. (LOTS: Level 3: Apply)	3	1	_	_	2	_	_	_	_	_	_	1	3	_	_
CO4. **Analyze** the issues related to various operating systems. (LOTS: Level 4: Analyze)	3	2	3		2	_	_	_	_	_	_	1	3	_	_
CO5. **Design** solutions for the memory and process management problems. (LOTS: Level 6: Create)	3	2	3	2	2	_	_	_	_	_	_	_	3	_	_
Level of Attainments PC/CSE/15-T															

Formal Language and Automata Theory

General Course Information

Course Code: PC/CSE/16-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: The students are expected to have a strong background in the fundamentals of discrete mathematics like in the areas of symbolic logic, set, induction, number theory, summation, series, combinatorics, graph, recursion, basic proof techniques.

About the Course:
Formal Languages and Automata theory presents the theoretical aspects of computer science, which lay the foundation for students of Computer Science. The course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine.

Course Outcomes: By the end of the course students will be able to:
CO1. **define** terminology related to theory of computation. (LOTS: Level 1: Remember)
CO2. **explain** the basic concepts and applications of Theory of Computation. (LOTS: Level 2: Understand)
CO3. **apply** the principles of Theory of Computation to solve computational problems. (LOTS: Level 3: Apply)
CO4. **compare and contrast** the hierarchy of grammars (LOTS: Level 5: Evaluate).
CO5. **Design various** types of automata for given problems. (LOTS: Level 6: Create)

Course Content

Unit I
Finite Automata and Regular Expressions: Finite State Systems, Basic Definitions Non- Deterministic finite automata (NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA Finite automata with E-moves, Regular Expressions, Equivalence of finite automata and Regular Expressions, Regular expression conversion and vice versa, Conversion ofNFA to DFA by Arden's Method.

Unit II
Introduction to Machines: Concept of basic Machine, Properties and limitations of FSM. Moore and mealy Machines, Equivalence of Moore and Mealy machines.
Properties of Regular Sets: The Pumping Lemma for Regular Sets, Applications of the pumping lemma, Closure properties of regular sets, Myhill-Nerode Theorem and minimization of finite Automata, Minimization Algorithm.

Unit III
Grammars: Definition, Context free and Context sensitive grammar, Ambiguity regular grammar, Reduced forms, Removal of useless Symbols and unit production, Chomsky Normal Form (CNF), Griebach Normal Form (GNF).
Pushdown Automata: Introduction to Pushdown Machines, Application of Pushdown Machines

Unit IV

Turing Machines: Deterministic and Non-Deterministic Turing Machines, Design of T.M, Halting problem of T.M., PCP Problem.

Chomsky Hierarchies: Chomsky hierarchies of grammars, Unrestricted grammars, Context sensitive languages, Relation between languages of classes.

Computability: Basic concepts, Primitive Recursive Functions.

Text and Reference Books:

- Hopcroaft & O. D. Ullman, R Mothwani, *Introduction to automata theory, language & computations*, AW,2001.
- K. L. P.Mishra & N. Chandrasekaran, *Theory of Computer Sc.(Automata, Languages and computation)*,PHI, 2000.
- Peter Linz, *Introduction to formal Languages & Automata*, Narosa, Publication, 2001.
- Ramond Greenlaw and H. James Hoover, *Fundamentals of the Theory of Computation-Principles andPractice*, Harcourt India Pvt. Ltd., 1998.
- H. R. Lewis & C. H. Papaditriou, *Elements of theory of Computation*, PHC, 1998.
- John C. Martin, *Introduction to Languages and the Theory of Computation*, T.M.H., 2003.

CO-PO Articulation Matrix Formal Language and Automata Theory Course (PC/CSE/16-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define** terminology related to theory of computation. (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO2. **Explain** the basic concepts and applications of Theory of Computation. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3. **Apply** the principles of Theory of Computation tosolve computational problems. (LOTS: Level 3: Apply)	2	1	2		2	–	–	–	–	–	–	–	3	–	–
CO4. **Compare and contrast** the hierarchy of Grammers (LOTS: Level 5: Evaluate).	3	2	2	2	2	–	–	–	–	–	–	–	3	–	–
CO5. **Design** various types of automata for given problems. (LOTS: Level 6: Create)	3	2	2	2	2	–	–	–	–	–	–	–	3	–	–
Level of Attainments PC/CSE/16-T															

Data Analytics using R

General Course Information

Course Code: PC/CSE/17-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic programming skills, Probability and Statistics

About the Course:
Data analytics is a growing and stimulating field that turns data into valuable insights. This course includes programming in R for acquiring, cleaning, visualizing and analyzing data. In addition, it also involves predictive modeling. This course will introduce students to the basic principles, tools and the craft for devising solutions for problems that come in the domain of data science. The emphasis of the course is on integration and synthesis of concepts and their applications for effective engineering solutions.

Course Outcomes: By the end of the course students will be able to:
CO1. **outline** concepts related to R programming and data analysis. (LOTS: Level 1:Remember)
CO2. **explain** the basic concepts and tools that are used to solve problems in data analytics. (LOTS: Level2: Understand)
CO3. **interpreting** results of descriptive and inferential statistics. (LOTS: Level 2: Understand)
CO4. **apply** R programming for reading, cleaning, visualizing and analysing data. (LOTS: Level3: Apply)
CO5. **analyse** the trends in data through exploratory data analysis. (LOTS: Level 4: Analyse)
CO6. **devise** solutions for descriptive and predictive modelling. (LOTS: Level 6: Create)

Course Content

Unit I

Introduction to R programming: Data types or objects in R, Creating and manipulating objects like factors, vectors and matrices, lists and data frames, Subsetting matrices and data frames, Vectorized operations for vectors and matrices and data frames.

Unit II

Control structure in R: If-else statements, for and while loops, loop functions like lapply, apply, sapply and mapply etc.; writing user defined functions in R. Getting data in and out of R.

Unit III

Doing basic descriptive statistics: Data types for data analysis and their mapping to R objects, Mean, Median, Mode, Quantiles, Five-point summary, Variance, Correlation and Covariance, normal distribution, uniform distribution using R, Hypothesis testing: Chi-Square test and student's T test.

