Learning Outcomes based Curricular Framework

The Curriculum Book

Bachelor of Technology

Computer Science & Engineering

(Data Science)

4-YEAR PROGRAMME
Choice Based Credit System
w. e. f. 2023-24

Scheme of Examination and Detailed Syllabus

(IIIrd - VIIIth Semester)

Faculty of Engineering and Technology

Chaudhary Devi Lal University

Sirsa-125055

B.Tech. CSE(DS) Credit Scheme – Semester I & II

Table 3(a): Courses' codes, titles, and credits (Group–A)

Course Code	Course Title	Workload/Credit			
	Semester I	Theory	Tutorial	Practical	Total
BSC/1-T BSC/1-T(i) BSC/1-T(iv)	Physics: Introduction to Electromagnetic Theory (ME) Oscillations, Waves and Optics (EE/ECE)	3/3	1/1	-	4/4
BSC/3-T	Mathematics-I	3/3	1/1	-	4/4
ESC/1-T	Basic Electrical Engineering	3/3	1/1	-	4/4
ESC/4-T	Workshop/Manufacturing Practices	3/3	-	-	3/3
BSC/1-P BSC/1-P(i) BSC/1-P(iv)	Physics Lab: Introduction to Electromagnetic Theory (ME) Oscillations, Waves and Optics (EE/ECE)	-	-	4/2	4/2
ESC/1-P	Basic Electrical Engineering Lab	-	-	2/1	2/1
ESC/4-P	Workshop/Manufacturing Practices Lab	-	-	4/2	4/2
MC/1	Induction Training	-	-	-	-
		12/12	**3/3**	**10/5**	**25/20**
	Semester II	Theory	Tutorial	Practical	Total
BSC/2-T	Chemistry	3/3	1/1	-	4/4
BSC/4-T	Mathematics-II	3/3	1/1	-	4/4
ESC/3-T	Programming for Problem Solving	4/4	-	-	4/4
HSMC/1-T	English	2/2	-	-	2/2
MC/2-T	Environmental Science	3/-	-	-	3/-
BSC/2-P	Chemistry Lab	-	-	4/2	4/2
ESC/2-P	Engineering Graphics and Design Lab	-	-	4/2	4/2
ESC/3-P	Programming for Problem Solving Lab	-	-	4/2	4/2
HSMC/1-P	English Lab	-	-	2/1	2/1
Total		**15/12**	**2/2**	**14/7**	**31/21**

Table 3(b): Courses' codes, titles, and credits (Group–B)

Course Code	Course Title	Workload/Credit			
	Semester I	Theory	Tutorial	Practical	Total
BSC/2-T	Chemistry	3/3	1/1	-	4/4
BSC/3-T BSC/5-T	Mathematics-I Mathematics-I (for CSE/IT/AI&ML)	3/3	1/1	-	4/4
ESC/3-T	Programming for Problem Solving	4/4	-	-	4/4
HSMC/1-T	English	2/2	-	-	2/2
BSC/2-P	Chemistry Lab	-	-	4/2	4/2
ESC/2-P	Engineering Graphics and Design Lab	-	-	4/2	4/2
ESC/3-P	Programming for Problem Solving Lab	-	-	4/2	4/2
HSMC/1-P	English Lab	-	-	2/1	2/1
MC/1	Induction Training	-	-	-	-
Total		**12/12**	**2/2**	**14/7**	**28/21**
	Semester II	Theory	Tutorial	Practical	Total
BSC/1-T BSC/1-T(ii) BSC/1-T(v)	Physics: Introduction to Mechanics (for CE) Semiconductor Physics (CSE/IT/AI &ML)	3/3	1/1	-	4/4
BSC/4-T BSC/6-T	Mathematics-II Mathematics-II (for CSE/IT/AI&ML)	3/3	1/1	-	4/4
ESC/1-T	Basic Electrical Engineering	3/3	1/1	-	4/4
ESC/4-T	Workshop/Manufacturing Practices	3/3	-	-	3/3
MC/3-T	Indian Constitution	3/-	-	-	3/-
BSC/1-P BSC/1-P(ii) BSC/1-P(v)	Physics Lab: Introduction to Mechanics (for CE) Semiconductor Physics (CSE/IT/AI&ML)	-	-	4/2	4/2
ESC/1-P	Basic Electrical Engineering Lab	-	-	2/1	2/1
ESC/4-P	Workshop/Manufacturing Practices Lab	-	-	4/2	4/2
Total		**15/12**	**3/3**	**10/5**	**28/20**

B.Tech. CSE(DS) Credit Scheme – Semester III & IV

Semester	Basic Sciences' Courses BSC (BSC/xx-T/P)		Engineering Sciences' Core/ Elective/ Open Courses ESC/ (PC/CDS/ xx -T/P)/ (PE/CDS/ xx -T/P)/ (OE/CDS/ xx -T/P)		Humanities, Social Sciences, Management Courses HSMC (HSMC/xx-T/P)		Mandatory Courses (MC/xx-T/P)		Grand Total Credit
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
III	01	03	07	18	01	02	01	00	23
IV	00	00	10	23	00	00	00	00	23

Courses codes, titles, and credits (Semester- III)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1	BSC/7-T	Mathematics-III	3/3	-/-	-	3/3
2	PC/CDS/31-T	Data Structures and Algorithms	3/3	-/-	-	3/3
3	PC/CDS/32-T	Object Oriented Programming using C++	3/3	-/-	-	3/3
4	PC/CDS/33-T	Statistical Analysis	3/3	-/-	-	3/3
5	PC/CDS/34-T	Computer Organisation and Architecture	3/3	-/-	-	3/3
6	ESC/5-T	Analog Electronic circuits	2/2	-/-	-	2/2
7	**MC/2-T	Environmental Science	3/-	-/-	-	3/-
8	HSMC/2-T	Human Values and Personality Development	2/2	-/-	-	2/2
9	PC/CDS/31-P	Data Structures and Algorithms using C/C++ Lab.	-/-	-/-	4/2	4/2
10	PC/CDS/32-P	Object Oriented Programming using C++ Lab.	-/-	-/-	4/2	4/2
		Total	**22/19**	**-/-**	**8/4**	**30/23**

Courses' codes, titles, and credits (Semester- IV)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1	PC/CDS/41-T	Data Mining Techniques	3/3	-/-	-	3/3
2	PC/CDS/42-T	Computer Networks	3/3	-/-	-	3/3
3	PC/CDS/43-T	Database Management System	3/3	-/-	-	3/3
4	PC/CDS/44-T	Analysis and Design of Algorithms	3/3	-/-	-	3/3
5	PC/CDS/45-T	Software Engineering	3/3	-/-	-	3/3
6	PC/CDS/46-T	Python Programming	3/3	-/-	-	3/3
7	PC/CDS/41-P	Data Mining Techniques Lab.	-/-	-/-	2/1	2/1
8	PC/CDS/42-P	Computer Networks Lab.	-/-	-/-	2/1	2/1
9	PC/CDS/43-P	Database Management System Lab.	-/-	-/-	2/1	2/1
10	PC/CDS/46-P	Python Programming Lab.	-/-	-/-	4/2	4/2
		Total	**18/18**	**-/-**	**10/5**	**28/23**
B.Tech. CSE(DS) student must undergo 6/8-week Summer Industrial Training after VI semester.						
1.	*** EEC/CDS/51-P	Industrial Training/ Internship	-	-	4/2	4/2

**Non-credit qualifying mandatory course. The assessment will be completely internal.

***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 V semester.

Note: Students will be allowed to use non-programmable scientific calculators only, however,sharing of calculator should not be permitted.

B.Tech. CSE(DS) Credit Scheme – Semester V & VI

Semester	**Basic Sciences' Courses BSC (BSC/xx-T/P)**		**Engineering Sciences' Core/ Elective/ Open Courses/ ESC / (PC/CDS/xx-T/P)/ (PE/CDS/xx-T/P)/ (OE/CDS/xx-T/P)**		**Humanities, Social Sciences, Management Courses HSMC (HSMC/xx-T/P)**		**Mandatory Courses (MC/xx-T/P)**		**Industrial Training (EEC/CDS/ xx-P)**		**Gran d Total Credi t**
	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	16	01	02	01	00	01	02	20
VI	00	00	09	23	01	02	00	00	00	00	24

Courses codes, titles, and credits (Semester V)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CDS/51-T	Foundations of Data Science	3/3	-/-	-	3/3
2.	PC/CDS/52-T	R Programming	2/2	-/-	-	2/2
3.	PC/CDS/53-T	Graph Theory	3/3	-/-	-	3/3
4.	PC/CDS/54-T	Cryptography and Network Security	3/3	-/-	-	3/3
5.	OE-I	Open Elective Course to 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/CDS/51-P	Foundations of Data Science Lab	-/-	-/-	2/1	2/1
9.	PC/CDS/52-P	R Programming Lab.	-/-	-/-	2/1	2/1
10.	*** EEC/CDS/51-P	Industrial Training/ Internship	-/-	-/-	4/2	4/2
Total Credit			**19/16**	**-/-**	**8/4**	**27/20**

***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/CDS/61-T	Operating Systems	3/3	-/-	-	3/3
2.	PC/CDS/62-T	Formal Language and Automata Theory	3/3	-/-	-	3/3
3.	PC/CDS/63-T	Artificial Intelligence	3/3	-/-	-	3/3
4.	PC/CDS/64-T	Machine Learning	3/3	-/-	-	3/3
5.	PE/CDS/61-T to PE/CDS/66-T	Professional / Programme Elective Course-I to be opted by students	3/3	-/-	-	3/3
6.	HSMC/3-T	Fundamentals of Management for Engineers	2/2	-/-	-	2/2
7.	OE-II	Open Elective Course to be opted by students from another branch	3/3	-/-	-	3/3
8.	PC/CDS/61-P	Operating Systems Lab. (UNIX/LINUX)	-/-	-/-	2/1	2/1
9.	PC/CDS/63-P	Artificial Intelligence Lab	-/-	-/-	2/1	2/1
10.	PC/CDS/64-P	Machine Learning Lab.	-/-	-/-	4/2	4/2
Total Credit			**20/20**	**-/-**	**8/4**	**28/24**
***A Mini-Project/Training based on open-source tools						

***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.

List of Professional/ Programme Elective Courses -I

1. PE/CDS/61-T: Embedded System Design
2. PE/CDS/62-T: Wireless and Mobile Communications
3. PE/CDS/63-T: Computer Graphics
4. PE/CDS/64-T: Bioinformatics
5. PE/CDS/65-T: Component based software Engineering
6. PE/CDS/66-T: PHP Programming

B.Tech. CSE(DS) Credit Scheme – Semester VII & VIII

Semester	**Basic Sciences' Courses BSC (BSC/xx-T/P)**		**Engineering Sciences' Core/ Elective/ Open Courses ESC / (PC/CDS/xx-T/P)/ (PE/CDS/xx-T/P)/ (OE/CDS/xx-T/P)**		**Humanities, Social Sciences, Management Courses HSMC (HSMC/xx-T/P)**		**Mandatory Courses (MC/xx-T/P)**		**Industrial Training (EEC/CDS/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	
VII	00	00	06	16	00	00	00	00	02	05	22
VIII	00	00	05	11	00	00	00	00	01	06	17

SEMESTER VII

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CDS/71-T	Robotics and Automation	3/3	-/-	-	3/3
2.	PC/CDS/72-T	Knowledge Engineering	3/3	-/-	-	3/3
3.	PE/CDS/71-T to PE/CDS/74-T	Professional/ Programme Elective Course- II tobe opted by students	3/3	-/-	-	3/3
4.	PE/CDS/75-T to PE/CDS/79-T	Professional/ Programme Elective Course- III tobe opted by students	3/3	-/-	-	3/3
5.	OE-III	Open Elective Course to be opted by students from another branch	3/3	-/-	-	3/3
6.	PE/CDS/75-P to PE/CDS/79-P	Professional/ Programme Elective Course- III Lab.	-/-	-/-	2/1	2/1
7.	EEC/CDS/71-P	Major Project-I	-/-	-/-	8/4	8/4
8.	EEC/CDS/72-P	Mini Project using open source tools	-/-	-/-	4/2	4/2
		Total Credits	**15/15**	**-/-**	**14/7**	**29/22**

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

List of Professional/ Programme Elective Course- II

1. PE/CDS/71-T: Software Project Management
2. PE/CDS/72-T: Soft Computing
3. PE/CDS/73-T: Distributed Operating Systems
4. PE/CDS/74-T: Cloud Computing

List of Professional/ Programme Elective Course-III

1. PE/CDS/75-T: Mobile Application Development
2. PE/CDS/76-T: Multimedia Technologies
3. PE/CDS/77-T: Digital Image Processing
4. PE/CDS/78-T: Blockchain Technology
5. PE/CDS/79-T Natural Language Processing

List of Professional/ Programme Elective Course-III (Labs)

1. PE/CDS/75-P: Mobile Application Development (Lab.)
2. PE/CDS/76-P: Multimedia Technologies (Lab.)
3. PE/CDS/77-P: Digital Image Processing (Lab.)
4. PE/CDS/78-P: Blockchain Technology (Lab.)
5. PE/CDS/79-P: Natural Language Processing (Lab.)

SEMESTER VIII

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CDS/81-T	Information Retrieval	3/3	-/-	-	3/3
2.	PE/CDS/81-T To PE/CDS/84-T	Professional/ Programme Elective Course-IV to be opted by students	3/3	-/-	-	3/3
3.	PE/CDS/85-T to PE/CDS/89-T	Professional/ Programme Elective Course-V to be opted by students	3/3	-/-	-	3/3
4.	PE/CDS/81-P to PE/CDS/84-P	Professional/ Programme Elective Course-IV Lab.	-/-	-/-	2/1	2/1
5.	PE/CDS/85-P To PE/CDS/89-P	Professional/ Programme Elective Course- V Lab.	-/-	-/-	2/1	2/1
6.	EEC/CDS/81-P	Major Project-II	-/-	-/-	12/6	12/6
Total Credit			**9/9**		**16/8**	**25/17**

List of Professional/ Programme Elective Course -IV

1. PE/CDS/81-T: Internet of Things
2. PE/CDS/82-T: Network Administration and Management
3. PE/CDS/83-T: Software Testing and Quality Assurance
4. PE/CDS/84-T: Artificial Neural Network

List of Professional/ Programme Elective Course -IV (Labs)

1. PE/CDS/81-P: Internet of Things (Lab.)
2. PE/CDS/82-P: Network Administration and Management (Lab.)
3. PE/CDS/83-P: Software Testing and Quality Assurance (Lab.)
4. PE/CDS/84-P: Artificial Neural Network (Lab.)

List of Professional/ Programme Elective Course -V

1. PE/CDS/85-T: Deep Learning
2. PE/CDS/86-T: Big Data Analytics
3. PE/CDS/87-T: Web Development
4. PE/CDS/88-T: Quantum Computing
5. PE/CDS/89-T: Digital Forensics

List of Professional/ Programme Elective Course -V (Labs)

1. PE/CDS/85-P: Deep Learning (Lab)
2. PE/CDS/86-P: Big Data Analytics (Lab)
3. PE/CDS/87-P: Web Development (Lab)
4. PE/CDS/88-P: Quantum Computing (Lab)
5. PE/CDS/89-P: Digital Forensics (Lab)

LIST OF OPEN ELECTIVES COURSES TO BE OFFERED BY CSE BRANCH / DEPARTMENT TO THE STUDENTS OF OTHER BRANCH/ DEPARTMENT

OE-I: List of Open electives (For V semester):

1. OE/CDS/51-T: Internet & Application
2. OE/CDS/52-T: Introduction to Software Engineering
3. OE/CDS/53-T: Fundamental of Computer Networks
4. OE/CDS/54-T: Fundamentals of Python Programming

OE-II: List of Open electives (For VI semester):

1. OE/CDS/61-T: Basics of Digital Marketing
2. OE/CDS/62-T: Cyber Laws and IPR
3. OE/CDS/63-T: Fundamentals of Information Security
4. OE/CDS/64-T: Big Data
5. OE/CDS/65-T: Introduction to Data Science

OE-III: List of Open electives (For VII semester):

1. OE/CDS/71-T: Basics of Cloud computing
2. OE/CDS/72-T: Introduction to Software Project Management
3. OE/CDS/73-T: Cyber security
4. OE/CDS/74-T: Intelligent Systems
5. OE/CDS/75-T: Basics of Machine Learning

Scheme of Examination
&
Detailed Syllabus of

B.Tech. CSE
(Data Science)

(III - VIII Semester)

Program Specific Outcomes (PSOs)

PSO1 **Developing Computational Systems**: Use principles of electronics and Micro-Processors, various programming languages, data structures, database management systems, computer algorithms, theory of computation and software engineering for designing and implementing computational systems.

PSO2 **Devising Networking Solutions**: Apply the knowledge of systems in the areas related to network technologies, mobile ad hoc and sensor networks, cloud computing, IoT and, information and web security for devising networking solutions.

PSO3 **Doing Data Analytics and Designing Intelligent Systems**: Utilize the approaches and tools of artificial intelligence and soft computing, data analytics and machine learning for designing and working with intelligent systems that can extract valuable information from large amount of data and learn from their environment.

* Programme Outcomes (POs) of Bachelor Programmes in Engineering & Technology have been specified in First Year common curriculum of B.Tech. Programmes.

Course Code	**Definition/ Category**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
MC	Mandatory Audit Courses
PC	Program Core
PE	Program Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)

B.Tech. CSE(DS) Credit Scheme – Semester III & IV

Semester	Basic Sciences' Courses BSC (BSC/xx-T/P)		Engineering Sciences' Core/ Elective/ Open Courses ESC (PC/CDS/ xx -T/P)/ (PE/CDS/ xx -T/P)/ (OE/CDS/ xx -T/P)		Humanities, Social Sciences, Management Courses HSMC (HSMC/xx-T/P)		Mandatory Courses (MC/xx-T/P)		Grand Total Credit
	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
III	01	03	07	18	01	02	01	00	23
VI	00	00	10	23	00	00	00	00	23

Courses codes, titles, and credits (Semester- III)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1	BSC/7-T	Mathematics-III	3/3	-/-	-	3/3
2	PC/CDS/31-T	Data Structures and Algorithms	3/3	-/-	-	3/3
3	PC/CDS/32-T	Object Oriented Programming using C++	3/3	-/-	-	3/3
4	PC/CDS/33-T	Statistical Analysis	3/3	-/-	-	3/3
5	PC/CDS/34-T	Computer Organisation and Architecture	3/3	-/-	-	3/3
6	ESC/5-T	Analog Electronic circuits	2/2	-/-	-	2/2
7	**MC/2-T	Environmental Science	3/-	-/-	-	3/-
8	HSMC/2-T	Human Values and Personality Development	2/2	-/-	-	2/2
9	PC/CDS/31-P	Data Structures and Algorithms using C/C++ Lab.	-/-	-/-	4/2	4/2
10	PC/CDS/32-P	Object Oriented Programming using C++ Lab.	-/-	-/-	4/2	4/2
		Total	**22/19**	**-/-**	**8/4**	**30/23**

Courses' codes, titles, and credits (Semester- IV)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1	PC/CDS/41-T	Data Mining Techniques	3/3	-/-	-	3/3
2	PC/CDS/42-T	Computer Networks	3/3	-/-	-	3/3
3	PC/CDS/43-T	Database Management System	3/3	-/-	-	3/3
4	PC/CDS/44-T	Analysis and Design of Algorithms	3/3	-/-	-	3/3
5	PC/CDS/45-T	Software Engineering	3/3	-/-	-	3/3
6	PC/CDS/46-T	Python Programming	3/3	-/-	-	3/3
7	PC/CDS/41-P	Data Mining Techniques Lab.	-/-	-/-	2/1	2/1
8	PC/CDS/42-P	Computer Networks Lab.	-/-	-/-	2/1	2/1
9	PC/CDS/43-P	Database Management System Lab.	-/-	-/-	2/1	2/1
10	PC/CDS/46-P	Python Programming Lab.	-/-	-/-	4/2	4/2
		Total	**18/18**	**-/-**	**10/5**	**28/23**
B.Tech. CSE(DS) student must undergo 6/8-week Summer Industrial Training after VI semester.						
1.	***EEC/CDS/51-P	Industrial Training/ Internship	-	-	4/2	4/2

**Non-credit qualifying mandatory course. The assessment will be completely internal.
***The students will have to undergo Industrial Training/ Internship for 6-8 week during summer vacations after the examination of VI semester which will be evaluated in V semester.
Note: Students will be allowed to use non-programmable scientific calculators only, however, sharing of calculator should not be permitted.

Detailed Syllabus of B.Tech. CSE(DS) III Semester

Mathematics-III

General Course Information

Course Code: BSC/7-T Course Credits: 3 Type: Basic Sciences Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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: Mathematics I and Mathematics II

About the Course

This is an advanced mathematics course that offers the knowledge of Fourier Series, Fourier Transforms, Functions of Complex Variables. These concepts are essential for students to solve problems in image processing, digital signal processing and other related engineering fields.

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

CO1. **define** concepts and terminology of Fourier Series and Fourier transforms, Functions ofcomplex variables and Power Series etc. (LOTS: Level 1: Remember)

CO2. **solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)

CO3. **apply** principles of functions of complex variables to solve computational problems.(LOTS: Level 3: Apply)

CO4. **compare** various concepts related to Fourier transforms and functions of complex variables. (LOTS: Level 4: Analyse)

CO5. **select** suitable method for given computational engineering problems and related domain. (LOTS: Level 4: Evaluate)

CO6. **integrate** the knowledge of Fourier Series and Fourier transforms, Functions of complex variables, and Power Series for solving real world problems. (LOTS: Level 6: Create)

Course Content

Unit I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosineseries.

Unit II

Fourier integrals, Fourier transforms, shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transformof Dirac delta function.

Linear Programming Problem (LPP): Introduction; Formulation of linear programming problem (LPP); Graphical method for its solution; Standard form of LPP; Basic feasible solutions; Simplex Method and Dual Simplex Method for solving LPP.

Unit III

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity.

Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions.

Unit IV

Complex integral, Cauchy Gaursat theorem (without proof), Cauchy integral formula (without proof), Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes and singularities of complex functions, Residues. Evaluation of real integrals using residues (around unit and semi-circle only).

Text and Reference Books:

1. F. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2015.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 1965.
3. R. K. Jain, S.R.K. Iyenger. *Advance Engineering. Mathematics*, 4th edition, NarosaPublishing House, 2012.
4. Michael D. Greenberg, *Advanced Engineering Mathematics*, 2nd edition, PearsonEducation, 2002.
5. Johnson and Miller *Probability and statistics for Engineers*, 8th edition, Pearson EducationIndia, 2015.

CO-PO Articulation Matrix Mathematics-III (BSC/7-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	-	-	-	-	-	-	-	-	-	-	-	2	2	2
CO2.	2	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO3.	2	2	2	2	-	-	-	-	-	-	-	-	3	2	3
CO4.	3	3	2	3	-	-	-	-	-	-	-	-	3	2	3
CO5.	3	3	2	3	-	-	-	-	-	-	-	-	3	2	3
CO6.	3	3	2	3	-	-	-	-	-	-	-	-	2	2	3
3 - High, 2-Medium, 1-Low															

Data Structures and Algorithms

General Course Information

Course Code: PC/CDS/31-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 examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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

About the Course:

Data Structure and Algorithms is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces data structures like arrays, linked lists, trees and graphs etc. and various operations to be implemented on these data structures for solving real world problems. It includes various sorting and searching algorithms as well. Further, it incorporates complexity analysis of algorithms implemented on various data structures.

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

CO1. **describe** various types of data structures and operations that can be implemented onthese data structures. (LOTS: Level 1: Remember)

CO2. **demonstrate** the use of various data structures and their related operations. (LOTS:Level 2: Understand)

CO3. **apply** data structure to solve computational problems. (LOTS: Level 3: Apply)

CO4. **compare** the suitability of alternative data structures and prescribed operations forvarious problem situations. (LOTS: Level 4: Analyse).

CO5. **defend** solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems. (LOTS: Level 5: Evaluate)

Course Content

Unit I

Introduction to data structures and their types, Abstract data types, Linear lists: Arrays and linked lists: memory representations, implementing operations like traversing, searching, inserting and deleting etc. Applications of arrays and linked lists. Representing sets and polynomials using linked lists.

Unit II

Stack and Queue: Static and linked implementations, Operations and Applications. Circular queues, Tress, Binary trees and related terminology, Tree traversals (Recursive), Threaded Binary Trees, Binary Search Trees implementation and operations, Priority queues.

Unit III

Height Balanced or AVL trees and B trees. Graph definitions and related terminology, memory representations and related operations (traversal, insertion, deletion, search), Path Matrix, Warshall's Shortest path algorithm Hashing, Hash tables, hash function and collision resolution.

Unit IV

Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Count sort, Heap sort, Comparison of searching and sorting techniques based on their complexity analysis, Time and space complexity of algorithms: Asymptotic analysis, Big O, Omega, Theta notations.

Text and Reference Books:

1. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., *Data Structures and Algorithms*, Addison-Wesley, 1983.
2. LangsamYedidyah, Augenstein J Moshe, Tenenbaum M Aaron, *Data Structures using Cand C++*, 3rdedition, PHI, 2009.
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., *Introduction to Algorithms*,MIT Press, 2009.
4. Robert L. Kruse, *Data Structure and Program Design in C*, Pearson Education India,2007.
5. Weiss, M. A., *Data Structures and Algorithm Analysis in C++*, Addison-Wesley, 2007.
6. Sahni, S., *Data Structures, Algorithms, and Applications in C++*, WCB/McGraw-Hill,2001.

CO-PO Articulation Matrix Data Structures and Algorithms Course (PC/CDS/31-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2.	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3.	2	2	-	-	2	-	-	-	-	-	-	-	3	2	2
CO4.	2	2	-	-	-	-	-		-	-	-	-	3	2	2
CO5.	3	3	-	1	-	-	-	-	-	-	-	-	3	2	2
3 –High, 2-Medium, 1-Low															

Object Oriented Programming using C++

General Course Information

Course Code: PC/CDS/32-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 examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are tobe 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: Knowledge of computer fundamentals and problem-solving using C programming

About the Course:

Objected Oriented Programming using C++ is an essential course for every graduate in Computer Science and Engineering. This course introduces the Object-Oriented concepts such asdata encapsulation, data hiding, data abstraction, reusability, exception handling etc., and their implementation using C++.

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

CO1. **List** the concepts related to object-oriented paradigms. (LOTS: Level 1: Remember)
CO2. **Distinguish** between structured and object-oriented approaches to programming.(LOTS: Level 2: Understand)
CO3. **Apply** object-oriented constructs for problem solving. (LOTS: Level 3: Apply)
CO4. **Detect** logical and run time errors and suggest appropriate modifications. (LOTS: Level4: Analyze)
CO5. **Justify** the design of a program for a given problem. (LOTS: Level 5: Evaluate)
CO6. **Design** solutions to programming problems using multiple object-oriented programming constructs together. (LOTS: Level 6: Create)

Course Content

Unit I

Introduction to object-oriented programming, C++ standard library, basics of a typical C++ environment, illustrative simple C++ programs, new features of ANSI C++ standard, OOPs concepts: Information hiding, encapsulation, data abstraction, access modifiers, controlling access to a class level, method, or variable (public, protected, private, block level, scope and mutable), other modifiers. Structure of class and struct in memory, accessing members of structures, Class scope and accessing class members, separating interface from implementation, pre-processors directives, macro programs, header files and namespaces, default constructors, chained constructor, default arguments with constructors, constant object and const member functions, object as member of class, use of destructors, virtual destructors, function overloading.

Unit II

Inline function, friend function and friend classes, using this pointer, dynamic memory allocationwith new and delete, static class members, polymorphism concepts, overloading, overriding methods, abstract classes, reusability, class's behaviors, inheritance, base classes and derived classes, protected members, casting base-class pointers to derived-class pointers, using member functions, overriding base-class members in a derived-class, public, protected and private inheritance, using constructors and destructors in

derived classes, implicit derived-class object to base- class object conversion, composition vs. inheritance.

Unit III

Virtual functions, abstract base classes and concrete classes, new classes and dynamic binding, virtual destructors, fundamentals of operator overloading, restrictions on operators overloading, operator functions as class members vs. as friend functions, overloading, <<, >> overloading unary operators, overloading binary operators. I/O Streams, files handling, creating a sequential access file, reading data from a sequential access file, updating sequential access files, random access files, creating a random-access file, writing data randomly to a random-access file.

Unit IV

Managing Console I/O, stream input/output classes and objects, stream output, stream input, unformatted I/O (with read and write), stream manipulators, exception handling, basics of C++ exception handling(try, throw, catch), rethrowing an exception, specific exception, processing unexpected exceptions, exception handling in constructors and destructors, inheritance with exception introduction to generic classes, function templates, overloading template functions, class template, non-type parameters.

Text and Reference Books:

1. H. M. Deitel and P. J. Deitel, *C++ How To Program*, 6th Ed., Prentice Hall, 2008.
2. Robert Lafore, *Object-Oriented Programming in C++*, 3rd Ed., Sams Publishing, 2001.
3. D. Ravichandran, *Programming with C++*, 3rd Ed., T.M.H, 2011.
4. E. Balagurusamy, *Object oriented Programming with C++*, 6th Ed., Tata McGraw-Hill,2013.
5. Horstmann, *Computing Concepts with C++ Essentials*, 3rd Ed., John Wiley, 2003.
6. Herbert Schildt , *The Complete Reference in C++*, 5th Ed., TMH, 2012.

CO-PO Articulation Matrix Object Oriented Programming Using C++ Course (PC/CDS/32-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2.	1	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3.	2	1	-	-	2	-	-	-	-	-	-	-	3	-	-
CO4.	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5.	2	3	-	-	-	-	-	-	1	-	-	-	3	-	-
CO6.	3	3	1	-	2	-	-	-	1	-	-	-	3	-	-
3 –High, 2-Medium, 1-Low															

Statistical Analysis

General Course Information

Course Code: PC/CDS/33-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 probability

About the Course:

It is important to know essentials of statistics to become a successful data analyst or researcher. This course is tailored to introduce the graduating engineering to the fundamentals of statistics so that they can analyze data and draw inference from it.

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

CO1. **define** basic tools of data analysis. (LOTS: Level 1: Remember)
CO2. **explain** the concepts given in descriptive and inferential statistics (LOTS: Level 2:Understand)
CO3. **apply** statistical concepts to solve real world statistical computing problems. (LOTS:Level 3: Apply)
CO4. **analyse** the trends in data using descriptive statistics. (LOTS: Level 4: Analyse)
CO5. **interpret** and evaluate statistical models. (LOTS: Level 5: Evaluate)
CO6. **conclude** the findings of statistical analysis. (LOTS: Level 6: Create)

Course Content

Unit I

Review of Descriptive Statistics and Probability Theory: Scale of measurement and data types, mean, median, mode, variance and standard deviation of sample data, Sample spaces and events, Conditional Probability, Bayes Theorem, Binomial Theorem.

Unit II

Random Variable and Distributions: Random variables, type of random variables, discrete uniform distribution, Bernoulli's distribution, Binomial distribution, Poisson's distribution, Continuous uniform distribution

Unit III

Hypothesis Testing: determining levels of significance, Testing of Hypothesis -Type I and Type II errors, classification of hypothesis tests. Hypothesis testing for Test of significance for large & small samples: test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations Sampling Distributions: t- test, Chi-square, Analysis of variance (ANOVA).

Unit IV

Statistical Learning and Linear Regression: Definition of statistical learning, Estimating a function f, The trade of between prediction accuracy and model comprehensibility, Regression versus Classification problems, Introduction to Linear Regression between variables and Multiple linear regression.

Text and Reference Books:

1. Ross Sheldon M., *Introduction to Probability and Statistics for Engineers andScientists*, 4th

edition,Academic Press, 2009.
2. Douglas S. Shafer and Zhang Zhiyi, *Beginning Statistics*, 2012. [Available freely onlineunder Creative Commons by-nc-sa 3.0 license]
3. Brain S. Everitt, *A Handbook of Statistical Analysis Using R*, Second Edition, LLC 2014
4. Roger D. Peng, *R Programming for Data Science*, Lean Publishing, 2015.
5. Michael J. Crawley, *Statistics, An introduction using R*, Second edition, John Wiley,2015
6. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of StatisticalLearning: DataMining, Inference and Prediction*, Springer, 2nd edition, 2009.

CO-PO Articulation Matrix Statistical Analysis Course (PC/CDS/33-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3.	2	2	2	2	3	_	_	_	_	_	_	_	_	_	3
CO4.	2	3	2	3	3	_	_	_	_	_	_	_	_	_	3
CO5.	2	2	2	3	3	_	_	_	_	_	_	_	_	_	3
CO6.	2	3	2	3	_	_	_	_	_	_	_	_	_	_	3
3 –High, 2-Medium, 1-Low															

Computer Organisation and Architecture

General Course Information

Course Code: PC/CDS/34-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions each of marks 2. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Digital Electronics and computer systems.

About the Course:

Computer Architecture and organization describes the role of instruction set architecture in digital computer, main memory, and input/output devices. It illustrates the simple data path and control design for processors. It helps to understand the different operations and concept of instructions. It would enable the students to learn the basic function and architecture of modern computer systems.

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

CO1. **outline** the general concepts of digital electronics and computer organisation and architecture. (LOTS: Level 1: Remember)
CO2. **discuss** the basic components and their interfacing. (LOTS: Level 2: Understand)
CO3. **apply** instructions for performing different operations. (LOTS: Level 3: Apply)
CO4. **analyse** the effect of addressing modes on the execution time of a program. (LOTS:Level 4: Analyse)
CO5. **contrast** different types of memory. (LOTS:Level 5: Evaluate)
CO6. **Design of** simple computer with different instruction sets. (LOTS: Level 6: Create)

Course Content

Unit I

Basic Principles: Boolean algebra and Logic gates, Combinational logic blocks (Adders, Subtractors, Multiplexers, Encoders, decoders, demultiplexers, K-Maps), Sequential logic blocks (Flip-Flops, Registers); Flynn's classification of computers (SISD, MISD, MIMD); CPU Architecture types: computer register, (accumulator, register, stack, memory/ register).

Unit II

Computer Organization: Store program control concept, Instruction codes, instruction cycle; type of instructions: memory reference, register reference, I/O reference; Basics of Logic Design, accumulator logic, micro-instruction formats.

Unit III

Instruction Set Architecture & Parallelism: Instruction set based classification of processors (RISC, CISC, and their comparison); Stack Organization, Instruction Formats; addressing modes: register, immediate, direct, indirect, indexed, Types of interrupts; Introduction to Parallelism: Goals of parallelism, Instruction level parallelism (pipelining, super scaling –basic features); Processor level parallelism.

Unit IV

Memory Hierarchy & I/O Techniques: The need for a memory hierarchy, Cache, main memory and

secondary memory, Main memory (Semiconductor RAM & ROM organization, memory expansion, Static & dynamic memory types); Cache memory (Associative & direct mapped cache organizations, mode of transfer, DMA (Direct memory transfer).

Text and Reference Books:

1. Mano, M. Morris, *Digital Logic and Computer Design*, Prentice Hall of India Pvt. Ltd.,1981.
2. M. Morris Mano, *Computer System Architecture*, Prentice Hall of India Pvt. Ltd., 1993.
3. Milles J. Murdocca, Vincent P. Heuring, *Computer Architecture and Organization, An Integrated Approach*, JohnWiley & Sons Inc., 2007.
4. William Stallings, 10th edition, *Computer Organization and Architecture*, Prentice Hall,2016.
5. Heuring, V.P., Jordan, H.F., *Computer Systems Design and Architecture*, AddisonWesley,1997.
6. R.P Jain, *Modern Digital Electronics*, 3rd Edition, Tata McGraw Hill, 2003.

CO-PO Articulation Matrix Computer Organization and Architecture Course (PC/CDS/34-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2.	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3.	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4.	2	2	-	1	-	-	-	-	-	-	-	1	3	-	-
CO5.	2	2	-	1	-	-	-	-	-	-	-	1	3	-	-
CO6.	3	2	-	-	2	-	-	-	-	-	-	-	3	-	-
3 –High, 2-Medium, 1-Low															

Analog Electronic circuits

General Course Information

Course Code: ESC/5-T Course Credits: 2 Type: Engineering Sciences' Courses Contact Hours: 2 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), andend semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It willcontain seven short answers type questions each of marks 2. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites: Digital Electronics and computer systems.

About the Course:
Computer Architecture and organization describes the role of instruction set architecture in digital computer, main memory, and input/output devices. It illustrates the simple data path and control design for processors. It helps to understand the different operations and concept of instructions. It would enable the students to learn the basic function and architecture of modern computer systems.

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

CO1. **Students** will be able to define the behavior of semiconductor devices. (LOTS: Level 1: Remember)
CO2. **describe** the current flow of a bipolar transistor in CB, CE and configurations. (LOTS: Level 2: Understand)
CO3. **illustrate** the biasing of transistors. (LOTS: Level 3: Apply)
CO4. **solve** the problems using the basic knowledge gained on electronic systems. (LOTS:Level 4: Analyse)
CO5. **examine** simple oscillator circuits and OP-AMP. (LOTS:Level 5: Evaluate)

Course Content

Unit I

Semi-Conductors and Diodes: Introduction, Insulators, semiconductors and metals, Mobility and conductivity, Intrinsic and extrinsic semiconductors, Charge density, PN junction diode- Characteristics and analysis, Rectifiers: Half wave rectifier, Full wave rectifier, bridge rectifier and their analysis, Types of diodes- Zener Diode, LED, varactor diode.

Unit II
Transistors: Construction and characteristics of BJT, Transistor configuration: CB, CE, CC configuration, Transistor biasing and bias stabilization: Operating point, Stability factor, Analysis of fixed bias, collector to base bias, Emitter resistance bias circuit and self-bias circuit.

Unit III

Oscillators: Introduction, Types of Oscillators, Barkhausen criterion, Hartley oscillator, Colpitt oscillator, RC-phase shift oscillator, Wein bridge oscillator. Regulated Power Supplies: Series and shunt voltage regulators, three terminal fixed IC voltage regulator (78xx/79xx), adjustable voltage regulator (LM 317), SMPS.