Unit IV

Exploratory Data Analysis: Visualizing data through various plots and charts (bar charts, histogram, frequency polygon, scatter plot, box plots etc.), Applying KNN.

Text and Reference Books:

- Hadley Wickham and Garrett Grolemund., *R for Data Science Import, Tidy, Transform and modelData*, O'Reilly, 2017.
- Roger D. Peng, *R Programming for Data Science*, Lean Publishing, 2015.
- Paul Teeter, *R Cookbook*, O'Reilly, 2011.
- W. N. Venables, D. M. Smith and the R core Team, *An introduction to R, Notes on R: A ProgrammingEnvironment for Data Analysis and Graphics*, version 3.3.2, 2016.
- Michael J. Crawley, *Statistics, An introduction using R*, Second edition, John Wiley, 2015
- Han, J., Kamber, M, Pei, J., *Data Mining Concepts and Techniques*, Third edition, Morgan Kaufmann,2012.
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: DataMining, Inference and Prediction*, Springer, 2nd edition, 2009.

CO-PO Articulation Matrix Data Analytics using R Course (PC/CSE/17-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Outline** concepts related to R programming and data analysis. (LOTS: Level 1:Remember)	1	-	-	-	-	_	_	_	_	_	_	_	_	_	2
CO2. **Explain** the basic concepts and tools that are used to solve problems in data analytics. (LOTS: Level 2: Understand)	1	-	-	-	-	_	_	_	_	_	_	_	_	_	3
CO3. **Interpreting** results of descriptiveand inferential statistics. (LOTS: Level 2: Understand)	3	2	-	3	-	_	_	_	_	_	_	_	_	_	3
CO4. **Apply** R programming for reading, cleaning, visualizing and analysing data. (LOTS: Level 3: Apply)	3	-	-	-	3	_	_	_	_	_	_	_	_	_	3
CO5. **Analyse** the trends in data through exploratory data analysis. (LOTS: Level 4: Analyse)	2	3	2	2	3	_	_	_	1	_	_	_	_	_	3
CO6. **Devise** solutions for descriptive and predictive modelling. (LOTS: Level 6: Create)	3	3	2	3	3	_	_	_	2	_	_	_	_	_	_
Level of Attainments PC/CSE/17-T															

Machine Learning

General Course Information

Course Code: PC/CSE/18-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration:3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basics of Linear Algebra and Statistics, Basics of Probability Theory, Data Structures and Computer Algorithms.

About the Course:
Machine learning is the study of computer algorithms that improve their performance through experience. Machine learning draws its conceptual foundation from the fields like artificial intelligence, probability and statistics, computational complexity, cognitive science, biology and information theory etc. The course introduces some of the key machine learning algorithms and the theory that form the backbone of these algorithms. The examples of such algorithms are classification algorithms for learning patterns from data, clustering algorithms for grouping objects based on similarity, neural network algorithms for pattern recognition, genetic algorithms for searching large and complex search spaces etc.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the concepts and working of different machine learning algorithms.(LOTS:Level 1: Remember)

CO2. **interpret** the results of machine learning algorithms. (LOTS: Level 2:Understand)

CO3. **apply** machine learning concepts and algorithms to given problems. (LOTS:Level 3: Apply)

CO4. **analyse** the performance of machine learning algorithms. ((LOTS: Level 4:Analyse)

CO5. **compare and contrast** different machine learning algorithms. (LOTS: Level 5:Evaluate)

CO6. **design** machine learning algorithms for optimization, pattern recognition and search problems. (LOTS: Level 6: Create)

Course Content

Unit I

Introduction: Well posed learning problems, designing a learning system, Issues in machine learning, the concept learning task, Concept learning as search, Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidate-eliminations, Inductive bias.

Unit II

Supervised Learning: Introduction to linear regression, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression, Logistic regression, basic decision tree learning (ID3) algorithm, Hypothesis space search in decision tree learning algorithm, Inductive bias in decision tree learning, Issues in decision tree learning, k-nearest neighbor learning.

Unit III

Unsupervised Learning: About clustering, type of data in clustering analysis, k-means and k- medoids,

DBSCAN density-based clustering method, Performance analysis of clustering algorithms, **Artificial Neural networks:** Neural Network representations, Appropriate problems for neural network learning, Perceptron. The perceptron training rule, Gradient descent and delta rule, Multilayer Networks and back propagation algorithm.

Unit IV

Bayesian Learning: Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least- squared error hypotheses, Naïve Bayes Classifier.

Evaluating Hypotheses: Estimating hypothesis Accuracy, Basics of sampling theory, Error estimation and estimating Binomial proportions, The binomial distribution, Mean and variance, Bias and variance, Confidence intervals, Two sided or one sided bounds, Central limit theorem, Hypothesis testing, Comparing learning algorithms

Text and Reference Books:

1. Tom M. *Mitchell, Machine Learning*, McGraw-Hill, 1997.
2. Bishop Christopher, *Pattern Recognition and Machine Learning*, Springer Verlag, 2006.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer, 2nd edition, 2009..J. Han and M. Kamber, Data Mining Concepts and Techniques, 3rd Edition, Elsevier, 2012.
4. S. Rajeshkaran, G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithm:Synthesis and Applications*, PHI, 2003.

CO-PO Articulation Matrix Machine Learning Course (PC/CSE/18-T)

List of Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Outline** the concepts and working of different machine learning algorithms. (LOTS: Level 1:Remember)	1	_	_	1	_	_	_	_	_	_	_	_	_	_	3
CO2. **Interpret** the results of machine learning algorithms. (LOTS: Level 2: Understand)	2	2	2	3	_	_	_	_	_	_	_	_	_	_	3
CO3. **Apply** machine learning concepts and algorithms to given problems. (LOTS: Level 3: Apply)	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO4. **Analyse** the performance of machine Learning algorithms. ((LOTS: Level 4: Analyse)	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO5. **Compare and contrast** different machine learning algorithms. (LOTS: Level 5: Evaluate)	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO6. **Design** machine learning algorithmsfor optimization, pattern recognition and search problems. (LOTS: Level 6: Create)	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
Level of Attainments PC/CSE/18-T															

Embedded System Design

General Course Information

Course Code: PE/CSE/1-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 Mode: Lectures (L) Examination Duration: 3 hours.	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Introduction to Microprocessors and Operating Systems.

About the Course:
An embedded system is a self-contained unit that have a dedicated purpose within a device. We come across a variety of applications of embedded systems in navigation tools, telecom applications, and networking equipment to name just a few. An Embedded System's Architecture begins with a view of embedded development and how it differs from the other systems. Students learn about setting up a development environment and then move on to the core system architectural concepts, exploring pragmatic designs, boot-up mechanisms, and memory management. They are also explored to programming interface and device drivers to establish communication via TCP/IP and take measures to increase the security of IoT solutions.

Course Outcomes: By the end of the course students will be able to:
CO1. **state** the concepts related to embedded system design. (LOTS: Level 1: Remember)
CO2. **discuss** the principles of embedded systems and their applications. (LOTS: Level 2:Understand)
CO3. **apply** the principles of embedded design for problem solving. (LOTS: Level 3: Apply)
CO4. **analyze** architectural design patterns and engineering tradeoffs. (LOTS: Level 4: Analyse)
CO5. **design** architectural patterns for connected and distributed devices in the IoT. (LOTS:Level 6: Create)

Course Content

Unit I

Embedded Systems: A Pragmatic Approach- Domain definitions, Embedded Linux systems, Low-end 8-bit microcontrollers, Hardware architecture, Understanding the challenge, Multithreading, RAM, Flash memory, Interfaces and peripherals, Asynchronous UART-based serial communication: -SPI - I2C - USB, Connected systems, The reference platform, ARM reference design, The Cortex-M microprocessor
Work Environment and Workflow Optimization: Workflow overview, C compiler, Linker, Build automation, Debugger, Embedded workflow, The GCC toolchain, The cross-compiler, Compiling the compiler, Linking the executable, Binary format conversion, Interacting with the target, The GDB session, Validation, Functional tests, Hardware tools, Testing off-target, Emulators.

Unit II

Architectural Patterns: Configuration management, Revision control, Tracking activities, Code reviews, Continuous integration, Source code organization, Hardware abstraction, Middleware Application code, The life cycle of an embedded project, Defining project steps, Prototyping Refactoring, API and documentation,
The Boot-Up Procedure: The interrupt vector table, Startup code, Reset handler, Allocating the stack, Fault handlers, Memory layout, Building and running the boot code, The make file, Running the application, Multiple boot stages, Bootloader, Building the image, Debugging a multi-stage system, Shared libraries

Unit III

Distributed Systems and IoT Architecture: Network interfaces, Media Access Control, Ethernet, Wi-Fi, Low- Rate Wireless Personal Area Networks (LR-WPAN), LR-WPAN industrial link-layer extensions, 6LoWPAN, Bluetooth, Mobile networks, Low-power Wide Area Networks (LPWANs), Selecting the appropriate network interfaces, The Internet Protocols, TCP/IP implementations, Network device drivers, Running the TCP/IP stack, Socket communication, Mesh networks and dynamic routing, Transport Layer Security, Securing socket communication, Application protocols, Message protocols, REST architectural pattern, Distributed systems; single points of failure, Summary

Unit IV

Low-Power Optimizations: System configuration, Hardware design, Clock management, Voltage control, Low-power operating modes, Deep-sleep configuration, Stop mode, Standby mode, Wake-up intervals, Measuring power, Development boards, Designing low-power embedded applications, Replacing busy loops with sleep mode, Deep sleep during longer inactivity periods, Choosing the clock speed, Power state transitions

Embedded Operating Systems: Real-time application platforms, FreeRTOS, ChibiOS, Low- power IoT systems, Contiki OS, Riot OS, POSIX-compliant systems, NuttX, Frosted, The future of safe embedded systems, Process isolation; Tock, Summary.

Text and Reference Books:

- Daniele Lacamera, *Embedded Systems Architecture*, Packt Publishing, May 2018, ISBN: 9781788832502.
- Raj Kamal, *Embedded Systems*, TMH, 2004.
- M.A. Mazidi and J. G. Mazidi, *The 8051 Microcontroller and Embedded Systems*, PHI,2004.
- David E. Simon, *An Embedded Software Primer*, Pearson Education, 1999.
- K.J. Ayala, , *The 8051 Microcontroller*, Penram International, 1991.
- Rajiv Kapadia, *8051 Microcontroller & Embedded Systems*, Jaico Press, 2004.
- Prasad, *Embedded Real Time System*, Wiley Dreamtech, 2004.
- John B. Peatman, *Design with PIC Microcontrollers*, Pearson Education Asia, 2002.
- Wayne Wolf, *Computers as components: Principles of Embedded Computing SystemDesign*, MorganKaufman Publication, 2000.
- Tim Wilmshurst, *The Design of Small-Scale embedded systems*, Palgrave, 2003.
- Marwedel, Peter, *Embedded System Design*, Kluwer Publishers, 2004.

CO-PO Articulation Matrix Embedded System Design Course (PE/CSE/1-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **State** the concepts related to embedded system design. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2. **Discuss** the principles of embedded systems andtheir applications. (LOTS: Level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3. **Apply** the principles of embedded design for problem solving. (LOTS: Level 3: Apply)	2	2	_	_	2	_	_	_	_	_	_	_	3	_	_
CO4. **Analyze** architectural design patterns and engineering tradeoffs. (LOTS: Level 4: Analyse)	3	3	2	2	2	_	_	_	_	_	_	_	3	_	_
CO5. **Design** architectural patterns for connected and distributed devices in the IoT. (LOTS: Level 6: Create)	3	3	2	3	3	_	_	_	_	_	_	_	3	_	_
Level of Attainments PE/CSE/1-T															

Wireless and Mobile Communication

General Course Information

Course Code: PE/CSE/2-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 Mode: Lectures (L) Examination Duration: 3	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites:
Basic knowledge of computer networks, Network Architecture and reference model, High Speed Network technologies, Ethernet, TCP/IP architecture.