Unit IV

Op-Amp: Block diagram, Op-Amp equivalent circuit and its analysis, Non-Inverting/Inverting op-amp, OP-AMP characteristics, integrator and differentiator, summing amplifier.

Text and Reference Books:

1. Integrated devices & Circuits by Millman & Halkias, McGraw Hill.
2. Electronics Devices and Circuit Theory by Robert L. Boylestad, Pearson.
3. Electronics Devices and Circuits-II by A.P.Godre& U.A. Bakshi.
4. Electronics Devices and Circuit by G.K. Mithal.

CO-PO Articulation Matrix Analog Electronic Circuits Course (ESC/5-T)

Course Outcomes	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	1	1	1	---	---	2	---	---	---	---	2	---	2	1
CO2.	3	---	2	2	---	1	2	1	1	---	1	2	---	2	1
CO3.	2	3	2	1	---	1	2	---	1	1	1	2	---	2	1
CO4.	2	3	3	3	3	2	1	1	2	1	1	2	---	2	1
CO5.	2	3	3	3	3	2	1	1	2	1	1	2	---	2	1
3 –High, 2-Medium, 1-Low															

Environmental Science

General Course Information

Course Code: MC/2-T Course Credits: 0 Type: Mandatory Courses Contact Hours: 03 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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 and its Outcomes:

This is a mandatory course to enhance the knowledge, skills and attitude of the graduating engineers to the environment. By studying this course students will understand our natural environment and its relationship with human activities.

Course outcomes: By the end of the course a student will be able to:

CO1. **state** the environment related issues and challenges in sustainable development

CO2. **demonstrate** the understanding of various environment hazards and means of protectionagainst these hazards. (LOTS: Level 2: Understand)

CO3. **apply** irreplaceable tool to provide first-hand knowledge on various environmentalaspects in the entire learning process. (LOTS: Level 3: Apply)

CO4. **analyze** impacts of human business and developmental activities on the environment.(LOTS: Level 4: analyze)

CO5. **design** and evaluate strategies for sustainable management of environmental eco-systems.(LOTS: Level 6: design)

Course content

Unit-I 9

Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness; Concept, Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem ,Ecological succession ,Food chains, Food webs and ecological pyramids; Introduction, types, characteristics features, structure and function of Forest ecosystem, Grassland ecosystem ,Desert ecosystem, Aquatic ecosystem (Ponds, Stream, lakes, rivers, oceans, estuaries); Biodiversity: Introduction, Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values; Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-II

Renewable and non-renewable resources, Natural resources and associated problems ,Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people; Water resources: Use and over utilization of surface and ground water, floods, droughts conflicts over water, dams benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources; Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water

logging, salinity; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: Land as a resource, land degradation, main induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for suitable lifestyle.

Unit-III

Definition of Environment Pollution; Causes, effects and control measures of: Air Pollution, Water Pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes effects and control measures of urban and industrial wastes; Role of and individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies; different laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation, Public awareness

Unit-IV

Social issues and the Environment: From unsustainable to Sustainable development, Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problem and concern, case studies; Environment ethics: Issues and possible solutions; Wasteland reclamation; Consumerism and waste products; Human Population growth, variation among nation, Population explosion- Family Welfare Programme, Environment and human health , Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Field Work: Visit to a local area to document environmental assets- river/forest/ grassland/hill/mountain; Study of simple ecosystems – ponds, river, hill slopes etc; Study of common plants, insects, birds; Visit to a local polluted site- Urban/Rural/Industrial/Agricultural.

Text and Reference Books:

1. Erach Bharucha, *Environmental Studies for Undergraduate Courses*, University presspvt. Ltd. (India), 2005.
2. Dr. D. D. Mishra, *Fundamental concepts in Environmental studies*, S. Chandpublications, 2008.
3. Dr. S. V.S. Rana, *Essentials of Ecology and Environmental Science*, PHI Learning Pvt.Ltd Delhi, 2013.
4. Anil Kumar De, *Environmental Chemistry*, Wiley Eastern Limited, 1994.
5. T. G. Miller, *Environmental Science*, Wadsworth Publishing Co, 13th4edition, 2013.
6. P. D. Sharma, *Ecology and Environment*, Rastogi publications, 13th edition, 2003.

CO-PO Articulation Matrix Environmental Science (MC/2-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
CO2.	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–
CO3.	–	–	–	–	3	–	–	–	–	–	–	2	–	–	–
CO4.	1	2	–	–	–	2	–	3	–	3	–	–	–	–	–
CO5.	1	2	2	–	–	–	3	–	3	–	2	–	–	–	–
3 –High, 2-Medium, 1-Low															

Human Values and Personality DevelopmentGeneral Course Information

General Course Information

Course Code: HSMC/2-T Course Credits: 2 Type: Humanities and Social Sciences Contact Hours: 02 hours/week Mode: Lectures) Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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 develop a holistic perspective based on self-exploration and co- existence in society and nature. The focus is on to understand harmony and being in harmony with the society and the environment around us. The students will nurture a habit of self-reflection and courage to act. This course includes practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

Course Outcomes: By the end of the course students will be able to:
CO1: **exhibit** awareness about oneself, one's surroundings and goals in one's life.
CO2: **stay** in harmony with society and nature.
CO3: **develop** healthy and harmonious relationships.
CO4: **work** in groups and develop team spirit.
CO5: **exhibit** leadership qualities.
CO6: **excel** in personal and professional life.

Course Content

Unit I
Understanding the concept of self. Exploration of self with JOHARI-Window. Self-Esteem, Characteristics of individuals with low and high self-esteem. Self Confidence, strategies of building self-confidence.
Personality: Definition &Types & Traits; Relevance and Importance of nature and nurture in the development ofpersonality.

Unit II
Nature of Socialization; Socialization Process, Contributions to Society and Nation. Importance of discipline andhard work. Ecologically responsibility of Engineers.
Professional Ethics: Competencies in professional values and ethics
Personal and Professional Excellence: Identifying long term choice and goals.

Unit III
Importance of Interpersonal relationships: Role and relationships, Maintaining healthy relationships. Importance andSteps to improve Interpersonal Communication.
Meaning and nature of teams, Internal and external factors affecting team building. Leadership Meaning, Nature and functions. leadership styles in organization. Meaning and nature of stress, causes, effect and

management.

Unit IV

Meaning and importance of human rights, Human right awareness.

Harmony in nature, understanding coexistence, harmony at all levels of coexistence, Human being as cause of imbalance in nature, Understanding the concept of happiness and well-being. Role and importance of positive emotions, Gratitude, hope and optimism.

Text and Reference Books:

1. Bates, A. P. and Julian, J.: Sociology - Understanding Social Behaviour.
2. Dressler, David and Cans, Donald: The Study of Human Interaction.
3. Pestonjee, D.M, Pareek, Udai, Agarwal Rita; Studies in Stress And its Management
4. Organizational Behaviour, Davis, K.
5. Hoover, Judhith D. Effective Small Group and Team Communication, 2002, Harcourt College Publishers
6. Dick, McCann &Margerison, Charles: Team Management, 1992 Edition, viva books
7. Pestonjee, D.M.; Stress and Coping: The Indian Experience
8. Clegg, Brian; Instant Stress Management – Bring calm to your life now.

CO-PO Articulation Matrix: Human Values and Personality Development (HSMC/2-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	-		-	-	-	-	-	2	-	-	-	3	_	_	_
CO2.	-	-	-	-	-	2	3	2	1	-	-	2	_	_	_
CO3.	-	-	-	-	-	-	-	2	2	2	-	2	_	_	_
CO4.	-	-	-	-	-	-	-	-	3	2	-	1	_	_	_
CO5.	-	-	-	-	-	-	_	-	3	-		-	_	_	_
CO6.	-	-	-	-	-	-	-	-	-	2	-	-	_	_	_
3 –High, 2-Medium, 1-Low															

Data Structures and Algorithms using C/C++Lab.

General Course Information

Course Code: PC/CDS/31-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: Programming in C language.

About the Course:
This lab. course involves implementation of basic and advance data structures and various operations on these data structures. The objective of the lab course is to train the students to solve the problems related to data structures and choose the appropriate data structure for solvingcomputational problem efficiently.

Course Outcomes: By the end of the lab course a student would be able to:

CO1. **Implement** various data structures and the related operations. (LOTS: Levels 3:Apply)
CO2. **Analyse** space and time complexity of algorithms. (LOTS: Level 4: Analyse)
CO3. **Compare** solutions on the basis of the appropriateness of data structure used and theefficiency of the operations implemented. (LOTS: Level 5: Evaluate)
CO4. **Integrate** knowledge of data structures to solve real world problems related to datastructure and algorithms. (LOTS: Level 6: Create)
CO5. **Create** written records for the given assignments with problem definition, design ofsolution and conclusions. (LOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices while solving problems individually or in groups(LOTS: Level 3: Apply).

List of experiments/assignments

1. Two assignments related to creating and manipulating matrices and linear lists.
2. Two assignments associated with linked list, operations on linked lists and theirapplications.
3. Two assignments on array and linked implementation of stacks and queues.
4. Two assignments on trees and their applications.
5. Two assignments on graphs and their applications.
6. Two assignments on different searching and sorting methods along with their complexityanalysis.
7. One assignment on challenging problems on data structures to be given 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 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 Data Structures and Algorithms Lab. Course (PC/CDS/31-P)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	-	-	-	1	-	-	-	2	-	-	-	3	-	-
CO2.	2	2	-	-	1	-	-	-	1	-	-	-	3	-	-
CO3.	2	2	-	-	1	-	-	-	1	-	-	-	3	-	-
CO4.	3	2	3	-	-	-	-	-	3	-	-	-	3	-	-
CO5.	-		-	-	-	-	-	-	-	3	-	-	-	-	-
CO6.	-		-	-	-	-	-	3	-	-	-	3	-	-	-
3 –High, 2-Medium, 1-Low															

Object Oriented Programming using C++ Lab.

General Course Information

Course Code: PC/CDS/32-P Course Credits: 2 Type: Professional Core Lab.Course Contact Hours: 4hours/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: Problem solving using C Lab.

About the course:

The lab course provides the opportunity to students to solve problems using Object Oriented Framework in C++ language. This includes implementing the concepts of data abstraction, data hiding, and encapsulation, reuse of code and, compile and runtime polymorphism.

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

CO1. **implement** problems with object-oriented framework. (LOTS: Level 3: Apply)
CO2. **analyse** the structure of programs for modular design. (LOTS: Level 4: Analyse)
CO3. **evaluate** robustness of a program by testing it on test/use cases. (LOTS: Level 5:Evaluate)
CO4. **design** class hierarchies for implementing inheritance/polymorphism. (LOTS: Level6: Create)
CO5. **create** a lab record of assignments including problem definitions, design of solutionsand conclusions. (LOTS: Level 6: Create)
CO6. **demonstrate** ethical practices and solve problems individually or in a group. (LOTS:Level 3: Apply)

List of assignments

1. A CPP using Static data member and static member function to record the occurrences of the entire object.
2. A CPP to calculate square and cube of a number using inline functions and macros. (Demonstrate the use of inline functions compared to macros).
3. A CPP to find the area of a rectangle, a triangle and surface area of a sphere using function overloading.
4. A CPP to show that “for each object constructors are called separately” and read the values through keyboard (Use Constructor).
5. A CPP to implement multiple inheritances for multiplication of two numbers.
6. A CPP to overload unary and binary operator using operator function with friend function.
7. A CPP to write and read text in a file. Also show the Use of ofstream and ifstream classes.
8. A CPP using Constructor in Derived classes to initialize alpha, beta and gamma and display corresponding values
9. A CPP to display roll number, marks obtained of students in two subjects, sports weight, and total score of students using Virtual base class
10. A CPP for invoking function that generates Exception, rethrows the exception, have multiple catch blocks.
11. A CPP to use Multiple Constructor in a class for displaying complex value.
12. A CPP to illustrate the use of a Vector Class Template for performing the scalar product of int type vector and float type vector.
13. A CPP to implement runtime polymorphism.

Note:

The experiments/assignments may vary from session to session and will be designed by the course coordinator. The assignments must meet the objective of the course and the levels of the given course outcomes. The course coordinator will provide the schedule for submission of the assignment.

CO-PO Articulation Matrix Object Oriented Programming using C++ Lab. (PC/CDS/32-P)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	-	-	1	-	-		2	-	-	2	3	-	-
CO2.	2	2	-	-	2	-	-	-	-	-	-	-	3	-	-
CO3.	2	2	-	-	2	-	-	-	-	-	-	-	3	-	-
CO4.	3	-	1	-	2	-	-	-	-	-	-	2	3	-	-
CO5.	-	-	-	-	-	-	-		-	3	-	-	-	-	-
CO6.	-	-	-	-	-	-	-	3	3	-	-	3	-	-	-
3 –High, 2-Medium, 1-Low															

Detailed Syllabus of B.Tech. CSE(DS) IV Semester

Data Mining Techniques

General Course Information

Course Code: PC/CDS/41-T Course Credits: 3 Type: Professional Core Contact Hours: 3 Mode: Lecture (L) Examination Duration: 3 Hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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: Knowledge of database systems, elementary knowledge of statistics and probability.

About the Course:

Today's era is the era of information. Data is growing exponentially day by day. There is a need to process and analyses the data to extract knowledge from it, so that one can use that knowledge for decision making. This course provides introductory concepts of data mining and data warehousing. The course will be taught with a database as well as machine learning perspectives. The objective of the course is to provide a comprehensive understanding of data mining tasks and evaluation of results obtained out of data mining processes.

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

CO1. **outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level1: Remember)

CO2. **explain** association of patterns, data mining functionalities, tasks of data mining. (LOTS: Level2: Understand)

CO3. **apply** various classification, clustering correlation and association mining for extracting valuable information from data. (LOTS: Level 3: Apply)

CO4. **evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate)

CO5. **plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level6: Create)

Course Content

Unit I

Introduction to Data Mining: Kind of data to be mined, Data Mining Functionalities, Technologies used in DataMining, Applications of data Mining, Major Issues in Data Mining.

Data Warehouse: Introduction, Data Warehouse and Database Systems, Data Warehouse Architecture, DataWarehouse Models, Data Cube and OLAP, Multidimensional data Model, Concept Hierarchies, OLAP operations

Pattern Mining: Mining Frequent Patterns, Associations and Correlations, Frequent Itemset Mining using A priori Algorithm, Generating Association Rules from Frequent Itemset. Pattern Growth Approach for Mining FrequentItemset, Pattern evaluation Methods.

Unit II

Classification: Introduction, Classification using Decision Tree Induction, Bayesian Classification Methods, RuleBased Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy.

Introduction to advanced classifiers: k-Nearest Neighbor, Support Vector Machine, Artificial Neural Network.

Unit III

Cluster Analysis: Introduction, overview of Basic Clustering Methods, Partitioning Methods: k-mean, k-medoids, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, Balanced Iterative Reducing and Clustering using Hierarchies (BIRCH), Chameleon: Multiphase Hierarchical Clustering Using Dynamic Modeling, Probabilistic Hierarchical Clustering, Density-based methods: DBSCAN, OPTICS, DENCLUE, Grid-based Methods: STING, CLIQUE, Evaluation of Clustering.

Unit IV

Outlier Detection: Introduction, types of outliers, challenges of outlier detection. Outlier detection methods: statistical approaches, proximity-based approaches, clustering based approaches, classification-based approaches, Outlier detection in high dimensional data.

Text and Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufmann Publishers,Third Edition, July 2011.
2. Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw Hill, 2004.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2014.
4. K. P. Soman, Shyam Diwakar and V. Ajay, Insight into Data Mining Theory and Practice, Easter Economy Edition, Prentice Hall of India, 2009.
5. G. K. Gupta, Introduction to Data Mining with Case Studies, Prentice Hall of India, 2006.
6. Daniel T. Larose, Data Mining Methods and Models, Wiley, 2006.
7. W. H. Inman, Building the Data Warehouse, Wiley India, 2005

CO-PO Articulation Matrix: Data Mining Techniques (PC/CDS/41-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	2	_	_	_	_	_	_	_	_	1	_
CO2.	1	_	_	_	3	_	_	_	_	_	_	_	_	2	_
CO3.	2	1	_	_	3	_	_	_	_	_	_	_	_	3	_
CO4.	3	2	2	3	3	_	_	_	_	_	_	_	_	3	_
CO5.	3	3	3	3	3	_	_	_	_	_	_	_	_	3	_
3 –High, 2-Medium, 1-Low															

Computer Networks

General Course Information

Course Code: PC/CDS/42-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 examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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 partsof 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 fromeach of the four units.

Pre-requisites: Basic knowledge of Digital and Analog Communication.

About the Course:

This course has been designed with an aim to provide students with an overview of the concepts and fundamentals of data communication and computer networks. The learner is given an opportunity to grasp various algorithms for routing of data, forwarding data and switching the data from hop to hop. Layered Architecture adds value to the subject contents.

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

CO1. **outline** various models, topologies and devices of Computer Networks. (LOTS: Level1: Remember)
CO2. **explain** the functions of various layers in Network Reference Model. (LOTS: Level 2: Understand)
CO3. **apply** different network concepts in various network communication protocols. (LOTS:Level 3: Apply)
CO4. **analyse** performance of various protocols in different scenarios. (LOTS: Level 4:Analyse)
CO5. **design** network for an organisation. (LOTS: Level 6: Create)

Course content

Unit I

Data communication: Components, Data representation and Data flow; Network: Uses, Topologies, Network Services, OSI and TCP/IP Reference Models; Network categories: LAN, MAN, WAN, Wireless Transmission Media, Switching Techniques: Circuit Switching, Packet Switching, Message Switching, Networking Devices**:** Hubs, Repeaters, Bridges, Modems, Switches, Routers, and Gateways.

Unit II

Data Link Layer-design issues, Framing & Error Handling: Framing Protocols, Error detection and correction mechanisms; Flow Control Protocols: Stop-and-wait, Sliding Window protocols: Go-back-N and Selective Repeat; Medium Access sub layer: Channel allocation methods, Multiple Access Communication: Random Access-ALOHA, Slotted-ALOHA, CSMA, CSMA- CD.
LAN Standards: Ethernet, Fast Ethernet & Gigabit Ethernet.

Unit III

Network Layer-Design issues, store and forward packet switching connection less and connection-oriented networks, Routing algorithms: Shortest path, flooding, Distance Vector Routing, Link State routing. Internetworking: IPV4 and IPV6, IP Addressing (Classful Addressing, Classless Addressing, Sub-netting), ARP, RARP, ICMP.

Unit IV

Transport Layer: Transport layer Services: Addressing, Multiplexing, Flow control, Buffering and Error control. Internet Transport Protocols: UDP, TCP, TCP Segment, TCP Connection.
Application Layer: Introduction to DNS, FTP, TELNET, HTTP, SMTP, Electronic Mail, WWWand Multimedia.

Text and Reference Books:

1. Andrew S Tanenbaum, *Computer Networks*, 5th Edition, Pearson publications, 2010.
2. Forouzan, *Data Communication and networking* ,5th Edition, Tata McGrawHill, 2012.
3. William Stalling, *Data & Computer Communication* 6th edition, LPE Pearson Education,2013.
4. Todd Lammle, *CCNA Study Guide*, 6th Edition, 2013.
5. RFCs and Internet Drafts available from Internet Engineering Task Force.