About the course:
This course attunes the students with mobile and wireless communication using the Networking infrastructure of organizations/institutes. Students learn to analyse Networks' Architecture for wireless communication and the protocols for various layers in the Wireless Networks, technologies used and application arena of Wireless Networks.

Course Outcomes: At the end of this course students will be able to:
CO1. **recall** different mobile and wireless communication concepts. (LOTS: Level 1:Remember)
CO2. **explain** working of different Mobile Communication Technologies used now a days.
(LOTS: Level 2: Understand)
CO3. **demonstrate** application of different mobile protocols for different Mobile and Wireless Communication Technologies. (LOTS: Level 2: Understand)
CO4. **analyze** the performance of different Mobile Communication technologies in differentscenarios /situations. (LOTS: Level 4: Analyse)
CO5. **design** a mobile network for any city/state/country using combination of different Mobile Technologies. (LOTS: Level 6: Create)

Course Content

Unit I
Mobile Communication**:** Wireless Transmission--- Frequencies, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular system. Specialized MAC, SDMA, FDMA, TDMA-fixed TDM, classical ALOHA, slotted ALOHA, CSMA, DAMA, PRMA, reservation TDMA. Collision avoidance, polling inhibit sense multiple access. CDMA, GSM- mobile services, architecture, radio interface, protocol, localization, calling, handover.

Unit II

Wireless LAN IEEE 802.11-System and protocol architecture, physical layer. Frame format. Bluetooth--- Protocol architecture, Frame format.

WiMAX – Layered Protocol architecture, format, Applications Introduction to LTE, LTE advanced, VoLTE

Unit III

Mobile network Layer: Mobile IP- goals, assumption, requirement, entities, terminology, IP packet delivery, Agent advertisement and discovery, registration, tunneling, encapsulation, optimization, reverse tunneling, IPV6. DHCP. Adhoc Networks—routing, Destination Sequence Distance Vector,

Unit IV

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP fast retransmission/ recovery, transmission/time out freezing, selective retransmission, Transaction oriented TCP.

Text and Reference Books:

- Jochen Schiller, *Mobile Communication*, 2nd Edition, Pearson, 2009.
- Andrew S Tanenbaum, *Computer Networks*, 5th Edition, Pearson 2013.
- William C Y Lee, *Mobile Communication Engineering*: *Theory and Applications*, 2nd Edition, McGrawHill, 1997.

CO-PO Articulation Matrix Wireless and Mobile Communication Course (PE/CSE/2-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Recall** different mobile and wireless communication concepts. (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	–	3	–
CO2. **Explain** working of different Mobile Communication Technologies used now a days. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	–	3	–
CO3. **Demonstrate** application of different mobile protocols for different Mobile and Wireless Communication Technologies.(LOTS: Level 2: Understand)	1	1	–	–	–	–	–	–	–	–	–	–	–	3	–
CO4. **Analyze** the performance of different Mobile Communication technologies in different scenarios / situations. (LOTS: Level 4: Analyse)	2	2	2	2	2	–	–	–	–	–	–	–	–	3	–
CO5. **Design** a mobile network for any city/state/country using combination of different Mobile Technologies. (LOTS: Level 6: Create)	3	3	3	3	3	–	–	–	–	–	2	2	–	3	–
Level of Attainments PE/CSE/2-T															

Graph Theory

General Course Information

Course Code: PE/CSE/3-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Basic knowledge of Abstract Algebra, Set Theory and Counting Techniques

About the Course:
Graph Theory is an elective course for every graduate in Computer Science and Engineering. The importance of Graph Theory reveals from the fact that it can be applied to solve any practical problem in electrical networks, operation research, data structure or social sciences etc. Also, Graph Theory provides easy representation of mathematical facts with insightful theories behind them. This course explains different types of graphical structures, related properties, various operations and facts related to these graphical structures with the help of proofs.

Course Outcomes: By the end of the course students will be able to:
CO1. **recognize** different kinds of Graphs. (LOTS: Level 1: Remember)
CO2. **demonstrate** various types of graphical structures with the operations implemented onthese structures. (LOTS: Level 2: Understand)
CO3. **apply** graph theory constructs for solving problems. (LOTS: Level 3: Apply)
CO4. **justify** various facts and results associated with graphical structures with the help ofproofs. (LOTS: Level 5: Evaluate)
CO5. **sketch** the graph to solve any problem in pictorial and easy representation. (LOTS: Level6: Create)

Course Content

Unit I
Introduction to graphs, Types of graphs -Regular, Complete, Bipartite, Isomorphic, Connected, Applications, Operations on Graphs, Walks, Path, Circuits, Euler Graphs, Hamiltonian Path and Circuits, Trees, Properties of Trees, Spanning Trees (Standard Results with proofs based on all mentioned topic).

Unit II
Cut-Sets, Properties of Cut-Set, All Cut-Sets in a graph, Fundamental Circuits and Cut-Sets, Connectivity and Separability, Network Flows, 1-Isomorphism, 2- Isomorphism, Planar Graphs, Kuratowski's Two Graphs (Standard Results with proofs).

Unit III
Sets with one operation, Sets with two operations, Modular Arithmetic and Galois Fields, Vector and Vector Spaces, Vector Space associated with a graph, Basic Vectors of a graph, Circuits and Cut-Set Subspaces, Orthogonal Vectors and Spaces, Intersection and Join of W and W_S.

Unit IV
Matrix representation of graphs, Incidence Matrix, Submatrices, Circuit Matrix, Fundamental Circuit Matrix and Rank, Coloring of graphs: Chromatic Number, Vertex Coloring of graphs, Edge Coloring of graphs, Coloring of Planar Graphs.

Text and Reference Books:

- V. K. Balakrishnan, *Graph Theory*, Tata McGraw Hill, 1st Edition, 2004.
- Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, Prentice-Hall ofIndia, Reprint, 2004.
- Frank Harary, *Graph Theory*, Narosa/Addison Wesley, Indian Student Edition, 1988.
- Bollobas, Bela, *Modern Graph Theory*, Springer Verlag New York, 1st Edition, 1998.
- R. Diestel, *Graph Theory*, Springer, 2nd Edition, 2000.
- Douglas B. West, *Introduction to Graph Theory*, Prentice Hall of India, 2nd Edition, 2002.

CO-PO Articulation Matrix Graph Theory Course (PE/CSE/3-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Recognize** different kinds of Graphs. (LOTS: Level1: Remember)	2	1	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2. **Demonstrate** various types of graphical structures with the operations implemented on these structures.(LOTS: Level 2: Understand)	2	1	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3. **Apply** graph theory constructs for solving problems. (LOTS: Level 3: Apply)	2	3	1		2	_	_	_	_	_	_	2	3	_	_
CO4. **Justify** various facts and results associated with graphical structures with the help of proofs. (LOTS: Level 5: Evaluate)	3	2	2	3	2	_	_	_	_	_	_	2	3	_	_
CO5. **Sketch** the graph to solve any problem in pictorialand easy representation. (LOTS: Level 6: Create)	3	_	1	2	2	_	_	_	_	_	_	2	3	_	_
Level of Attainments PE/CSE/3-T															

Bio-informatics

General Course Information:

Course Code: PE/CSE/4-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: None

About the Course:
The scope of Bio-informatics is growing rapidly. Analysing data related to bio-informatics is notpossible without computational skills. This course is designed to impart fundamental knowledge of bio-informatic which would enable students to understand the intricacies of Bioinformatics. The students will learn about the characteristic of bio-informatic data and the tools for analysis of such data.

Course Outcomes: By the end of the course students will be able to:
CO1. **list** the applications of bioinformatics and biological databases. (LOTS: Level 1:Remember)
CO2. **explain** storage and retrieval of biological data from various biological databases.
(LOTS: Level 2: Understand)
CO3. **apply** the knowledge of bio-informatic concepts. (LOTS: Level 3: Apply)
CO4. **identify** challenges in bioinformatics and computational biology. (LOTS: Level 4:Analyse)
CO5. **compare and contrast** various algorithms for sequence alignment and scoring algorithms. (LOTS: Level 5: Evaluate)
CO6. **devise** schemes for addressing bio-informatic problems. (LOTS: Level 6: Create)

Course Content

Unit: I
Bioinformatics: Introduction to Bioinformatics, Scope, Overview of molecular biology & genetics, Nucleic acid; structure & function, Protein structure & function; DNA Replication, Transcription, Translations, Genetic code, Codon Bias, Molecular Biology Techniques used in Bioinformatics.
Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA etc.). Search and retrieval of biological information and databases sequence, databank (NCBI)12hrs

Unit: II
Sequence Alignment
Pairwise Sequence Alignment: Evolutionary Basis, Sequence Homology versus Sequence Similarity, Sequence Similarity versus Sequence Identity, Methods, Scoring Matrices, Statistical Significance of Sequence Alignment
Database Similarity Searching: Unique Requirements of Database Searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with the Smith–Waterman Method.

Unit: III
Multiple Sequence Alignment: Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Practical Issues.

Profiles and Hidden Markov Models: Position-Specific Scoring Matrices, Profiles, Markov Model and Hidden Markov Model.
Protein Motifs and Domain Prediction: Identification of Motifs and Domains in Multiple Sequence Alignment, Motif and Domain Databases Using Regular Expressions, Motif andDomain Databases Using Statistical Models, Protein Family Databases, Motif Discovery in Unaligned Sequences, Sequence Logos**.**

Unit: IV
Molecular Phylogenetics
Phylogenetics Basics: Molecular Evolution and Molecular Phylogenetics, Terminology, Gene Phylogeny versus Species Phylogeny, Forms of Tree Representation, Procedure.
Phylogenetic Tree Construction Methods and Programs: Distance-Based Methods, Character-Based Methods, Phylogenetic Tree Evaluation, Phylogenetic Programs

Text and References Books:

- T K Attwood and D J Parry Smith , *Introduction to Bioinformatics,* Pearson Education Asia, Singapore,2001.
- Sensen, C.W., *Essentials of Genomics and Bioinformatics*, John Wiley and Sons. 2002
- Attwood, T. and Pary-Smith, D., *Introduction to Bioinformatics*, Prentice Hall.1999
- Baxevanis, A.D. and Ouellette, B.F.F., *Bioinformatics: A Practical Guide to the Analysis ofgenes andProtein* , Wiley- Interscience, 2001
- Stuart M. Brown, *Bioinformatics: A Biologists Guide to Computing and the Internet*, NKU MedicalCentre, NY USA, 2000.

CO-PO Articulation Matrix Bio-informatics Course (PE/CSE/4-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **List** the applications of bioinformatics and biological databases. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	_	_	2
CO2. **Explain** storage and retrieval of biological data from various biological databases. (LOTS: Level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3. **Apply** the knowledge of bio-informatic concepts. (LOTS: Level 3: Apply)	2	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO4. **Identify** challenges in bioinformatics and computational biology. (LOTS: Level 4: Analyse)	_	2	_	_	_	_	_	_	_	_	_	_	_	_	3
CO5. **Compare and contrast** various algorithms for sequence alignment and scoring algorithms. (LOTS: Level 5: Evaluate)	2	3	2	_	2	_	_	_	_	_	_	_	_	_	3
CO6. **Devise** schemes for addressing bio-informatic problems. (LOTS: Level 6: Create)	3	3	2	3	2	_	_	_	_	_	_	_	_	_	3
Level of Attainments PE/CSE/4-T															

Components Based Software Engineering

General Course Information

Course Code: PE/CSE/5-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Data Structure & Algorithms

About the Course:
To understand the importance, limitations and challenges of processes involved in software development. To gain knowledge of various software models as waterfall and evolutionary models and software design activities. To learn about software requirements analysis and specification. To learn cost estimation, software testing, maintenance and debugging.