CO-PO Articulation Matrix Computer Networks Course (PC/CDS/42-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2.	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3.	2	1	-	-	2	-	-	-	-	-	-	-	-	3	-
CO4.	2	2	2	1	2	-	-	-	-	-	-	-	-	3	-
CO5.	3	2	2	-	2	-	-	-	-	-	-	-	-	3	-
3 –High, 2-Medium, 1-Low															

Database Management System

General Course Information

Course Code: PC/CDS/43-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/weekMode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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.

Prerequisite: Knowledge of UNIX, Windows, a programming language and data structures

About the Course:
This course includes a detailed coverage of principles of database design and models. Studentslearn querying a database using SQL, normalization techniques, transaction processing etc.

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

CO1. **describe** fundamental elements of Database Management System. (LOTS: Level 1: Remember)
CO2. **discuss** principles of relational Database modelling. (LOTS: Level 2: Understanding)
CO3. **apply** SQL for designing queries for Relational Databases. (LOTS: Level 3: Apply)
CO4. **contrast** various concurrency control and recovery techniques with concurrenttransactions in DBMS. (LOTS: Level 5: Evaluate)
CO5. **design** models of databases using ER modelling and normalization for real lifeapplications. (LOTS: Level 6: Create)

Course Content

Unit I

Overview: Overview of File Systems and Database Systems, Characteristics of the Data Base Approach, Database users, Advantages and Disadvantages of a DBMS, Responsibility of Database Administrator.

Data Base Systems Concepts and Architecture: DBMS architecture and various views of Data, Data Independence, Database languages, Data Models: Relational Database Model, Hierarchical Data Model, Network Data Model, Schemas and Instances.

Unit II

E-R Model: Entity Types, Attributes & Keys, Relationships, Roles and Structural Constraints, E- R Diagrams, Reduction of an E-R Diagram to Tables. Relational Model and Query Language: Overview of Relational Database, Key Integrity Constraints, Relational Algebra, Relational Calculus, SQL fundamentals, Basic Operators, Missing information and NULL values.

Unit III

Relational Database Design: Overview of normalization, Database Anomalies, Candidate and Super Key, Functional Dependencies, Integrity Constraints, Decomposition, Normal forms: First, Second, Third Normal, Boyce Codd, Normal Form, Multi-valued Functional Dependenciesand Fourth Normal Form, Join Dependencies and Fifth Normal Form, Denormalization.

Unit IV

Concurrency Control Techniques: Overview of database Transactions, Transaction states, ACID properties of a Transaction, Transaction Recovery, Serializability, Concurrency Control, Locking Techniques, Time-stamp ordering, Multi-version Techniques, Deadlock, Recovery Techniques in centralized DBMS.

Text and Reference Books:

1. Elmasri, R., and Navathe, S. B., *Fundamentals of Database Systems*, 3rd Edition, AddisonWesley, 2002.
2. Silberschatz, A., Korth, H. F., and Sudarshan, S., Database *System Concepts,* McGrawHill, 2011.
3. Pannerselvam R., *Database Management Systems*, 2nd Edition, PHI Learning, 2011.
4. Desai, B. C., *An Introduction to Database System*, Galgotia Publication, 2010.
5. Leon, A., and Leon, M., *Database Management Systems*, Ist Edition, Vikas Publishing,2009.
6. Mata-Toledo, R., Cushman, P., Sahoo, D., *Database Management Systems*, Schaums'Outline series, TMH, 2007.

CO-PO Articulation Matrix Database Management System Course (PC/CDS/43-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	--	--	--	--	--	--	--	--	--	--	--	3	--	--
CO2.	1	--	--	--	--	--	--	--	--	--	--	--	3	--	--
CO3.	1	--	--	_	2	--	--	--	--	--	--	--	3	--	--
CO4.	1	2	--	--	--	--	--	--	--	--	--	--	3	--	--
CO5.	3	2	3	1	2	--	--	--	--	--	--	--	3	--	--
3 –High, 2-Medium, 1-Low															

Analysis and Design of AlgorithmsGeneral Course Information

Course Code: PC/CDS/44-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 examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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: Knowledge of Data Structure and a Programming Language

About the Course:
This Course focus on effective and efficient design of algorithms. In this course various algorithm design techniques and their analysis is to be studied. After studying this course, a student is expected to apply better techniques for solving computational problems efficiently andprove it analytically.

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

CO1. **state** terminology and concepts algorithmic techniques. (LOTS: Level 1:Remember)
CO2. **discuss** various algorithmic techniques. (LOTS: Level 2: Understand)
CO3. **apply** appropriate algorithmic techniques to solve computational problems.(LOTS: Level 3: Apply)
CO4. **analysing** algorithms for their efficiency by determining their complexity.(LOTS: Level 4: Analyse)
CO5. **compare** the pros and cons of applying the different algorithmic techniquesto solve problems. (LOTS: Level 5: Evaluate)
CO6. **formulate** efficient and effective algorithmic solutions for different real-world problems. (LOTS: Level: 6 Create)

Course Content

Unit I
Algorithms, Algorithms as a technology, Insertion sort, analyzing algorithms, asymptotic notations, Divide and Conquer: General method, binary search, merge sort, quick sort, Strassen‟s matrix multiplication algorithms and analysis of algorithms for these problems.

Unit II
Sorting and Data Structures: Heapsort, Hash Tables, Red and Black Trees, Greedy Method: General method, knapsack problem, minimum spanning trees, single source paths and analysis ofthese problems.

Unit III
Dynamic Programming: General method, matrix chain multiplication, longest common subsequence,
Back Tracking: General method, 8 queen's problem, graph colouring, Hamiltonian cycles, Analysis of these problems.

Unit IV
Branch and Bound: Method, O/I knapsack and traveling salesperson problem, NP Completeness:Polynomial time, NP-complete problems.

Text and Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronalde L. Rivest, Clifford Stein, *Introductionto Algorithms*, MIT press, 3rd Edition, 2009.
2. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekaran, *Fundamental of ComputerAlgorithms*, Galgotia publication Pvt. Ltd., 1999.
3. S. Dasgupta, C. Papadimitriou, and U. Vazirani, *Algorithms*, McGraw-Hill HigherEducation, 2006.

CO-PO Articulation Matrix Analysis and Design of Algorithms Course (PC/CDS/44-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	--	--	--	--	--	--	--	--	--	--	--	2	--	--
CO2.	1	--	--	--	--	--	--	--	--	--	--	--	3	--	--
CO3.	2	--	1	--	--	--	--	--	--	--	--	--	3	2	2
CO4.	3	2	1	--	2	--	--	--	--	--	--	--	3	2	2
CO5.	3	2	1	--	--	--	--	--	--	--	--	--	3	2	2
CO6.	3	3	2	2	--	--	--	--	--	--	--	--	3	2	2
3 –High, 2-Medium, 1-Low															

Software Engineering

General Course Information

Course Code: PC/CDS/45-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 examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 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: Knowledge of algorithms, flow charts and a programming language.

About the Course:

Software Development is generally a quite complex and time-consuming process. Moreover, depending on the nature and complexity of the software requirements, Software Engineering plays an important role. This course will help the students to understand the systematic approach to requirement analysis, design, development, operations and maintenance of software systems. Besides this, it also guides students in developing the optimal software systems.

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

CO1. **define** the various concepts related to software engineering. (LOTS: Level 1:Remember)
CO2. **demonstrate** the use of stages of various Software Life Cycle Models. (LOTS: Level 2: Understanding)
CO3. **apply** the Software Requirement Analysis and Software Design Process. (LOTS: Level3: Apply)
CO4. **analyse** the size, cost, complexity, reliability, quality and maintenance of a softwaresystem. (LOTS: Level 4: Analyse)
CO5. **construct** software model according to the requirements of a customer. (LOTS: Level6: Create)

Course Content

Unit I

Introduction: Software Crisis, Software Process, Evolution of Software Engineering, Software Characteristics, Software Metrics and SDLC. Software Life Cycle Models: Water Fall Model, Increment Process Model, Evolutionary Process Models, Unified Process. Selection of Life Cycle Model.
Software Requirements, Analysis and Specifications: Requirement Engineering, Requirements Elicitation, Requirements Analysis: Data Flow Diagram, Data Dictionary, Entity-Relationship Diagrams, Decision Table, Decision Tree and Structured Charts. Requirements Documentation and Requirements validation.

Unit II

Software Project Management: Size Estimation, Cost Estimation, Constructive Cost Model (COCOMO), Putnam Resource Allocation Model. Software Risk Management: Software Risks, Risk Identification, Risk Mitigation, Monitoring, and Management, RMMM Plan.

Unit III

Software Design: Software Design Fundamentals, Design Principles, Strategy of Design, Function Oriented Design, and Object-Oriented Design, IEEE Recommended Practice for Software Design Descriptions.
Software Quality: Basic Concepts, ISO 9126, McCall's Quality Factors, Software Quality Assurance, SQA Activities, ISO 9000 Quality Standards, and CMM.

Unit IV

Software Testing: Testing fundamentals, Verification and Validation, Test Plan, Test Case, Levels of Software Testing: Unit Testing, Integration Testing, Top Down and Bottom-up TestingIntegration Testing, Alpha and Beta Testing, System Testing, White Box Testing and Black Box Testing, Debugging and Software Testing Tools.

Maintenance and Reengineering**:** Software Maintenance, Software Supportability,Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering.

Text and Reference Books:

1. K. K. Aggarwal and Yogesh Singh, *Software Engineering*, 3rd Edition, New AgeInternational Publishers Ltd., Reprint 2014.
2. Roger S. Pressman, *Software Engineering: A Practitioners Approach* 7th Edition, McGraw Hill Education, 2014.
3. Rajib Mall, *Fundamental of Software Engineering*, Prentice Hall India, 2004.
4. Pankaj Jalote, *An integrated Approach to Software Engineering*, 3rd Edition, Narosa Publications, 2014.
5. Ian Sommerville, *Software Engineering*, 10th Edition, Addison-Wesley, 2015.
6. Carlo Ghezzi, Mehdi Jazayeri and Dino Mandrioli, *Fundamentals of SoftwareEngineering*, 2nd Edition, Pearson, 2007.
7. Waman S Jawadekar, *Software Engineering-Principles and Practice*, Tata McGraw-Hill,2004.

CO-PO Articulation Matrix Software Engineering Course (PC/CDS/45-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	1	1	_	2	_	_	_	_	_	2	_	3	_	_
CO4.	2	3	2	_	2	_	_	_	_	2	2	_	3	_	_
CO5.	3	3	2	_	3	_	_	_	2	2	3	_	3	_	_
3 –High, 2-Medium, 1-Low															

Python Programming

General Course Information

Course Code: PC/CDS/46-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. **analyse** the results of data analysis or machine learning programs (LOTS: level 4: Analyse)
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, 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 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 Matplotlib: Python for Data Visualization, Visualization Section.

Text and Reference Books:

- Ashok Namdev Kamthane, *Programming and Problem Solving with Python*, Mc GrawHill EducationPublication, 2018.
- John Guttag, *Introduction to Computation and Programming using Python*, Springer,Revised andExpanded 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 Structuresand Algorithmsin Python*, Wiley, 2016.
- Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2013.
- Reema Thareja, *Python Programming Using Problem Solving Approach* , OxfordPublications, 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/CDS/46-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	2
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3.	3	2		2	_	3	_	_	_	_	_	_	_	_	3
CO4.	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO5.	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO6.	3	3	2	3		3	_	_	_	_	_	_	3		3
3 –High, 2-Medium, 1-Low															

Data Mining Techniques Lab.

General Course Information

Course Code: PC/CDS/41-P Course Credits: 1 Type: Professional CoreLab. 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:

The objective of this lab is to enable students to use tools for applying advanced data reduction, classification and clustering techniques.

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

CO1. **apply** advanced data mining algorithms. (LOTS: Level 3: Apply)
CO2. **usages** of modern data mining tools such as WEKA, R/Python packages. (LOTS: Level 3: Apply)
CO3. **evaluate** the performance of data mining models. (LOTS: Level 5: Evaluate)
CO4. **design** advanced data mining experiments. (LOTS: Level 6: Create)
CO5. **create** lab assignment record that includes problem definitions, solutions, results and conclusions.(HOTS: Level 6: Create).
CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/ assignments:

1. Five assignments on advanced classification algorithms (Advanced Classifiers).
2. Five assignments on clustering problems
3. Four assignments on data reduction and attribute selection
4. Two assignments on discovering association rules.

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 Mining Techniques Lab. (PC/CDS/41-P)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	3	_	3	_	_	_	_	_	_	_	_	3	_
CO2.	1	-	_	_	3	_	_	_	_	_	_	_	_	3	_
CO3.	3	2	_	_	3	_	_	_	_	_	_	_	_	3	_
CO4.	3	3	_	3	3	_	_	_	_	_	_	_	_	3	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	3	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Computer Networks Lab.

General Course Information

Course Code: PC/CDS/42-P Course Credits: 1 Type: Professional CoreLab. 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: knowledge of programming, digital and analog communication.

About the Course:

This course has been designed with an aim to provide students with an overview of the concepts and fundamentals of data communication and computer networks. Students learn about various topologies, network devices, routing protocols, firewall amongst other features and devices of Computer Networks.

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

CO1. **demonstrate** various network topologies and networking devices. (LOTS: Level: 3:Apply)
CO2. **justify** a particular routing protocol for any implemented data communication networks.(LOTS: Level: 5: Evaluate)
CO3. **construct** a network and implement various network protocols. (LOTS: Level: 6:Create)
CO4. **devise** solutions for various routing and switching problems in Computer Networks.(LOTS: Level: 6: Create)
CO5. **create** lab records for the solutions of the assignments. (LOTS: Level: 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level: 3: Apply)

List of Experiments/assignments:

1. Familiarization with networking components and devices: LAN Adapters - Hubs - Switches - Routers etc.
2. Familiarization with transmission media and Tools: Co-axial cable - UTP Cable - Crimping Tool - Connectors etc.
3. Installation and introduction of simulation tools PacketTracer/ GNS3.
4. Preparing the UTP cable for cross and direct connections using crimpingtool.
5. Introduction to various interior and exterior routing protocols.
6. Configuration of RIP protocol on routers to configure a network topology.
7. Implementation EIGRP protocol on router.
8. Implementation OSPF protocol on a larger network.
9. Configuration of ARP protocol in network.
10. Configuration of a wireless device in simulated environment.
11. Implementation BGP protocol between two different networks.
12. Implementation of static routing in simulation environment.
13. Configuration of TELNET protocol on router for remote access.
14. Configuration of access lists on network to stop unwanted traffic on network.
15. Configuration of zone-based firewall in network.

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 Computer Networks Lab. (PC/CDS/42-P)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	_	_	_	_	_	_	_	_	_	_	_	3	_
CO2.	2	2	2	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	2	3	3	_	2	_	_	_	_	_	_	_	_	3	_
CO4.	3	3	3	3	3	_	_	_	_	_	_	_	_	3	_
CO5.	_	_	_	_	_	_	_	_	_	3	--	--	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Database Management System Lab.

General Course Information

Course Code: PC/CDS/43-P Course Credits: 1 Type: Professional CoreLab. 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: Exposure to a programming language, MS Access.

About the Course:

This lab. course on DBMS involves a rigorous training on Oracle programming. It provides a strong formal foundation in database concepts, technology and practice to the students to groom them into well-informed database application developers. The objective of the lab course is to develop proficiency in the execution of commands of the database design and query using Oracle.

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

CO1. **implement** database problems using Oracle DML/DDL commands. (LOTS: Level 3:Apply)
CO2. **enforce** integrity constraints on a database using a state-of-the-art RDBMS. (LOTS:Level 3: Apply)
CO3. **analyse** the design of a relational database. (LOTS: Level 4: Analyse)
CO4. **design** a relational database for a given schema. (LOTS: Level 6: Create)
CO5. **create** lab assignment record that includes problem definitions, solutions, results andconclusions. (LOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments:

1. Use oracle software and login with valid user id and password. Explore its GUI andpractice some basic commands of it.
2. Three assignments related to creation of database with tables having different fields anddatatypes.
3. Two assignments on the creation of table with different types of constraints.
4. Two assignments on insert, delete and modify records from the tables.
5. Two assignments on modifying the table using the alter command.
6. Two assignments on exploring select statement using various clauses like where, orderby, group by, having and aggregate functions.
7. Two assignments on the use of set operations to query the tables.
8. Two assignments on creating joins and views on the tables.
9. One assignment on generating sub-queries.

Note:

The actual experiments/assignments will be designed by the course coordinator. Oneassignment 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 Database Management System Lab. (PC/CDS/43-P)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	1		_	2	_	_	_	_	_	_	_	3	_	_
CO2.	2	2	_	_	2	_	_	_	_	_	_	_	3	_	_
CO3.	3	3	1	_	2	_	_	_	_	_	_	_	3	_	_
CO4.	3	3	2	3	3	_	_	_	_	_	_	_	3	_	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Python Programming Lab.

General Course Information

Course Code: PC/CDS/46-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 ofapplications. 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: Level3: 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 toperform 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 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 Python Programming Lab. Course (PC/CDS/46-P)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	1	_	_	3	_	_	_	_	_	_	_	_	_	3
CO2	2	3	_	3	3	_	_	_	_	_	_	_	_	_	3
CO3.	3	3	1	3	3	_	_	_	_	_	_	_	_	_	3
CO4.	3	3		3	3	_	_	_	_	_	_	_	_	_	3
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

B.Tech. CSE(DS) Credit Scheme – Semester V & VI

Semester	Basic Sciences' Courses BSC (BSC/xx-T/P)		Engineering Sciences' Core/ Elective/ Open Courses ESC (PC/CDS/xx-T/P)/ (PE/CDS/xx-T/P)/ (OE/CDS/xx-T/P)		Humanities, Social Sciences, Managementt Courses HSMC (HSMC/xx-T/P)		Mandatory Courses (MC/xx-T/P)		Industrial Training (EEC/CDS/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	16	01	02	01	00	01	02	20
VI	00	00	09	22	01	02	00	00	00	00	24

Courses codes, titles, and credits (Semester V)

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CDS/51-T	Foundations of Data Science	3/3	-/-	-	3/3
2.	PC/CDS/52-T	R Programming	2/2	-/-	-	2/2
3.	PC/CDS/53-T	Graph Theory	3/3	-/-	-	3/3
4.	PC/CDS/54-T	Cryptography and Network Security	3/3	-/-	-	3/3
5.	OE-I	Open Elective Course to 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/CDS/51-P	Foundations of Data Science Lab	-/-	-/-	2/1	2/1
9.	PC/CDS/52-P	R Programming Lab.	-/-	-/-	2/1	2/1
10.	***EEC/CDS/51-P	Industrial Training/ Internship	-/-	-/-	4/2	4/2
Total Credit			**19/16**	**-/-**	**8/4**	**27/20**

***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/CDS/61-T	Operating Systems	3/3	-/-	-	3/3
2.	PC/CDS/62-T	Formal Language and Automata Theory	3/3	-/-	-	3/3
3.	PC/CDS/63-T	Artificial Intelligence	3/3	-/-	-	3/3
4.	PC/CDS/64-T	Machine Learning	3/3	-/-	-	3/3
5.	PE/CDS/61-T to PE/CDS/66-T	Professional / Programme Elective Course-I to be opted by students	3/3	-/-	-	3/3
6.	HSMC/3-T	Fundamentals of Management for Engineers	2/2	-/-	-	2/2
7.	OE-II	Open Elective Course to be opted by students from another branch	3/3	-/-	-	3/3
8.	PC/CDS/61-P	Operating Systems Lab. (UNIX/LINUX)	-/-	-/-	2/1	2/1
9.	PC/CDS/63-P	Artificial Intelligence Lab	-/-	-/-	2/1	2/1
10.	PC/CDS/64-P	Machine Learning Lab.	-/-	-/-	4/2	4/2
Total Credit			20/20	-/-	8/4	28/24
***A Mini-Project/Training based on open-source tools						

***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.

List of Professional/ Programme Elective Courses -I

7. PE/CDS/61-T: Embedded System Design
8. PE/CDS/62-T: Wireless and Mobile Communications
9. PE/CDS /63-T: Computer Graphics
10. PE/CDS/64-T: Bioinformatics
11. PE/CDS /65-T: Component based software Engineering
12. PE/CDS/66-T: PHP Programming

Detailed Syllabus of B.Tech. CSE(DS) V Semester

Foundations of Data Science

General Course Information

Course Code: PC/CDS/51-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: Student should have a fundamental understanding of Fundamentals of Programming Languages (C, C++, and Java & Python) and a strong mathematical foundation.