Course Outcomes:
By the end of the course students will be able to:
CO1. Understand the difference between software engineering discipline with the other engineering disciplines (LOTS: Level 1:Remember)
CO2. Elaborate knowledge of various software models (LOTS: Level 2: Understand)
CO3. Analyze about software requirements analysis and specification(LOTS: Level 4:Analyse)
CO4. Able to get the knowledge of various software design activities.)LOTS: Level 6: Create)

Course Content

Unit I
Software Engineering Fundamentals: Definition of software product and process, Software Characteristics, Components, Applications, Layered Technologies, Processes and Product, Methods and Tools, Generic View of Software Engineering, Software Crisis, Software development paradigms, Techniques of Process Modelling,
Software Process and lifecycle models.

Unit II
Software Requirements Analysis & Specification: System specification, Software requirements specification (SRS) standards, Analysis and Design Modelling: ER Diagram, Dataflow Model, Control Flow Model, Control and Process Specification,
Data Dictionary

Unit III

Software Design: Software architecture, Modular Design-cohesion and coupling, Process- oriented design, Process and Optimization, Data-oriented design, User- interface design, Real-time software design, Architectural Designing, Interface Design, Procedural Design, Object Oriented Design.

CASE Tools: Computer-aided software engineering, Introduction to CASE, Building Blocks of CASE, Relevance of CASE tools, High-end and low-end CASE tools, automated support for data dictionaries, DFD, ER diagrams, Integrated Case
Environment, CASE workbenches.

Unit IV

Coding and Testing: Choice of Programming languages, Coding standards for Software. User Interface Design: Concepts of Ui, Interface Design Model, Internal and External Design, Evaluation, Interaction and Information Display Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing. Configuration Management: Concepts in Configuration Management, The Configuration Management Process: Planning and Setting up Configuration Management, Perform Configuration Control, Status Monitoring and Audits. Software Maintenance: What is software maintenance, Maintenance Process & Models, Reverse Engineering, Software re-engineering, Configuration Management issues and concept, Configuration planning & techniques, Software versions and change control process, Documentation.

Text and Reference Books:

- Hennessey and Patterson, "Computer Architecture: A quantitative Approach", MorganKaufman.
- Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hillinternational Edition
- Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill
- El-Rewini, H., & Abd-El-Barr, M. (2005). Advanced computer architecture and parallel processing (Vol. 42). John Wiley & Sons.

CO-PO Articulation Matrix Components Based Software Engineering Course (PE/CSE/5-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Understand the difference between software engineering discipline with the otherengineering disciplines (LOTS: Level 1:Remember)	2	2	-	-	-	2	_	_	_	_	1	_	_	_	_
CO2. Elaborate knowledge of various software models (LOTS: Level 2: Understand)	-	2	-	-	-	_	_	1	_	_	_	3	_	_	_
CO3. Analyze about software requirements analysis and specification(LOTS: Level 4:Analyse)	-	-	-	2	-	_	_	_	1	_	_	_	_	_	_
CO4: Able to get the knowledge of various software design activities. (LOTS: Level 6: Create)	-	-	2	-	-	3	_	_	_	_	_	_	_	_	_
Level of attainment: PE/CSE/5-T													_	_	_

PHP Programming

General Course Information

Course Code: PE/CSE/6-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: Data Structure & Algorithms

About the Course:

To introduce the necessary knowledge to design and develop dynamic, database-driven web applications using PHP. To understand basics of web programming, POST and GET in form submission. To illustrate how server-side programming works on the web. To analyzehow to Read, write cookies and develop PHP application.

Course Outcomes:

By the end of the course students will be able to:

CO1. Understand principle of Web page design and about types of Websites (LOTS: Level 1:Remember)

CO2. Explain and recognize the basic concept of HTML, CSS, JavaScript and theirapplication in web designing. (LOTS: Level 2: Understand)

CO3. Implement the dynamic web pages with validation using JS object by applying different handling mechanism. (LOTS: Level 3: Apply)

CO4. Develop a simple web application using server-side PHP programming and Database Connectivity using My SQL (LOTS: Level 6: Create)

Course Content

Unit I

HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms. Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties. Introduction to JavaScript: Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes

Unit II

Introduction to PHP, Language Features, PHP Basics, PHP's Supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures, Arrays, Strings and Regular Expressions, Working with the File and Operating System.

Unit III

Handling Html Form With PHP: Capturing Form Data, Dealing with Multi-valuefiled, and Generating File uploaded form, Redirecting a form after submission. Function: What is a function, Define a function, Call by value and Call by reference, Recursive function.

Unit IV

PHP state management: Using query string (URL rewriting), Using Hidden field, Using cookies, Using session. PHP string matching with regular expression: What is regular expression, Pattern matching in PHP, Replacing text, Splitting a string with a Regular Expression. PHP OOPs concepts, Abstract
class, Inheritance, Constructor.

Text and Reference Books:

- Beginning PHP and MySQL,W. Jason Gilmore, Apress, 2010, Fourth Edition
- Head First PHP & MySQL, Lynn Beighley & Michael Morrison, First Edition,O'Reilly.
- Developing Web Applications in PHP and AJAX, Harwani, McGraw Hill
- PHP6 and MySQL, Steve Suehring, Tim Converse and Joyce Park, Wiley India 2010,Second Edition

CO-PO Articulation Matrix Components of Software Engineering Course (PE/CSE/6-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Understand principle of Web page design and about types of Websites (LOTS: Level 1:Remember)	2	2	-	-	3	-	-	1	-	-	-	-	–	–	–
CO2. Explain and recognize the basic concept of HTML, CSS, JavaScript and theirapplication in web designing. (LOTS: Level 2: Understand)	-	2	2	-	-	-	1	-	-	-	-	-	–	–	–
CO3. Implement the dynamic web pages with validation using JS object by applyingdifferent handling mechanism. (LOTS: Level 3: Apply)	-	-	2	-	2	-	-	-	1	-	-	-	–	–	–
CO4. Develop a simple web application using server-side PHP programming and Database Connectivity using My SQL (LOTS: Level 6: Create)	-	-	2	-	2	-	3	-	1	-	-	-	–	–	–
Level of attainment PE/CSE/6-T													–	–	–

Fundamentals of Management

General Course Information

Course Code: HSMC/3-T Course Credits: 3 Type: Humanities and Social Sciences including Management Contact Hours: 3 hours/week Mode: Lecture (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. Class Performance will be measured through percentage of lectures attended (04 marks). Assignments, quiz etc. will have weightage of 06 marks For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units.