About the Course:
This course involves studying the concept of data science and data science life cycle. Moreover, students learn about the techniques for generating quality data inputs.

Course Outcomes: By the end of the course students will be able to:
CO1. To understand the concept of data science and data science life cycle (LOTS: Level 1: Remember)
CO2. To apply the pre-processing techniques for generating quality data inputs (LOTS: Level 2: Understand)
CO3. To analyse the concept and parameters of exploratory data analytics (LOTS: Level 3: Apply)
CO4. To develop the regression models using data science and analytics process (LOTS: Level 3: Apply)
CO5. To analyse various tools and techniques of data visualization (LOTS: Level 4: Analyse)
CO6. handling data, encoding, tools apply, and types of data visualization (LOTS: Level 6: Create)

Course Content

Unit I
Evolution of Data Science, Introduction to Data Science – Types of Data, Data Science Vs Big Data, Concept of Big Data, Concept of Data Warehousing, Introduction to Data Mining, Role of Data Scientist, Data Science Life Cycle, Data Science Roles – Data Science Project Stages – Data Science Applications in Various Fields – Data Security Issues, thinking in a structured way to solve data science problem statements.

Unit II
Need of Data Pre-processing,Pre-processing of data and data collection, Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization, Data Storage, and management,Data preparation with Sandbox for analytics.Introduction to Data Analytics/Concept of Data Analytics Types of Data Analytics, Descriptive Statistics, Mean, Standard Deviation, Skewness, and Kurtosis, Box Plots, Pivot Table, Heat Map , Correlation Statistics , ANOVA , Exploratory Data Analytics, Confidence (statistical) intervals; variances and correlations

Unit III
Simple and Linear Regression – Visual Model Evaluation – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – In-sample Evaluation Measures – Prediction and Decision Making

Unit IV
Metrics for Out-of-Sample Evaluation Error – Cross Validation – Overfitting – Under fitting and Model Selection – Ridge Regression Prediction – Grid Search Testing Multiple Parameters Data handling /Data

wrangling using Python Definition, Types of visualization, data visualization, Data types, Data encoding , mapping variables , Conventional data visualization tools, Techniques for visual data representations, Types of data visualization

Text and reference books:

1.G. Strang . Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA, 2016.
2. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA, 2010
3. Montgomery, D. C. and G. C. Runger. Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011.
4. David G. Luenberger . Optimization by Vector Space Methods, John Wiley & Sons (NY), 1969.
5. Cathy O'Neil and Rachel Schutt . Doing Data Science, O'Reilly Media, 2013.
6.Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.
7.Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.
8. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

CO-PO Articulation Matrix Foundations of Data Science Course (PC/CDS/51-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	-	_	_	_	_
3 –High, 2-Medium, 1-Low															

R Programming

General Course Information

Course Code: PC/CDS/52-T Course Credits:2 Type: Professional Core 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-requisite: Knowledge of C programming is required, basic understanding of Statistics & Data Structure

About the Course:

This course involves studying the concept of R programming. Moreover, students learn about the techniques for techniques for using R language.

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

CO1. To install, Code and Use R Programming Language in R Studio IDE to perform basic tasks on Vectors, Matrices and Data frames. (LOTS: level 1: Understand)

CO2. To describe key terminologies, concepts and techniques employed in Statistical Analysis. (LOTS: level 2: Understand)

CO3. To define, Calculate, Implement Probability and Probability Distributions to solve a wide variety of problems. (LOTS: level 3: Apply)

CO4. To conduct and Interpret a variety of Hypothesis Tests to aid Decision Making. (LOTS: level 4: Analyse)

CO5. To understand, Analyse, Interpret Correlation and Regression to analyse the underlying relationships Between different variables. (LOTS: level 5: Evaluate)

CO6. Understand the concept of structured query language , xml and function. (LOTS: level 6: Create)

Unit I

Introduction: What exactly is R? R and R-Studio, Installation, R-Studio, Overview Functioning in the Console Arithmetic, Operators, Logical Procedures Making Use of Functions, Obtaining Assistance in R and Leaving R-Studio, Operators, variables in R: Variables, Numeric, Characteristic, and Logical Data, Vectors, Data Frames, Factors, Numeric, Character, and Factor Vector Sorting.

Unit II

Control Statements: If, if…else statement, if else () function, switch function, repeat loop, while loop, for loop, break statement, next statement, while loops, for loops, R Plot, R Line, R Bars

Unit III

Data Types in R: Creating Vectors, accessing elements of a Vector, Operations on Vectors, Vector Arithmetic, creating matrices, accessing matrices' elements Matrices operations, transpose a matrix Creating strings, copying, and pasting Using format to format integers and strings manipulation of strings Creating and modifying lists, as well as manipulating list elements combining lists, converting lists to vectors, Arrays are created, and array elements are accessed. Calculations between array components, data frame creation Data frame operations, data frame access, and data frame manipulation Putting together data frames from a variety of sources

Unit IV

Data Visualization: Data visualization need and visualize data through various plots and charts(bar chart, histogram,scatterplot,box plot).

Text and Reference Books:

1. Peng, R.D. (2020). R Programming for Data Science.

2. R in Action, By - Robert L. Kabacoff, Latest Edition – Second

3. R for Data Science , Hadley Wickham and Garrett Gorlemund, Latest Edition – First Publisher - O'Reilly

4. Phillips, N.D. (2018). YaRrr, The Pirate's Guide to R.

5. Grolemund, G. and Wickham, H. (2019). R for Data Science

CO-PO Articulation Matrix R Programming Course (PC/CDS/52-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

Graph Theory

General Course Information

Course Code: PC/CDS/53-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 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 on these 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 of proofs. (LOTS: Level 5: Evaluate)
CO5. **sketch** the graph to solve any problem in pictorial and easy representation. (LOTS: Level 6: 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 ofPlanar 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 of India, 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 (PC/CDS/53-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	1	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2.	2	1	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	3	1		2	_	_	_	_	_	_	2	3	_	_
CO4.	3	2	2	3	2	_	_	_	_	_	_	2	3	_	_
CO5.	3	_	1	2	2	_	_	_	_	_	_	2	3	_	_
3 –High, 2-Medium, 1-Low															

Cryptography and Network Security

General Course Information

Course Code: PC/CDS/54-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 i
nto 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, terminology and background, 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, Hill Cipher. Cryptanalysis of Classical Cryptosystems.

Unit II
Mathematical Foundations: Elementary Number theory, Finite fields, Groups and Subgroups, Number theory: Divisibility, gcd, prime numbers, primality testing. Congruences, solution of congruences, Chinese remainder theorem, Fermat and Euler's theorem, Modular Arithmetic.

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-Hall International, 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/CDS/54-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	3	3	2	2	2	_	_	_	_	_	_	_	_	3	_
CO4.	2	2	2	3	3	_	_	_	_	_	_	_	_	3	_
CO5.	3	3	2	3	3	_	_	3	_	3	_	_	_	3	_
CO6.	3	3	2	3	3									3	_
3 –High, 2-Medium, 1-Low															

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 about the 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 IV

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/2-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3.	2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO4.	3	2	2	3	3	-	-	-	2	-	-	3	-	-	-
CO5.	3	_	3	3	_	_	3	-		3	3	3	-	-	-
3 –High, 2-Medium, 1-Low															

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. **recognise** 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 Materialis m: Charvak School of Thought

Unit II

Sufism and Sufi saints, Kabir, Nanak and Guru Jambheshwar ji Maharaj etc., CompositeCulture of Indian sub-continent.

Unit III

Jyotirao Phule and Savitri Bai Phule and other 19th Century Social Refor 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-Continentbefore, 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, Vol2, 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 theFootstepsof 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 casteprotestin nineteen century, Western India, Camridge 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, AzimPrem JiUniversity, 2014.

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

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	-	1		-	-		-	-	-	-	-	1	-	-	-
CO2.	-	2	1	-	-	3	-	-	-	-	-	1	-	-	-
CO3.	-	3	3	2	-	3	-	-	-	-	-	3	-	-	-
CO4.	-	2	3	3	-	3	1	-	-	-	-	3	-	-	-
CO5.	-	3	3	3	-	3	-	-	-	-		3	-	-	-
3 –High, 2-Medium, 1-Low															

Foundations of Data Science Lab

General Course Information

Course Code: PC/CDS/51-P Course Credits: 1 Type: Professional Core Lab. Course Mode: Lab practice and assignments 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: Student should have a fundamental understanding of Fundamentals of Programming Languages (C, C++, and Java & Python) and a strong mathematical foundation.

About the Course:
This course involves studying the concept of data science and data science life cycle. Moreover, students learn about the techniques for generating quality data inputs.

Course Outcomes: By the end of the course students will be able to:
CO1. To understand the concept of data science and data science life cycle (LOTS: Level 1: Remember)
CO2. To apply the pre-processing techniques for generating quality data inputs (LOTS: Level 2: Understand)
CO3. To analyse the concept and parameters of exploratory data analytics (LOTS: Level 3: Apply)
CO4. To develop the regression models using data science and analytics process (LOTS: Level 3: Apply)
CO5. To analyse various tools and techniques of data visualization (LOTS: Level 4: Analyse)
CO6. handling data, encoding, tools apply, and types of data visualization (LOTS: Level 6: Create)

List of experiments/assignments

1 Determine the need for data science and use Python's built-in data types and techniques to tackle basic challenges.
2 Using the OOP paradigm, create an application with user-defined modules and packages. Install, configure and run Hadoop and HDFS
3 Use NumPy arrays for efficient storage and data operations.
4. Use Python Data Structures, Intrinsic NumPy objects, and Random Functions to create NumPy arrays.
5. NumPy array manipulation (indexing, slicing, reshaping, joining, and splitting).
6. Using Universal Functions and Mathematical Methods to compute on NumPy arrays
7. Import any CSV file into a Pandas Data Frame and run the following commands:
(a) Visualize the first and last 10 records
(b) Determine the shape, index, and column details
(c) Select/Delete records (rows)/columns based on circumstances
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 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 Foundations of Data Science Lab Course (PC/CDS/51-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	-	_	_	_	_
3 –High, 2-Medium, 1-Low															

R Programming Lab.

General Course Information

Course Code: PC/CDS/52-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-requisite: Knowledge of C programming is required, basic understanding of Statistics & Data Structure

About the Course:
This course involves studying the concept of R programming. Moreover, students learn about the techniques for techniques for using R language.

Course Outcomes: By the end of the course students will be able to:
CO1. To install, Code and Use R Programming Language in R Studio IDE to perform basic tasks on Vectors, Matrices and Data frames. (LOTS: level 1: Understand)
CO2. To describe key terminologies, concepts and techniques employed in Statistical Analysis. (LOTS: level 2: Understand)
CO3. To define, Calculate, Implement Probability and Probability Distributions to solve a wide variety of problems. (LOTS: level 3: Apply)
CO4. To conduct and Interpret a variety of Hypothesis Tests to aid Decision Making. (LOTS: level 4: Analyse)
CO5. To understand, Analyse, Interpret Correlation and Regression to analyse the underlying relationships Between different variables.. (LOTS: level 5: Evaluate)
CO6. Understand the concept of structured query language , xml and function. (LOTS: level 6: Create)

List of experiments/assignments

1. . Install R Studio and explore its GUI.
2. Understand and manipulate object like vector, factor, matrices ,lists and data frame.
3.Write a program to check whether a year (integer) entered by the user is a leap year or not?
4.For data visualization ,use different charts and writeing the finding on the basis of these charts.
5 For data manipulation, use if else statement. Contrast if else statement.
6. Make a list and a data frame that stores the grades for any three subjects for ten students. Determine the total, average, maximum, and minimum marks for each subject.
7. Outline the steps for importing data from Excel to CSV files and using data viewer functions such as rm(), dim(), head(), tail(), sorting, filtering, and searching to view a subset of rows.

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 R Programming Course (PC/CDS/52-P)

Course Outcomes	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

Industrial Training/Internship

General Course Information

Course Code: EEC/CDS/51-P Course Credits: 2 Contact Hours: 4 hours/week Mode: Industrial Training /Internship	**Course Assessment Methods (100 Marks)** An internal evaluation is done by a faculty member appointed by theChairperson of the Department. Significance and originality of the problem addressed and the solutionprovided: 20 Knowledge of the problem domain and tool used (VIVA-VOCE):25 Report Writing: 20 Judgment of the skill learnt and system developed: 20 Level 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 skillsand 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: Analyse)
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 and other similar systems. (LOTS: Level 5: Evaluate)
CO5. **prepare** training report by organising ideas in an effective manner.

CO-PO Articulation Matrix Industrial Training (EEC/CDS/51-P)

Course Outcomes	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	3	3	2		1	_	_	2	_	1	_	_	_	_
CO2.	2	_	_	_	3	_	_	_	3	_	_	_	_	_	_
CO3.	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO4.	_	_	_	_	_	_	_	_	_	_	_	3	_	_	_
CO5.	_	_	_	_	_	_	_	3	_	3	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

Detailed Syllabus of B.Tech. CSE(DS) VI Semester

Operating Systems

General Course Information:

Course Code: PC/CDS/61-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: Analyse)
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 IV

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, WileyIndianEdition, 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 HallIndia, 2000.

CO-PO Articulation Matrix Operating System Course (PC/CDS/61-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	3	1	_	_	2	_	_	_	_	_	_	1	3	_	_
CO4.	3	2	3		2	_	_	_	_	_	_	1	3	_	_
CO5.	3	2	3	2	2	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Formal Language and Automata Theory

General Course Information

Course Code: PC/CDS/62-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 ofT.M., PCP Problem. Chomsky Hierarchies: Chomsky hierarchies of grammars, Unrestricted grammars, Contextsensitive e 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/CDS/62-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	1	2		2	_	_	_	_	_	_	_	3	_	_
CO4.	3	2	2	2	2	_	_	_	_	_	_	_	3	_	_
CO5.	3	2	2	2	2	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Artificial Intelligence

General Course Information

Course Code: PC/CDS/63-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: Students needs to have basic knowledge of linear algebra, vector, matrix, probability, Propositional Logic & python programming.

About the Course:

This course involves studying the concept of Artificial Intelligence. Moreover, students learn about the different search strategies of Artificial Intelligence.

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

CO1. To understand the fundamentals of Artificial Intelligence (LOTS: Level 1:Remember)
CO2. To design smart system using different search strategies of Artificial Intelligence (LOTS: Level2: Understand)
CO3. To analyze various basic probability notations, game theory. (LOTS: Level 2: Understand)
CO4. To apply various algorithms for Artificial Intelligence application development (LOTS: Level3: Apply)
CO5. To implement Artificial Intelligence solutions using logical reasoning (LOTS: Level 4: Analyse)
CO6. To analyze the knowledge presentation and expert systems (LOTS: Level 6: Create)

Course Content

Unit I

Introduction: History & overview of Artificial Intelligence, Different Definitions, Problem Solving Strategies, Applications, Physical Symbol System Hypothesis, production systems, Characteristics of production, Agents and Environments – Concept of rationality – Nature of environments – Structure of agents.

Unit II

Searching Techniques:Uninformed Search, depth first search , breadth first search, Heuristic Search Strategies (Greedy Best First Search, A* Search, Memory Bounded Heuristic Search) Evolutionary algorithms Local Search Algorithms (Hill-Climbing Search, Simulated Annealing Search, Local Beam Search.

Unit III

Game Playing : Constraint Satisfaction Problems(CSP), constraint propagation, backtracking search for CSP, local search for CSP, structure of CSP , Minimax & Alpha-Beta Pruning Algorithm, Imperfect Real-time decisions, Knowledge Based Agents, Example, Propositional Logic, Reasoning Patterns in Propositional Logic, Syntax and semantics of First Order Logic, Inference in First Order Logic Knowledge Base Reasoning Systems for Categories (Semantic Networks, Description Logics), Reasoning with default Information Acting under uncertainty

Unit IV

Formalized & Propositional Logic :Formalized symbolic logic: Propositional logic-first order predicate logic, off conversion to clausal form, inference rules, the resolution principle, Dealing with inconsistencies and uncertainties, fuzzy logic. Probabilistic Reasoning Structured knowledge, graphs, frames and related structures, Knowledge organization and manipulation. Matching Techniques, Knowledge organizations, Management. Knowledge Representation and Expert Systems: Knowledge representation, Natural Language processing, Pattern recognition, expert systems, introduction to machine learning Case Study: Sentiment Analysis, Case Study: Object Recognition. Ontological engineering

Text and Reference Books:

1. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-GrawHill.
2. Introduction to AI & Expert System: Dan W.Patterson, PHI.
3. Artificial Intelligence by Luger (Pearson Education)
4. Artificial Intelligence, A Modern Approach. Stuart Russell and Peter Norvig.
5. Thomas Haslwanter, "An Introduction to Statistics with Python with Applications in the Life
6. Sciences", Springer International Publishing Switzerland 2016, ISBN 978-3-319- 28315-9, ISBN 978-3-319-28316-6 (eBook)
7. Peter Bruce and Andrew Bruce, "Practical Statistics for Data Scientists", First Edition, O'Reilly Media, ISBN- 978-1-491-95296-2
8. Allen B. Downey, "Think Stats", Second Edition, O'Reilly Media, ISBN: 978-1-491- 90733-7

CO-PO Articulation Matrix Artificial Intelligence Course (PC/CDS/63-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

Machine Learning

General Course Information

Course Code: PC/CDS/64-T CourseCredits:3 Type: Professional Core Contact Hours: 3 Mode: Lectures (L) ExaminationDuration:3hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4marks), assignments (6marks), and the end-semester examination (70marks). For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number1 will be compulsory and based on the entire syllabus. It will contain even 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: Level1: 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: Analyze)
CO5. **Compare and contrast** different machine learning algorithms. (LOTS: Level5: 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, 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, Inductive bias in decision tree learning, Issues in decision tree learning.