Pre-requisites: None

About the Course:
Fundamentals of Management for Engineers is a necessary course for B. Tech. (CSE) graduates wishing to work with organizations in their near future. It helps them acquiring managerial, planning and decision-making skills. This course makes students ready to work in teams as well as play leadership roles.

Course Outcomes: By the end of the course students will be able to:
CO1. **define** fundamental concepts of management (LOTS: Level 1: Remember)
CO2. **explain** the basic principles of management related to planning and decision making,HRM and motivation, and leadership. (LOTS: Level 2: Understand)
CO3. **apply** the managerial skills to solve real world management problems. (LOTS: Level 3:Apply)
CO4. **identify** leadership roles in various scenarios. (LOTS: Level 4: Analyse)
CO5. **evaluate** a business model based on principles of management. (LOTS: Level 5: Evaluate) CO6. **prepare** a plan for a start up in IT sector. (LOTS: Level 6: Create)

Course Content

Unit I
Management Definition: Scope and process of management, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management, Evolution of Management, Scientific and Administrative Management, The Behavioral approach, The Quantitative approach, The Systems Approach, Contingency Approach, IT Approach.

Unit II
Planning and Decision Making: General Framework for Planning, Planning Process, Types of plans, Management by objectives, Development of business strategy.
Decision making and Problem Solving: Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making, Bounded Rationality and Influences on Decision Making, Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

Unit III
Organization HRM and Controls: Organizational Design & Organizational Structures, Delegation, Empowerment, Centralization, Decentralization, Organizational culture, Organizational climate and

Organizational change, Talent management, Talent management Models and strategic human Resource planning; Recruitment and selection; Training and development, Performance Appraisal. Types of controls and controlling Techniques.

Unit IV

Leading and Motivation: Leadership, Power and authority, Leadership styles; Behavioral leadership, Situational leadership, Leadership skills, Leader as mentor and coach, Leadership during adversity and crisis; Handling employee and customer complaints, Team leadership. Motivation: Types of motivation, Relationship between motivation, performance and engagement, Content motivational theories.

Text and Reference Books:

- Robert N Lussier, *Management Fundamentals*, 5th edition, Cengage Learning, 2013.
- Stephen P. Robbins, *Fundamentals of Management*, Pearson Education, 2009.
- Weihrich Koontz, *Essentials of Management*, fifth edition, Tata Mc Graw Hill, 1990.
- Dubrin Andrew, *Management Essentials*, 9th edition, Cengage Learning, 2012.

CO-PO Articulation Matrix Fundamentals of Management Course (HSMC/3-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Define** fundamental concepts of management (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO2. **Explain** the basic principles of management related to planning and decision making, HRM and motivation, and leadership. (LOTS: Level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO3. **Apply** the managerial skills to solve real world management problems. (LOTS: Level 3: Apply)	2		1	_	_	_	_	_	_	_	_	_	_	_	_
CO4. **Identify** leadership roles in various scenarios. (LOTS: Level 4: Analyse).	_	_	_	_	_	_	_	3	3	_	_	_	_	_	_
CO5. **Evaluate** business model based on principles of management.	2	3	2		_	_	_	_	_	_	_	2	_	_	_
CO6. **Prepare** a plan for start-up in IT sector	3	3	3	2	_	3	_	_	_	3	3	_	_	_	_
Level of Attainments HSMC/3-T															

Operating Systems Lab. (UNIX/LINUX)

General Course Information

Course Code: PC/CSE/15-P Course Credits: 1 Type: Professional Core Lab. Course Contact Hours: 2 hours/week Mode: Lab practice and assignments	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA- VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic programming skills.

About the Course:
This lab. course on data science involves a rigorous training on R programming. It incorporates solving problems related to data science in statistical and predictive modelling framework. The objective of the lab course is to equip the students to solve the practical data science problems related to intelligent data analysis using R.

Course Outcomes: By the end of the course students will be able to:
CO1. **apply** commands related to vi and Emacs editors, general utilities and file systems. (LOTS: Level 3: Apply)
CO2. **write** basic shell scripts and use *sed* commands as well as *awk* programming. (LOTS: Level 3: Apply)
CO3. **analyse** the results of memory management and disk management commands. (LOTS:Level 4: Analyse)
CO4. **evaluate** solutions for different operating system problems such as scheduling, memory management and file management. (LOTS: Level 5: Evaluate)
CO5. **create** lab record for assignments that includes problem definitions, design of solutionsand conclusions. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3:Apply)

List of experiments/assignments:

- Study of WINDOWS and Linux operating system (Linux kernel, shell, basic commandspipe & filter commands).
- Study vi editor.
- Administration of LINUX Operating System.
- Writing of Shell Scripts (Shell programming).
- AWK programming.
- Write a C program to simulate different scheduling algorithms
- Write a C program to simulate different file allocation strategies

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet theobjective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Operating System Lab. (PC/CSE/15-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Apply** commands related to vi and Emacs editors, General utilities and file systems. (LOTS: Level 3: Apply)	1	_	_	_	_	_	_	_	_	_	_	_	1	_	_
CO2. **Write** basic shell scripts and use *sed* commands aswell as *awk* programming. (LOTS: Level 3: Apply)	2	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3. **Analyse** the results of memory management anddisk management commands. (LOTS: Level 4: Analyse)	2	2		2	2	_	_	_	_	_	_	_	3	_	_
CO4. **Evaluate** solutions for different operating system problems such as scheduling, memory managementand file management. (LOTS: Level 5: Evaluate)	2	2		2	2	_	_	_	_	_	_	_	3	_	_
CO5. **Create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (LOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6. **Demonstrate** use of ethical practices, self-learningand team spirit. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
Level of Attainments PC/CSE/15-P															

Data Analytics using R Lab.