Unit III

Unsupervised Learning: About clustering, type of data in clustering analysis, DB SCAN density-based clustering method, Performance analysis of clustering algorithms,
Artificial Neural networks: Neural Network representations, Appropriate problems for neural network learning, Perceptron, perceptron training 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.

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.

Text and Reference Books:

1. TomM.Mitchell, Machine Learning, McGraw-Hill,1997.
2. Bishop Christopher,Pattern Recognition and MachineLearning,SpringerVerlag,2006.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: DataMining, Inference and Prediction, Springer,2nd edition, 2009. J.Han and M.Kamber, DataMining Concepts and Techniques, 3rdEdition, Elsevier, 2012.
4. S.Rajeshkaran,G.A.VijayalakshmiPai,NeuralNetworks,FuzzyLogicandGeneticAlgorithm:SynthesisandApplications,PHI, 2003

CO-PO Articulation Matrix Machine Learning Course (PC/CDS/64-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	1	_	_	_	_	_	_	_	_	_	_	3
CO2.	2	2	2	3	_	_	_	_	_	_	_	_	_	_	3
CO3.	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO4.	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO5.	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO6.	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
3 –High, 2-Medium, 1-Low															

Embedded System Design

General Course Information

Course Code: PE/CDS/61-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 makefile, 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/CDS/61-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	2	_	_	2	_	_	_	_	_	_	_	3	_	_
CO4.	3	3	2	2	2	_	_	_	_	_	_	_	3	_	_
CO5.	3	3	2	3	3	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Wireless and Mobile Communication

General Course Information

Course Code: PE/CDS/62-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, HighSpeed 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 differentMobile 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, handover, security.

Unit II
Wireless LAN IEEE 802.11-System and protocol architecture, physical layer. Frame format.Bluetooth--- Protocol architecture, Frame format.
WiMAX – Layered Protocol architecture, frame types, format, Applications Introduction to LTE.

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/CDS/62-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	1	1	_	_	_	_	_	_	_	_	_	_	_	3	_
CO4.	2	2	2	2	2	_	_	_	_	_	_	_	_	3	_
CO5.	3	3	3	3	3	_	_	_	_	_	2	2	_	3	_
3 –High, 2-Medium, 1-Low															

Computer Graphics

General Course Information

Course Code: PE/CDS /63-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: 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, scanline 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 Graphics Principles 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*, Standard Pub., 2002.
- N. Krishanmurthy, *Introduction to Computer Graphics*, T.M.H, 2002.

CO-PO Articulation Matrix Computer Graphics Course (PE/CDS /63-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	1	_	_	2	_	_	_	_	_	_	_	3	_	_
CO4.	2	1	_	_	2	_	_	_	_	_	_	_	3	_	_
CO5.	-	2	2	2	1	_	_	_	_	_	_	_	3	_	_
CO6.	1	2	2	_	3	_	_	_	_	_	-	_	3	_	_
3 –High, 2-Medium, 1-Low															

Bio-informatics

General Course Information:

Course Code: PE/CDS/64-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 not possible 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 scoringalgorithms. (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)

Unit: II

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 and Domain 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/CDS/64-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	2
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3.	2	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO4.	_	2	_	_	_	_	_	_	_	_	_	_	_	_	3
CO5.	2	3	2	_	2	_	_	_	_	_	_	_	_	_	3
CO6.	3	3	2	3	2	_	_	_	_	_	_	_	_	_	3
3 –High, 2-Medium, 1-Low															

Component Based Software Engineering

General Course Information

Course Code: PE/CDS/65-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: 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)
CO5. Compare and contrast Configuration Management issues and concept. (LOTS:Level 5: Evaluate)

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 of Software Engineering Course (PE/CDS/65-T)

Course Outcomes	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	_	_	_	2	_	_	_	_	1	_	_	_	2
CO2.	_	2	_	_	_	_	_	1	_	_	_	3	_	_	_
CO3.	_	_	_	2	_	_	_	_	1	_	_	_	_	_	_
CO4.	_	_	2	_	_	3	_	_	_	_	_	_	_	_	_
CO5.	2	3	2	_	2	_	_	_	_	_	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

PHP Programming

General Course Information

Course Code: PE/CDS/66-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: 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 analyze how 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 applyingdifferent handling mechanism. (LOTS: Level 3: Apply)

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

CO5.**To implement** PHP state management: Using query string (LOTS: Level 4: Analyse)

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, andGenerating 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 PHP Programming Course (PE/CDS/66-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	_	_	3	_	_	1	_	_	_	_	_	_	_
CO2.	_	2	2	_	_	_	1	_	_	_	_	_	_	_	_
CO3.	_	_	2	_	2	_	_	_	1	_	_	_	_	_	_
CO4.	_	_	2	_	2	_	3	_	1	_	_	_	_	_	_
CO5.	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

Fundamentals of Management for Engineers

General Course Information

Course Code: HSMC/3-T Course Credits: 2 Type: Humanities and Social Sciences including Management Contact Hours: 2 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; Behavioural 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 for Engineers Course (HSMC/3-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	_	1	_	_	_	_	_	_	_	_	_	_	_	_
CO4.	_	_	_	_	_	_	_	3	3	_	_	_	_	_	_
CO5.	2	3	2		_	_	_	_	_	_	_	2	_	_	_
CO6.	3	3	3	2	_	3	_	_	_	3	3	_	_	_	_
3 –High, 2-Medium, 1-Low															

Operating Systems Lab. (UNIX/LINUX)

General Course Information

Course Code: PC/CDS/61-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 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 Operating System Lab. (PC/CDS/61-P)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	1	_	_
CO2.	2	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	2		2	2	_	_	_	_	_	_	_	3	_	_
CO4.	2	2		2	2	_	_	_	_	_	_	_	3	_	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

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Artificial Intelligence Lab.

General Course Information

Course Code: PC/CDS/63-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: Students needs to have basic knowledge of linear algebra, vector, matrix, *59/probability, Propositional Logic & python programming.

About the Course:
This course involves studying the concept of Artificial Intelligence. Moreover, students learn about the different search strategies of Artificial Intelligence.

Course Outcomes: By the end of the course students will be able to:
CO1. To understand the fundamentals of Artificial Intelligence (LOTS: Level 1:Remember)
CO2. To design smart system using different search strategies of Artificial Intelligence (LOTS: Level2: Understand)
CO3. To analyze various basic probability notations, game theory. (LOTS: Level 2: Understand)
CO4. To apply various algorithms for Artificial Intelligence application development (LOTS: Level3: Apply)
CO5. To implement Artificial Intelligence solutions using logical reasoning (LOTS: Level 4: Analyse)
CO6. To analyze the knowledge presentation and expert systems (LOTS: Level 6: Create)

List of experiments/assignments

1. Study & list tuple, set, dictionary, classes, inheritance in Python
2. Study and understand simple reflex and Model Based Agent
3. Implement graph in Python for profit or loss in banking application
4. Describe the given problem statement using PEAS description.
5. Implement basic searching algorithm for given AI problem
6. Write a program to solve 8 Queens' problem
7. Implement memory bounded A* & A* algorithm for given problem.
8. Implement Alpha Beta Tree search.
9. Implement classical planning algorithm
10. Solve Robot Obstacle/transversal problem means end analysis.

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 Artificial Intelligence Course (PC/CDS/63-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	_	_	_	_	_
3 –High, 2-Medium, 1-Low															

Machine Learning Lab.

General Course Information

Course Code: PC/CDS/64-P Course Credits: 2 Type: Professional Core Lab. Course Mode: Lab practice andassignments Contact Hours: 4 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 and Octave/MATLAB.

About the Course:

In this lab. Course, students learn to solve optimization, supervised and unsupervised learning problems 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. (Describedatasets 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 thesealgorithms.
3. Two assignments related to clustering algorithms and interpreting the results of thesealgorithms.
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/CDS/64-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	3	3	_	_	_	_	_	_	_	_	_	3
CO2.	3	3	2	3	3	_	_	_	_	_	_	_	_	_	3
CO3.	3	3	2	3	3	_	_	_	_	_	_	_	_	_	3
CO4.	3	3	2	3	3	_	_	_	_	_	_	_	_	_	3
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

B.Tech. CSE(DS) Credit Scheme – Semester VII & VIII

Semester	Basic Sciences' Courses BSC (BSC/xx-T/P)		Engineering Sciences' Core/ Elective/ Open Courses ESC (PC/CDS/xx-T/P)/ (PE/CDS/xx-T/P)/ (OE/CDS/xx-T/P)		Humanities, Social Sciences, Managementt Courses HSMC (HSMC/xx-T/P)		Mandatory Courses (MC/xx-T/P)		Industrial Training (EEC/CDS/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	
VII	00	00	06	16	00	00	00	00	02	06	22
VIII	00	00	05	11	00	00	00	00	01	06	17

SEMESTER VII

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CDS/71-T	Robotics and Automation	3/3	-/-	-	3/3
2.	PC/CDS/72-T	Knowledge Engineering	3/3	-/-	-	3/3
3.	PE/CDS/71-T to PE/CDS/74-T	Professional/ Programme Elective Course- II tobe opted by students	3/3	-/-	-	3/3
4.	PE/CDS/75-T to PE/CDS/79-T	Professional/ Programme Elective Course- III tobe opted by students	3/3	-/-	-	3/3
5.	OE-III	Open Elective Course to be opted by students from another branch	3/3	-/-	-	3/3
6.	PE/CDS/75-P to PE/CDS/79-P	Professional/ Programme Elective Course- III Lab.	-/-	-/-	2/1	2/1
7.	EEC/CDS/71-P	Major Project-I	-/-	-/-	8/4	8/4
8.	*** EEC/CDS/72-P	Mini Project using open source tools	-/-	-/-	4/2	4/2
		TOTAL CREDITS	15/15	-/-	14/7	29/22

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

List of Professional/ Programme Elective Course- II

5. PE/CDS/71-T: Software Project Management
6. PE/CDS/72-T: Soft Computing
7. PE/CDS/73-T: Distributed Operating Systems
8. PE/CDS/74-T: Cloud Computing

List of Professional/ Programme Elective Course-III

6. PE/CDS/75-T: Mobile Application Development
7. PE/CDS/76-T: Multimedia Technologies
8. PE/CDS/77-T: Digital Image Processing
9. PE/CDS/78-T: Blockchain Technology
10. PE/CDS/79-T Natural Language Processing

List of Professional/ Programme Elective Course-III (Labs)

6. PE/CDS/75-P: Mobile Application Development (Lab.)
7. PE/CDS/76-P: Multimedia Technologies (Lab.)
8. PE/CDS/77-P: Digital Image Processing (Lab.)
9. PE/CDS/78-P: Blockchain Technology (Lab.)
10. PE/CDS/79-P: Natural Language Processing (Lab.)

SEMESTER VIII

#	Course Code	Course Title	Workload/Credit			
			Theory	Tutorial	Practical	Total
1.	PC/CDS/81-T	Information Retrieval	3/3	-/-	-	3/3
2.	PE/CDS/81-T To PE/CDS/84-T	Professional/ Programme Elective Course-IV to be opted by students	3/3	-/-	-	3/3
3.	PE/CDS/85-T to PE/CDS/89-T	Professional/ Programme Elective Course-V to be opted by students	3/3	-/-	-	3/3
4.	PE/CDS/81-P to PE/CDS/84-P	Professional/ Programme Elective Course-IV Lab.	-/-	-/-	2/1	2/1
5.	PE/CDS/85-P To PE/CDS/89-P	Professional/ Programme Elective Course- V Lab.	-/-	-/-	2/1	2/1
6.	EEC/CDS/81-P	Major Project-II	-/-	-/-	12/6	12/6
Total Credit			9/9		16/8	25/17

List of Professional/ Programme Elective Course -IV

1. PE/CDS/81-T: Internet of Things
2. PE/CDS/82-T: Network Administration and Management
3. PE/CDS/83-T: Software Testing and Quality Assurance
4. PE/CDS/84-T: Artificial Neural Network

List of Professional/ Programme Elective Course -IV (Labs)

5. PE/CDS/81-P: Internet of Things (Lab.)
6. PE/CDS/82-P: Network Administration and Management (Lab.)
7. PE/CDS/83-P: Software Testing and Quality Assurance (Lab.)
8. PE/CDS/84-P: Artificial Neural Network (Lab.)

List of Professional/ Programme Elective Course -V

6. PE/CDS/85-T: Deep Learning
7. PE/CDS/86-T: Big Data Analytics
8. PE/CDS/87-T: Web Development
9. PE/CDS/88-T: Quantum Computing
10. PE/CDS/89-T: Digital Forensics

List of Professional/ Programme Elective Course -V (Labs)

6. PE/CDS/85-P: Deep Learning (Lab)
7. PE/CDS/86-P: Big Data Analytics (Lab)
8. PE/CDS/87-P: Web Development (Lab)
9. PE/CDS/88-P: Quantum Computing (Lab)
10. PE/CDS/89-P: Digital Forensics (Lab)

Policy Document for providing exemptions in attendance to the B.Tech. students of the University/ Institute/ College for undertaking various internships/trainings during their final/penultimate semester

1. Background:

It has been realized that the students pursuing B. Tech. programmes offered by the University/affiliated Institutes/Colleges are facing challenges as under:

1. Students selected in industry during their programme are asked to join the industry for internship/training of duration up to one semester.

2. The provision is not there in these programmes to allow the students to join the internship by way of getting the required attendance of semester from internship/training.

3. So, students are not able to join such internship/training consequential to two-fold loss:
   (a) Job opportunity.
   (b) Skill development in industry environment.

But, presently, in the B. Tech. Programmes run by the University, there is no provision for the students to join the industry for such internship/training of/for more than 6–8-week duration. To facilitate the students for joining longer duration internships/trainings, a need for framing a policy document was felt.

Keeping in view the above challenges/statutory position and to avoid hardship to students and to improve the employability of the students, Ch. Devi Lal University, Sirsa has framed a policy to accord exemptions in attendance to students undertaking various internships/trainings during their final/penultimate semester of the B. Tech. Programmes.

2. Applicability of the policy with following Provisions:

The policy is applicable to the students studying in the final semester/ penultimate semester of B. Tech. programmes.

2.1 Provisions:

Student covered as per section title 'Applicability of the Policy' will be governed by the following provisions:

1. The student will be allowed to join the organization for internship/training in the final semester/ penultimate semester of the course for a period of up to one semester only if he/she must be passed/ cleared in all courses/subjects in all the semester examination whose results have been declared.

2. The student will earn his attendance from the organization during the period of internship.

3. Attendance will be certified by the organization, failing which student will be debarred from appearing in the University examinations of that semester.

4. The student will have to give an undertaking that he/she will appear in all the internal/external examination/practical as per requirements of the Programme and as per Schedule of the University examination for that programme. For this he/she will have to do the necessary preparation by himself/herself and Institute/department will not be responsible for the same.

5. If the student is selected in a company/industry/organization etc., and is asked to join the organization in the final semester/ penultimate semester for a period of upto one semester; then formally constituted Internship Facilitation Committee (IFC) will examine and give its recommendation as deemed fit.

b. Composition of Internship Facilitation Committee (IFC):

The composition of IFC will be as under:

1. Dean, Faculty of Engg. & Tech./Director/ Principal (or Nominee) (Chairperson)
2. Chairperson/Head/ In-charge of the concerned Department/Branch (Member)
3. In-Charge Academic Branch/Academic In-charge of Institute (Member)
4. Senior most faculty of the department other than Chairperson/ Director/Head of the Department/Branch (Member)
5. Training and Placement officer/ In-Charge TPO of the Institute /College/Department (Member Secretary)

Any offer by the organisations providing internship on demanding charges from a student will be discouraged by the Internship Facilitation Committee (IFC). Member Secretary of the IFC will schedule the meeting and maintain all the records.

3. Conclusion:

The students can only be allowed to join the internship/training in company/ industry/ organization etc. with exemptions in attendance on the final recommendation of Internship Facilitation Committee (IFC) of the Institute / Department and permission given by the Department/Institute/College authority.

Detailed Syllabus of B.Tech. CSE(DS) VII Semester

Robotics and Automation

General Course Information

Course Code: PC/CDS/71-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: Brief knowledge of programming languages/ Python/ R/ Matlab

About the Course:
The objective of this course is to introduce different types of robotics and demonstrate them to identify different parts and components and its operations.

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

CO 1.To explain the fundamental concepts of robotics
CO2.To apply mathematical representations and transformations
CO3.To analyzes the differential motion and statics of manipulators using velocity and Jacobian matrices.
CO4.To implements path planning techniques for robot motion in joint space and Cartesian space.
CO5.To understands the dynamics of robotic manipulators and apply control schemes for manipulator motion.
CO6.To applies force control methods for robotic manipulators and understand the challenges involved.

Course Content

Unit I
Basic concepts: Brief History-Types of Robots–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

Unit II
Direct and inverse kine matics Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various Joints-Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct Kinematics-Inverse kinematics-SCARA robots-Solvability–Solution Methods-Closed form solution.

Unit III
Linearandangularvelocities-ManipulatorJacobian-Prismaticandrotaryjoints–Inverse-Wristandarm singularity-Static Analysis-Force and moment Balance.

Unit IV
Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric descriptions - Straight line and circular paths - Position and orientation planning. Robot sensing and perception, Types of sensors (e.g., vision, force/torque, proximity), Sensor fusion techniques, Object recognition and tracking, Robot localization and mapping.

Text and Reference Books:

1. Introduction to Robotics: Mechanics and Control" byJohnJ. Craig

CO-PO Articulation Matrix Robotics and Automation Course (PC/CDS/71-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	1	_	_	_	_	_	_	_	_	_	_	3	_	_
CO4.	3	2	1		2	_	_	_	_	_	_	_	3	_	_
CO5.	2	2	1		2	_	_	_	_	_	_	_	3	_	_
CO6.	3	3	2	2	3	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Knowledge Engineering

General Course Information

Course Code: PC/CDS/72-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 knowledge of Algorithms and probability.

About the Course:

Artificial Intelligence is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces the concepts of Artificial Intelligence and challenges inherent in building intelligent systems. It includes the role of knowledge representation in problem solving and how these are used in making intelligent machine. Further it incorporates the concepts of expert system and its applications.

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

CO1. outline various Artificial Intelligence techniques. (LOTS: Level 1: Remember)CO2. illustrate reasoning under uncertainty. (LOTS: Level 2: understand)

CO3. apply search and knowledge representation techniques to solve AI problems. (LOTS:Level 3: Apply)

CO4. compare strengths and weaknesses of AI algorithms (LOTS: Level 4: Analyse).

CO5. combine various AI techniques to solve intelligent systems' problems. (LOTS:Level6: Create)

Course Content

Unit I

Introduction: Introduction to AI, Turing Test, AI problems, State Space Search, production system

Problem Solving Using Search: Blind search techniques - Breadth first search, Depth first search. Heuristic search techniques - Generate and test, Hill Climbing, Best first search, A* Algorithm, AO* Algorithm, The Minimax Search Procedure, Adding Alpha-Beta Cut-offs.

Unit II

Knowledge Representation**:** Introduction, Knowledge Representation- Representation and Mappings, Symbolic Logic - Propositional logic, Predicate logic- Representing simple facts in logic, Computable functions and Predicates, Unification, Resolution.

Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, LogicProgramming, Forward versus Backward Reasoning, Matching.

Unit III

Reasoning Under Uncertainty: Introduction to Nonmonotonic Reasoning, Probability andBaye's Theorem, Certainty Factors and Rule-based Systems, Bayesian Networks.

Fuzzy logic system: Introduction, Crisp Set, Fuzzy Sets, Fuzzy Membership Functions,Operations on Fuzzy Sets, Fuzzy Relations.

Unit IV

Planning: Introduction, Components of Planning System, Goal Stack Planning, NonlinearPlanning using Constraint Posting, Hierarchical Planning.

Expert System and Applications: Introduction, Architecture, Rule based Expert Systems,Applications of Expert Systems.

Text and Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, *Artificial intelligence*,McGraw Hill Education.3rd edition, 2009.
2. Stuart Russel and Peter Norvig, *Artificial intelligence: A modern Approach*,Pearson Education, 3rdedition, 2015.
3. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert System*,Pearson Education.1stedition, 2007.
4. Deepak Khemani, *A first course in Artificial Intelligence*, McGraw HillEducation. 3rd edition, 1stedition, 2013.
5. George F. Luger, *Artificial Intelligence: Structures and Strategies for ComplexProblem Solving*, Pearson Education, 5th edition, 2009.

CO-PO Articulation Matrix Knowledge Engineering Course (PC/CDS/72-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3.	2	2	_	2	2	_	_	_	_	_	_	_	_	_	3
CO4.	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO5.	3	3	3	3	2	2	_	_	_	_	_	3	_	_	3
3 –High, 2-Medium, 1-Low															

Software Project Management

General Course Information

Course Code: PE/CDS/71-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: Preliminary knowledge of Software Engineering.

About the Course:

The course involves training students in software project management and project planning. It focuses on the need for careful planning, monitoring and control for delivering quality projects in time. Besides this student learn to measure the success of a project in meeting its objectives.

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

CO1. **outline** basic concepts related to stepwise project planning. (LOTS: Level 1:Remember)
CO2. **demonstrate** the knowledge about Quality Control, Standard and Risk Management. (LOTS: Level2: Understand)
CO3. **illustrate** the Activity Planning, and Resource Allocation Process. (LOTS:Level 2: Understand)
CO4. **apply** the concept of team structure and organization structure. (LOTS: Level 3:Apply)
CO5. **compare** various Project Evaluation and Estimation Techniques. (LOTS: Level 4:Analyse)
CO6. **plan** activities necessary for completing the software projects successfully. (LOTS:Level 6: Create)

Course Content

Unit I

Introduction to Software Project Management (SPM): Definition of Software Project, Software Project Vs Other types of projects, activities covered by SPM, categorizing software projects, project as system, management control, Requirement specification, Information and control in organization, project management lifecycle.

Stepwise Project Planning: Introduction, selecting a project.

Unit II

Project Evaluation and Estimation: Cost-Benefit analysis, cash flow forecasting, cost benefit evaluation techniques, Selection of an appropriate project, choosing technologies, choice of process models, rapid application development, waterfall model, V process model and spiral model.

Activity Planning: Objectives of activity planning, project schedule, projects and activities, sequencing and scheduling activities, network planning model.

Unit III

Risk Management: Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to schedule.

Resource Allocation: Introduction, the nature of resources, identifying resource requirements, scheduling resources, creating critical paths.

Unit IV

Managing Contracts and People: Introduction, types of contract, stages in contract placement, terms of contract, contract management, acceptance, managing people and organizing teams: Introduction, understanding organization behavior.

Software Quality: Introduction, the place of software quality in project planning, the importance of software quality, defining software quality, McCall's software quality factors, product versus process quality management, techniques to enhance software quality.

Text and Reference Books:

1. Bob Hughes and Mike Cotterell , *Software Project Management*, Sixth Edition, TMH,2018.
2. Walker Royce , *Software Project Management*, , Addison Wesley, 1998.
3. Pankaj Jalote , *Software Project Management in Practice*, Pearson, 2002.
4. Ramesh, *Managing Global Software Projects*, TMH, 2005.

CO-PO Articulation Matrix Software Project Management Course (PE/CDS/71-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2.	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3.	1	–	–	–	2	–	–	–	–	–	–	–	3	–	–
CO4.	2	2	_	_	2	–	–	–	2	–	–	–	3	–	–
CO5.	2	2	2	2	2	–	–	–	–	–	2	_	3	–	–
CO6.	3	3	_	3	3	–	–	–	__	2	3	2	3	–	–
3 –High, 2-Medium, 1-Low															

Soft Computing

General Course Information

Course Code: PE/CDS/72-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 Probability Theory, Set Theory and, Data Structure and Computer Algorithms

About the Course:

We need to learn soft computing techniques to make intelligent machines that possess human like abilities to reason, learn and handle the uncertainty and vagueness often inherent in real world problems. Unlike conventional computing, soft computing techniques are tolerant of imprecision, uncertainty and approximations, and provide low cost, robust and tractable solutions to the complex real-world problems where conventional methods fail to do so. This introductory course on soft computing is going to cover Genetic Algorithms, Artificial Neural Networks and Fuzzy Logic.

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

CO1. **define** the terminology and concepts related to soft computing techniques. (LOTS:Level 1: Remember)
CO2. **discuss** soft computing techniques including genetic algorithms, fuzzy systems and neuralnetworks. (LOTS: Level 2: Understand)
CO3. **solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks.(LOTS: Level 3: Apply)
CO4. **analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems.(LOTS: Level 4: Analyse)
CO5. **justify** the design of a soft computing algorithm for a given problem. (LOTS: Level 5:Evaluate)
CO6. **design** Genetic Algorithms and Neural Networks to solve optimization and patternrecognition problems. (LOTS: Level 6: Create)

Course Content

Unit I

Introduction to Soft Computing and related definitions: Defining soft computing, Differentiating the situations for application of hard and soft computing; Working of a simple Genetic Algorithm: Representation/Encoding Schemes, initializing a GA population, evaluation function, genetic operators, Function optimization using GA. Study of parameters of genetic algorithms and its performance, selection mechanisms. Scaling of GA population.

Unit II

Designing Genetic Algorithms for different applications: Different types encoding schemes, role of fitness function, different types of genetic operators, Designing GAs for numerical optimization, knapsack problem.

Unit III

Fuzzy sets: Basic terminology and definitions, Operations on Fuzzy sets, MF formulations and parameterization, MFs of one and two dimensions, Derivatives of parameterized MFs, Fuzzy numbers, Extension principle and fuzzy relations, Operations on Fuzzy relations, Linguistic variables, Fuzzy If-Then Rules, Compositional rule of inference.

Unit IV

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation l earning, Back propagation learning algorithm.

Text and Reference Books:

1. David. E. Goldberg, *Genetic Algorithms in Search, Optimization and machine learning*,Addison Wesley,1999.
2. Zbigniew Michalewicz, *Genetic algorithms + Data Structures = Evolution Programs*,Springers-Verlag,1999.
3. M. Mitchell, *An Introduction to Genetic Algorithms*, Prentice-Hall, 1998.
4. S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and GeneticAlgorithms: Synthesis & Applications*, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, *Principles of Soft Computing*, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 1997.
7. Simon O. Haykin, *Neural Networks, A Comprehensive Foundation*, PHI, 1994.

CO-PO Articulation Matrix Soft Computing Course (PE/CDS/72-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3.	3	3	_	_	2	_	_	_	_	_	_	_	_	_	3
CO4.	3	3	_	2	2	_	_	_	_	_	_	_	_	_	3
CO5.	3	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO6.	3	3	3	3	3	_	_	_	_	_	_	_	_	_	3
3 –High, 2-Medium, 1-Low															

Distributed Operating System

General Course Information

Course Code: PE/CDS/73-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: Knowledge of operating system, computer networks and a programminglanguage

About the Course:

This course focuses on the study of distributed system concepts and its applications. In this course various advantages of distributed computing system are studied. After studying this course, a student will be expected to understand the design issues of the distributed operating systems and propose solutions for problems specific to the domain.

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

CO1. **state** the basic concepts of distributed systems and their advantages over simple clientserver-based computer networks. (LOTS: Level 1: Remember)

CO2. **explain** strategies for synchronization, scheduling policies and deadlock avoidance indistributed environment. (LOTS: Level 2: Understand)

CO3. **apply** distributed operating system's concepts to solve the problems inherent indistributed systems. (LOTS: Level 3: Apply)

CO4. **analyse** trends in distributed file systems. (LOTS: Level 4: Analyse)

CO5. **compare** and **contrast** strategies for synchronization, scheduling policies anddeadlock avoidance and distributed file systems. (LOTS: Level 5: Evaluate)

Course Content

Unit I

Introduction: Introduction to distributed system, Goals of distributed system, Hardware and Software concepts, Design issues, Communication in distributed system: Layered protocols, ATM networks, Client-Server model, Remote Procedure Calls and Group Communication, Middleware and Distributed Operating Systems.

Unit II

Synchronization in Distributed System: Clock synchronization, Mutual Exclusion, Election algorithm, Bully algorithm, Ring algorithm, Atomic Transactions, Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock Detection.

Unit III

Processes and Processors in distributed systems: Threads, System models, Processors Allocation, Schedulingin Distributed System, Real Time Distributed Systems.

Unit IV

Distributed file systems: Distributed file system design, Distributed file system Implementation, Trends in Distributed file systems. Distributed Shared Memory: What is shared memory, Consistency models, Page based distributed shared memory, shared variables distributed shared memory.

Text and Reference Books:

1. Tanenbaum A.S., Van Steen M., *Distributed Systems: Principles and Paradigms*,Pearson Education,
2. Pradeep K Sinha, *Distributed Operating Systems: Concepts and Design*, Prentice Hall ofIndia, 2007.
3. Liu M.L., *Distributed Computing, Principles and Applications*, Pearson Education,2004.
4. Nancy A Lynch, *Distributed Algorithms*, Morgan Kaufman Publishers, USA, 2003.

CO-PO Articulation Matrix Distributed Operating System Course (PE/CDS/73-T)

Course Outcomes	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1.	1	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3.	2	1	–	–	–	–	–	–	–	–	–	–	3	–	–
CO4.	2	2	2	2	–	–	–	–	–	–	–	–	3	–	–
CO5.	2	2	3	3	–	–	–	–	–	–	–	–	3	–	–
3 –High, 2-Medium, 1-Low															

Cloud Computing

General Course Information

Course Code: PE/CDS/74-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: Basics of Computer Network, Distributed System.

About the Course:

The objective of the course is to give students a comprehensive view of storage and networking infrastructures for highly virtualized cloud ready deployments. The course discusses the concepts and features related to Virtualized data-Centre and cloud, information storage and design of applications.

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

CO1. **define** concepts related to cloud computing. (LOTS: Level 1: Remember)
CO2. **express** deployment models for clouds. (LOTS: Level 2: Understand)
CO3. **apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)
CO4. **analyse** cloud computing services used at various levels. (LOTS: Level 4: Analyse)
CO5. **assess** real time cloud services. (LOTS: Level 5: Evaluate)

Course Content

Unit I

Introduction: Distributed Computing, Cluster Computing, Grid Computing, Overview of Cloud Computing, History of Cloud Computing, Defining a Cloud, Benefits of Cloud Computing, Cloud Computing Architecture, Services Models(XaaS), Infrastructure as a Service, Platform as a Service, Software as a Service.

Unit II

Deployment Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Dynamic Provisioning and Resource Management, Virtualization: Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Pros and Cons of Virtualization, Xen, VMware, Hyper-V.

Unit III

Cloud Platform in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services, Additional Services, Google App Engine- Architecture and Core Concepts, Application Life Cycle, Cost Model, Microsoft Azure – Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance.

Unit IV

Cloud Application: Scientific Applications, Protein Structure Prediction, Satellite Image Processing, Business and Consumer Applications-CRM and ERP, Media Applications, Multiplayer Online gaming. Cloud Security.

Text and Reference Books:

1. Rajkumar Buyya, Christian Vecchiola and S ThamaraiSelvi, *Mastering CloudComputing*, Tata Mc Graw Hill Education Pvt. Ltd., 2013.
2. Kai Hwang, Geofferyu C. Fox and Jack J. Dongarra, *Distributed and Cloud Computing*,Elsevier, 2012.
3. John W. Ritting and James F. Ransome, *Cloud Computing: ImplementationManagement and Security*, CRC press, 2012.

CO-PO Articulation Matrix Cloud Computing Course (PE/CDS/74-T)

Course Outcomes	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	2	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	2	2	2	_	2	_	_	_	_	_	_	_	_	3	_
CO4.	3	3	2	3	2	_	_	_	_	_	_	_	_	3	_
CO5.	3	3	3	3	3	2	_	_	_	_	_	2	_	3	_
3 –High, 2-Medium, 1-Low															

Mobile Application Development

General Course Information

Course Code: PE/CDS/75-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: Java Programming and Object-Oriented programming, Knowledge of RDBMSand OLTP.

About the Course:

Mobile Application Development has been introduced as a Professional Elective course for Students of BTech (CSE/IT) keeping in view the Employers' requirements. Android Platform forms the basis for developing Mobile Applications since the last decade as compared to IOS Platform for Apple Products. The Environment requires User Interface to be developed using Buttons, Check-Boxes, Alert Dialog and its kind.

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

CO1. state basic of Android , its Evolution and its Architecture. (LOTS: Level 1: Remember)
CO2. demonstrate the Lifecycle of Software for Android Mobile Applications. (LOTS: Level 2: Understand)
CO3. prepare Mobile Applications on the Android Platform. (LOTS: Level 3: Apply)
CO4. compare working with Buttons and other Widgets for Visual Environment. (LOTS: Level4: Analyse)
CO5. develop Mobile Applications using data storage in SQLite Database and evaluate its Performance. (LOTS: Level 6: Create)

Course content

Unit I

Mobile OS Architecture: Android, Blackberry OS, Firefox OS, IOS, Window OS, ARM and MIPS processor, Challenges of the mobile platform, Hello Android example, Internal Details, Dalvik VM, Software Stack, Android Core Building Blocks, Android Emulator,AndroidManifest.xml, R.java file, Hide Title Bar, Screen Orientation.

Unit II

UI Widgets: Working with Button, Toast, Custom Toast, Button, Toggle Button, Switch Button, Image Button, Check Box, Alert Dialog, Spinner, Auto Complete Text View, Rating Bar, Date Picker, Time Picker, Progress Bar, Quick Contact Budge, Analog Clock and Digital Clock, Working with hardware Button, File Download.

Unit III

Activity, Intent & Fragment: Activity Lifecycle, Activity Example, Implicit Intent, ExplicitIntent, Fragment Lifecycle, Fragment Example, Dynamic Fragment.
Android Menu: Option Menu, Context Menu, Popup Menu Layout Manager: Relative Layout, Linear Layout, Table Layout, Grid Layout.

Unit IV

Adaptor: Array Adaptor, Array List Adaptor, Base Adaptor.

View: Grid View, WebView, Scroll View, Search View, Tab Host, Dynamic List View, ExpandedList View.

SQLite: SQLite API, SQLite Spinner, SQLite List View

XML & JSON: XML Parsing SAX, XML Parsing DOM, XML Pull Parser, JSON basics, JSONParsing.

Text and Reference Books:

1. Redazione Io Program Mo, *Android Programming*, 2011
2. John Horton, *Android Programming for Beginners*, packet publishing, 2015
3. Jason Wei, *Android Database Programming*, packet publishing, 2012
4. Mark L Murphy, *Android Programming Tutorials*, 3rd Edition, 2010
5. Bill Phillips et al., *Android Programming - The "Big Nerd Ranch*" Guide 2017
6. Rick Rogers et al., *Android Application Development: Programming with the Google SDK*,2009

CO-PO Articulation Matrix Mobile Application Development Course (PE/CDS/75-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	2	2	_	2	_	_	_	_	_	_	_	3	2	_
CO4.	_	_	2	_	1	_	_	_	_	_	_	_	3	_	_
CO5.	3	2	2	3	3	3	_	_	2	_	1	2	3	3	_
3 –High, 2-Medium, 1-Low															

Multimedia Technologies

General Course Information

Course Code: PE/CDS/76-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: Basics of Computer Graphics

About the Course:
Multimedia is a core and an essential course for every graduate in Computer Science and Engineering The objective of this course is to make students learn how to develop multimedia programs and demonstrate how still images, sound, and video can be digitized on the computer.

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

CO1. **outline** the basic concepts of multimedia technology. (LOTS: Level 1: Remember)
CO2. **discuss the concepts** of animation, digitized sound, video control, and scannedimages. (LOTS: Level 2: Understand)
CO3. **use** basic instructional design principles in the development of Multimedia. (LOTS:Level 3: Apply)
CO4. **compare** various audio and video file formats. (LOTS: Level 4: Analyse)
CO5. **devise** solutions for multimedia problems. (LOTS: Level 6: Create)

Course Content

Unit 1
Introduction to Multimedia concepts, Types of Multi-media Applications, Methods to deliver Multimedia, Introduction to Multimedia Database, Multimedia Input and Output Devices.

Unit II
Introduction about font and faces, Using Text in Multimedia, Applying different types of text inmultimedia Font Editing and Design tools, Hypermedia and Hypertext application.

Unit III
The power of images, Making Still Images, Coloring, Image File Formats (GIF, JPEG, PNG etc.) The power of sound, MIDI Vs. Digital Audio, Audio File Formats (AIFF, WAV, MPEG, MOV etc.) Adding Sound to multimedia project.

Unit IV
Working of a Video and its Display, Digital Video Containers (Codecs & Video Format Converters) Obtaining Video Clips, Shooting and editing Video, Non Linear Editing (NLE) in Videos The stages of Multimedia Project, Hardware and Software requirements, Authoring Systems Team for Multimedia Development, Different stages of multimedia, The internet and multimedia

Text and Reference Books:

1. Tay Vaughan, *Multimedia: Making It Work*, Tata McGraw Hills, 2008.
2. James E Shuman, *Multimedia in Action*, Vikas Publishing House, 1997.
3. Andreas Holzinger, *Multimedia Basics Technology*, *Volume* 1, Firewall Media, 2005.
4. Rangan Parekh, *Principles of Multimedia*, Tata McGraw Hills, 2007.

CO-PO Articulation Matrix Multimedia Technologies Course (PE/CDS/76-T)

Course Outcomes	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	2	2	_	_	_	_	_	_	_	_	_	3	_	_
CO4.	2	2	2	_	2	_	_	_	_	_	_	_	3	_	_
CO5.	3	3	2	3	3	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Digital Image Processing

General Course Information

Course Code: PE/CDS/77-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: knowledge of basic linear algebra, basic probability theory, basic programming techniques, and Fourier Transforms.

About the Course:

Digital Image Processing is a Professional Elective course that provides a theoretical foundation of digital image processing concepts. This course provides a mathematical foundation for digital manipulation of images, image acquisition, pre-processing, enhancement, segmentation and compression. Students learn algorithms that perform basic image processing operations (e.g., histogram processing, noise removal and image enhancement and restoration). Algorithms for image analysis (e.g., image compression, image segmentation and image representation) are explained.