General Course Information

Course Code: PC/CSE/17-P Course Credits: 1 Type: Professional Core Lab. Course Contact Hours:2 hours/week Mode: Lab. practice and assignments	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA- VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Basic programming skills and knowledge of statistics

About the Course:
This lab. course on data science involves a rigorous training on R programming. It incorporates solving problems related to data science in statistical and predictive modelling framework. The objective of the lab course is to equip the students to solve the practical data science problems related to intelligent data analysis using R.

Course Outcomes: By the end of the course students will be able to:
CO1. **implement** R programming concepts for data analysis. (LOTS: Level 3: Apply)
CO2. **analyse** the trends in data through exploratory data analysis. (LOTS: Level 4: Analyse)
CO3. **evaluate** the results of descriptive and inferential statistics. (LOTS: Level 5: Evaluate)
CO4. **devise** solutions for descriptive and predictive modelling. (LOTS: Level 6: Create)
CO5. **create** lab. Record of assignment solutions that include problem definition, solutions and interpretation of results. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, independent enquiry and self-learning, and team spirit to solve unseen problems. (LOTS: Level 3: Apply)

List of experiments/assignments

- Install R studio and explore its GUI. Explore the base R package- datasets. See the list of datasetsavailable in the package. Write description for the following datasets:
- HairEyeColor
- Iris
- Airquality
- mtcars
- In addition to general description of the dataset, it should include the number of attributes and instances, class of the datasets. It should also include the type of each attribute. Apply *summary()* and *str()* functions to these datasets.
- Three assignment related to creating and manipulating objects like vectors, factors, matrices, lists and data frames.

- Two assignments on the use of control, looping statements and user defined functions.
- Two assignment on finding descriptive statistics and exploratory data analysis.
- Two assignments on making different charts and writing the finding on the basis of these charts.
- Two assignments on hypothesis testing for descriptive and inferential statistics.
- Two assignments on predictive modelling using R packages in groups of two or three studentsdepending on the size of the assignment.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Data Analytics using R Lab. (PC/CSE/17-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Implement** R programming concepts for data analysis. (LOTS: Level 3: Apply)	2	1	-	-	3	_	_	_	_	_	_	_	_	_	2
CO2. **Analyse** the trends in data through exploratory data analysis. (LOTS: Level 4: Analyse)	2	2	-	3	3	_	_	_	_	_	_	_	_	_	3
CO3. **Evaluate** the results of descriptive and inferential statistics. (LOTS: Level 5: Evaluate)	3	3	-	3	3	_	_	_	_	_	_	_	_	_	3
CO4. **Devise** solutions for descriptive and predictive modelling. (LOTS: Level 6: Create)	3	3	1	3	3	_	_	_	_	_	_	_	_	_	3
CO5. **Create** lab. Record of assignment solutions that include problem definition, solutions and interpretation ofresults. (LOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6. **Demonstrate** use of ethical practices, independent enquiry and self-learning, and team spirit to solve unseen problems. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
Level of Attainments PC/CSE/17-P															

Machine Learning Lab.

General Course Information

Course Code: PC/CSE/18-P Course Credits: 1 Type: Professional Core Lab. Course Mode: Lab practice andassignments Contact Hours: 2 hours / week	**Course Assessment Methods (internal: 50; external: 50)** The internal and external assessment is based on the level of participation in lab. sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA- VOCE, the quality of lab. file and ethical practices followed. The internal examination is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Pre-requisites: Programming in Java, Python, R and Octave/MATLAB.

About the Course:
In this lab. Course, students learn to solve optimization, supervised and unsupervised learningproblems using machine learning tools. Students will use machine learning tools available in WEKA, R, Python and Octave etc. The lab experiments involve downloading datasets and applying machine learning techniques on these datasets. The course has a special focus on interpreting and visualizing results of machine learning algorithms.

Course Outcomes: By the end of the course students will be able to:

CO1. **implement** machine learning algorithms using modern machine learning tools.(LOTS: Level 3: Apply)
CO2. **analyse** the trends in datasets using descriptive statistics. (LOTS: Level 4: Analyse)
CO3. **apply** descriptive and predictive modelling. (LOTS: Level 3: Apply)
CO4. **compare and contrast** machine learning algorithms for a given problem. (describe datasets using descriptive statistics. (LOTS: Level 5: Evaluate)
CO5. **create** lab records of assignment by incorporating problem definitions, design ofsolutions, results and interpretations. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3:Apply)

List of experiments/assignments

1. Install WEKA/R/Python/Octave and learn to use these software packages.
2. Two assignments related to classification algorithms and interpreting the results of these algorithms.
3. Two assignments related to clustering algorithms and interpreting the results of these algorithms.
4. Three assignment on designing neural networks for solving learning problems.
5. Two assignment on ranking or selecting relevant features.
6. Two assignments on linear regression and logistic regression.
7. One assignment to be done in groups.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Machine Learning Lab. Course (PC/CSE/18-P)

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	**Implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply)	2	2	2	3	3	–	–	–	–	–	–	–	–	–	3
CO2.	**Analyse** the trends in datasets using descriptivestatistics. (LOTS: Level 4: Analyse)	3	3	2	3	3	–	–	–	–	–	–	–	–	–	3
CO3.	**Apply** descriptive and predictive modelling.(LOTS: Level3: Apply)	3	3	2	3	3	–	–	–	–	–	–	–	–	–	3
CO4.	**Compare and contrast** machine learning algorithms for a given problem. (describe datasetsusing descriptive statistics. (LOTS: Level 5: Evaluate)	3	3	2	3	3	–	–	–	–	–	–	–	–	–	3
CO5.	**Create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (LOTS:Level 6: Create)	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO6.	**Demonstrate** use of ethical practices, self- learning and team spirit. (LOTS: Level 3: Apply)	–	–	–	–	–	–	–	3	3	–	–	3	–	–	–
Level of Attainments PC/CSE/18-P																