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

CO1. **state** concepts related to image acquisition and processing. (LOTS: Level 1: Remember)
CO2. **illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand)
CO3. **apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply)
CO4. **compare** various image processing techniques. (LOTS: Level 4: Analyse)
CO5. **assess** the various image processing techniques for a given problem. (LOTS: Level 5: Evaluate)
CO6. **design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (LOTS: Level 6: Create)

Course contents

Unit I

Introduction and fundamental to digital image processing: What is digital image processing, Origin of digital image processing, Examples that use digital image processing, Fundamental steps in digital image processing, Components of digital image processing system, Image sensing and acquisition, Image sampling, Quantization and representation, Basic relationship between pixels. Image enhancement in spatial domain and frequency domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial and the frequency domain filters.

Unit II

Image Restoration: Image degradation/restoration Process, Noise models, Restoration in presence of noise, Inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations. Color Image Processing: Color fundamentals, Color models, Basics of full color image processing, Color transformations.

Unit III

Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression. Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

Unit IV

Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors.

Recognition: Pattern and Pattern classes

Text and Reference Books:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, PearsonEducation, Ed, 2001.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson Education, PHI, 2001.
3. Tinku Acharya and Ajoy K. Ray, *Image Processing-Principles and Applications*,John Wiley & Sons,4. Inc., 2005.
4. Chanda and D. Dutta Majumdar, *Digital Image Processing and Analysis*, PHI, 2003.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis, andMachine Vision*, 2ndedition, PWS Publishing Company, Thomson Learning, 1999.

CO-PO Articulation Matrix Digital Image Processing Course (PE/CDS/77-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	_	_	_	_	_	_	_	_	_	_	_	_	2
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3.	3	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO4.	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO5.	3	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO6.	3	3	2	3	3	_	_	_	_	_	_	2	_	_	3
3 –High, 2-Medium, 1-Low															

Blockchain Technology

General Course Information

Course Code: PE/CDS/78-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: Discrete Mathematics

About the Course:

To understand the function of Blockchain as a method of securing distributed ledgers. To familiarize the functional/operational aspects of cryptocurrency ecosystem. To demonstrate about wallets and learn their utilization of wallet during transaction. To analyze and apply that how to write and apply the Smart Contracts.

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

CO1: explain the blockchain Technology in real life(LOTS: Level 2: Understand)
CO2: Apply the smart contracts on Ethereum platform. (LOTS: Level 3: Apply)
CO3: Develop the use cases on Hyperledger. (LOTS: Level 6: Create)
CO4: Analyze the major research challenges and technical gaps existing between theory andpractice in Blockchain (LOTS: Level 5: Evaluate)
CO5. Compare various Ethereum Virtual Machine techniques. (LOTS: Level 4: Analyse)

Course Content

Unit I

Introduction to Cryptography, Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, Euclid's Algorithm, RSA algorithm, Diffie-Hellman key exchange algorithm, ElGamal Encryption, Elliptic curve cryptography, SHA 256, Digital Signature, Zero Knowledge Proof (ZKP)

Unit II

Introduction from barter system to Cryptocurrency, fundamental of Blockchain, Block structure, Genesis Block, Orphaned Blocks, Stale Block, Uncle Block, Distributed Ledger Technology (DLT), peer-to- peer network, Merkle Tree, Lifecycle of Blockchain, Evolutions of Blockchain, Fork, double spending money, Transactions and UTXO's, Types of Blockchain. Need of Blockchain, Benefits of Blockchain.

Unit III

Cryptocurrencies: Bit Coin (BTC), Ethereum (ETH), Ripple (XRP), Lite Coin (LTC), Bitcoin Cash(BCH), Mining pools, Mining, Difficulty Level, Current Target, Nonce, how miners picks transactions, How do mem pools work, 51% attack Consensus Algorithms: Proof of Work (PoW), Asynchronous Byzantine Agreement, Proof of Stake (PoS), Hybrid models (PoW + PoS),

Unit IV

Wallets, Types of wallets-Hardware, Software, Paper, Web, Desktop.
Ethereum - Ethereum network, Ethereum Virtual Machine (EVM), Wallets for Ethereum, Solidity - Smart Contracts, Truffle, Web3, some attacks on smart contracts, Design and issue Cryptocurrency ICO, Mining, Gas - Transactional Fee & Incentivization, D Apps, Decentralized Autonomous Organizations (DAO).

Text and Reference Books:

- Mastering Blockchain, Imran Bashir, Packet Publishing
- https://bitcoinbook.cs.princeton.edu/ Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Gold Feder Prince to University Press.
- Grokking Bitcoin, Kalle Rosenbaum, Manning Publications.
- Blockchain Basics, Daniel Drescher, A press Publication

CO-PO Articulation Matrix blockchain Technology Courses: (PE/CDS/78-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	-		-	-	-	-	-	2	-	-	-	3	-	-	-
CO2.	-	-	-	-	-	2	3	2	1	-	-	2	-	-	-
CO3.	-	-	-	-	-	-	-	2	2	2	-	2	-	-	-
CO4.	-	-	-	-	-	-	-	-	3	2	-	1	-	-	-
CO5.	-	-	-	-	-	-	_	-	3	-		-	-	-	-
3 –High, 2-Medium, 1-Low															

Natural Language Processing

General Course Information

Course Code: PE/CDS/79-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: Mathematics

About the Course:

To understand the basic Concepts of Natural Language Processing. To demonstrate the problems using NLP Techniques. To apply of basic programming tools for NLP. To analyze the statistical approach in machine Translation.

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

CO1:Explain the approaches to syntax and semantics in NLP. (LOTS: Level 2: Understand)
CO2: Analyze the approaches of generation, dialogue and summarization within NLP.(LOTS: Level 5: Evaluate)
CO3: Illustrate the methods for statistical approaches to machine translation. (LOTS: Level 6: Create)
CO4: Apply Machine learning techniques and models for Machine Translation. (LOTS: Level 3: Apply)
CO5. Compare various Machine techniques. (LOTS: Level 4: Analyse)

Course Content

Unit I

Introduction: Introduction to the Morphology, Syntax, Semantics by linking the "linguistics view" (computational linguistics) with the "artificial intelligence view" (natural language processing).

Unit II

Morphology: Analysis and generation of language on word level: e.g., problems with compounding and idiomatic phrases, homophonous strings as well as loan words and their processing using e.g., finite state automata as well as semantic networks. Ambiguities in words like "pen" and "pipe", but will also discuss some
complex strings.

Unit III

Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for
Ambiguity Resolution in Parsing, Multilingual Issues.

Unit IV

Semantic Analysis: Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus. Representing Linguistically Relevant Concepts – Syntax Driven Semantic Analysis - Semantic Attachments –Syntax Driven Analyzer. Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval

Text and Reference Books:

- Daniel Jurafsky, James H. Martin "Speech and Language Processing" Second Edition, Prentice Hall, 2008.
- Tanvier Siddiqui: Natural Language Processing and Information Retrieval, U.S. Tiwary
- Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
- C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999

CO-PO Articulation Matrix Natural Language Processing Course: (PE/CDS/79-T)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	-	-	-	3	1	-	3	-	-	2	-	-	-
CO2.	-	2	-	3	-	1	2	3	1	-	2	-	-	-	-
CO3.	-	-	2	-	-	-	3	-	1	-	-	-	-	-	-
CO4.	-	-	2	-	2	-	-	3	-	-	-	-	-	3	-
CO5.	3	3	2	3	3	–	–	–	–	–	–	2	–	–	3
3 –High, 2-Medium, 1-Low															

Mobile Application Development Lab.

General Course Information

Course Code: PE/CDS/75-P Course Credits: 1 Type: Professional Elective Lab. Course Mode: Lab practice and assignments 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: Java programming, Object-oriented programming, RDBMS and OLTP**About the Course:** This course on Mobile Application Development is a developmental lab. work on Mobile programming. It incorporates creating Applications related to Android Studio framework. The objective of the lab course is to equip the students to solve the practical Mobile problems related to Application development.

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

CO1. **apply** Android programming concepts for calling, display, creation and validation.(LOTS: Level 3: Apply)
CO2. **generate** solutions for content providers and permissive models. (LOTS: Level 6:Create)
CO3. **compare** the visual effects generated by Android and visual studio frameworks.(LOTS: Level 4: Analyse)
CO4. **design** applications for Android Programming by using Android Studioframework. (LOTS: Level6: Create)
CO5. **create** lab record of the solutions for assignment. (LOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, independent enquiry and self-learning to solveunseen problems. (LOTS: Level 3: Apply)

List of experiments/assignments:

1. Create “Hello World” application to display “Hello World” in the middle of the screenin red color with white background.
2. Create sample application with login module. (Check username and password), validateit for login screen or alert the user with a Toast.
3. Create and validate a login application using username as Email ID else login buttonmust remain disabled.
4. Create a Login application and open a browser with any one search engine.
5. Create an application to display “Hello World” string the number of times user inputs a numeric value. (Example. If user enters 5, the next screen should print “Hello World” five times.)
6. Create spinner with strings from the resource folder (res >> value folder). Onchanging spinner value, change image.
7. Create an application to change screen color as per the user choice from a menu.
8. Create a background application that will open activity on specific time.
9. Create an application that will have spinner with list of animation names. On selectinganimation name, that animation should effect on the images displayed below.
10. Create an UI listing the engineering branches. If user selects a branch name, display thenumber of semesters and subjects in each semester.
11. Use content providers and permissions by implementing read phonebook contactswith content providers and display in the list.
12. Create an application to call a phone number entered by the user in the Edit Text box.
13. Create an application that will create database to store username and password.

14. Create an application to insert, update and delete a record from the database.

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 Mobile Application Development Lab. Course (PE/CDS/75-P)

Course Outcomes	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	_	3	–	–	–	–	–	–	–	3	–	–
CO2.	2	2	2	2	3	–	–	–	–	–	–	–	3	–	–
CO3.	2	2	2	2	3	–	–	–	–	–	–	–	3	–	–
CO4.	3	3	2	3	3	–	–	–	–	–	–	–	3	–	–
CO5.	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO6.	–	–	–	–	–	–	–	3	3	–	–	3	–	–	–
3 –High, 2-Medium, 1-Low															

Multimedia Technologies Lab.

General Course Information

Course Code: PE/CDS/76-P Course Credits: 1 Type: Professional Elective 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: Basic programming skills and knowledge of computer graphics.

About the Course:

This lab. course on Multimedia technologies involves a rigorous training on Adobe Photoshop, Macromedia Flash and blender. It incorporates solving problems related to animation and modelling framework. The objective of the lab course is to Learn to navigate and use modellingtools that will help students to gain a strong foundation in 3D design software Blender.

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

CO1. **apply** the fundamental principles of different elements of multimedia. (LOTS:Level 3: Apply)
CO2. **use** modern tools for applying state-of-the art multimedia technologies. (LOTS:Level 3: Apply)
CO3. **analyse** various tools for an application. (LOTS: Level 4: Analyse)
CO4. **create** elegant posters, sceneries, animated stories and movie clips. (LOTS: Level6: Create)
CO5. **creating** record of lab experiments. ((LOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team work. (LOTS: Level 3:Apply)

List of experiments/assignments:

Adobe Photoshop

1. Introduction to Photoshop Basics.
2. Design a poster for 2019 elections and show the difference in quality and resolution forPrint and Web.
3. Pick any picture of a magazine cover page and make changes using selection tool.
4. Draw a landscape using multiple Layers.
5. Paint a scenery of a park using different tools of Photoshop.
6. Take image from different Image Sources show variation in resolution.
7. Use effective cropping techniques to design a collage.
8. Design a scenery showing correction of image tonality.
9. Make a poster by adjusting Image Colours.
10. Painting the cover page of your magazine with Special Photoshop Tools.
11. Design a card on the occasion of Diwali using at least 3 different filters.
12. Make your passport size picture with all editing and print multiple copies of the same onA4 size page.

Macromedia Flash

13. Introduction to the layout and tools of Flash.
14. Move a car from left to right of the screen using symbols.
15. Design a movie clip.
16. Using timeline, design the casting of the movie directed by you.
17. Depict a small story using 2 D animation.Blender
18. Introduction to Blender and its various tools.
19. Create an object using blender and show its motion.
20. Using Selections and Transform make a scenery.

21. Design a character for your game using modelling.
22. Depict the change in Materials, Lights and Rendering in 3 different frames.
23. Using Blender show compositing.

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 Multimedia Technologies Lab. Course (PE/CDS/76-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	1	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2.	_	_	_	_	3	_	_	_	_	_	_	_	3	_	_
CO3.	_	_	_	_	3	_	_	_	_	_	_	_	3	_	_
CO4.	2	2	2	3		_	_	_	_	_	_	_	3	_	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Digital Image Processing Lab.

General Course Information

Course Code: PE/CDS/77-P Course Credits: 1 Type: Professional Elective 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: The students are expected to have a knowledge of computer graphics concepts.

About the Course:

This Lab course on Digital Image Processing is a developmental lab. work. It incorporates transformation of images in spatial and frequency domains, compression, restoration and reconstruction of images in SCILAB/MATLAB. The objective of the lab course is to equip the students to solve the practical Image processing problems.

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

CO1. **implement** digital image processing concepts for image compression, restorationand reconstruction in SCILAB/MATLAB. (LOTS: Level 3: Apply)

CO2. **verify** the results of applying image processing problems to images (compression,expansion, multi-resolution processing etc.) (LOTS: Level 4: Analyze)

CO3. **measure** the quality of image after the digital image processing techniques areimplemented to an image. (LOTS: Level 5: Evaluate)

CO4. **devise** solutions for Image Processing tasks problems. (LOTS: Level 6: Create)

CO5. **design** Lab record for the assignments including aim, hardware and softwarerequirements and solutions to the given problems. (LOTS: Level 6: Create)

CO6. **use** ethical practices, independent enquiry, self-learning and team spirit. (LOTS: Level3: Apply).

List of experiments/assignments

1. Two/Three introductory assignments on SCILAB/MATLAB.
2. Two assignments on Point processing and Pixel Operations e.g. scan your signature andmake it clean with thresholding.)
3. One/Two assignments on Image flipping.
4. Two assignments on Image Arithmetic such as Addition, subtraction, multiplication anddivision.
5. Create an application to display “Hello World” string the number of times user inputs a numeric value. (Example. If user enters 5, the next screen should print “Hello World” five times.)
6. Two/Three assignments on performing Logical operations on Digital images such asNAND, NOR, EX-OR on these images.
7. Two/Three assignments on calculation and equalization of histogram for an input image.
8. Two/Three assignments on geometric transformation of image such as translation,Scaling, Rotation, Shrinking, Zooming.
9. One/Two assignments on adding noise to the image and apply image restorationtechniques to improve quality of image.
10. Perform low pass and high pass filtering in frequency domain.

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 Digital Image Processing Lab. Course (PE/CDS/77-P)

Course Outcomes	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	–	3	–	–	–	–	–	–	–	–	–	3
CO2.	3	3	2	–	3	–	–	–	–	–	–	–	–	–	3
CO3.	3	3	2	_	3	–	–	–	–	–	–	–	–	–	3
CO4.	3	3	3	3	3	_	–	–	–	–	–	–	–	–	3
CO5.	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO6.	–	–	–	–	–	–	–	3	3	–	–	3	–	–	–
3 –High, 2-Medium, 1-Low															

Block Chain Technology Lab

General Course Information

Course Code: PE/CDS/78-P Course Credits: 1 Type: Professional Elective 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: Discrete Mathematics

About the Course:
This course involves studying the tools such as Python, VS Cod, understand the concept of Blockchain, demonstrate the Cryptocurrencies.

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

CO1. **Understand** the functional or operational aspects of cryptocurrency ecosystem.(LOTS: Level 1: Understand)
CO2. **Demonstrate** the emerging abstract models for Blockchain Technology. (LOTS: Level 4: Analyze)
CO3. **Able** to work with Web Wallets, Mobile Wallets, Desktop Wallets, Paper Wallets. (LOTS: Level 3: Apply)
CO4. **Apply** Blockchain in use cases like Real state, Supply chain, voting, ICO, etc (LOTS: Level 6: Create)
CO5. **Compare** various techniques. (LOTS: Level 4: Analyse)

(10 Programs like these)Detailed Contents:

1. Create a Blockchain
2. Create new blocks and add to the chain
3. Structure of a block: Index, Timestamp, Transaction List, Proof, Previous Block Hash
4. Initialize Blockchain
5. Adds new transaction
6. Hashing a block
7. Registering a node to the network
8. Validates the chain
9. Validates block before submission chain
10. Implement Proof of Work Consensus
11. Create a Cryptocurrency
12. Create a Smart Contracts had coins ico, Calculator, simple wallets
13. Supply chain smart contract
14. Voting Smart Contract

CO-PO Articulation Matrix Blockchain Technology Course (PC/CDS/78-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	–	3	–	–	–	–	–	–	–	–	–	3
CO2.	3	3	2	–	3	–	–	–	–	–	–	–	–	–	3
CO3.	3	3	2	–	3	–	–	–	–	–	–	–	–	–	3
CO4.	3	3	3	3	3	–	–	–	–	–	–	–	–	–	3
CO5.	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–
3 –High, 2-Medium, 1-Low															

Natural Language Processing Lab

General Course Information

Course Code: PE/CDS/79-P Course Credits: 1 Type: Professional Elective Lab. Course Mode: Lab practice and assignments 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

Pre-requisites: Fundamental of computer and Software engineering

About the Course:

This course involves studying algorithms available for the processing of linguistic information and computational, properties of natural languages and knowledge on various morphological, syntactic and semantic NLP tasks.

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

CO1. Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of naturallanguage. (LOTS: Level 1: Understand)
CO2. Demonstrate understanding of the relationship between NLP and statistics & machine learning. (LOTS: Level 3: Apply)
CO3. Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling (LOTS: Level 6: Create)
CO4. correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis. (LOTS: Level 3: Apply)
CO5. Develop systems for various NLP problems with moderate complexity (LOTS: Level 6: Create)

List of exercises

1. How to tokenize a given text?
2. How to get the sentences of a text document?
3. How to tokenize text with stop words as delimiters?
4. How to remove stop words and punctuations in a text?
5. How to perform stemming?
6. How to lemmatize a given text?
7. How to extract usernames from emails?
8. How to find the most common words in the text excluding stop words?
9. How to do spell correction in a given text?
10. How to classify a text as positive/negative sentiment?
11. How to extract Noun and Verb phrases from a text?
12. How to find the ROOT word of any word in a sentence?
13. Write a Python program to load the iris data from a given csv file into a data frame and print the shape of the data, type of the data and first 3 rows.
14. schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Natural Processing Lab Course (PE/CDS/79-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	_	3	–	–	–	–	–	–	–	–	–	3
CO2.	3	3	2	_	3	–	–	–	–	–	–	–	–	–	3
CO3.	3	3	2	_	3	–	–	–	–	–	–	–	–	–	3
CO4.	3	3	3	3	3	_	_	_	_	_	_	_	_	_	3
CO5.	_	_	–	–	–	–	–	–	–	3	–	–	–	–	_
3 –High, 2-Medium, 1-Low															

Major Project -I

General Course Information

Course Code: EEC/CDS/71-P Course Credits: 4 Mode: Self learning under theguidance of faculty members. Contact hours: 8 hours/week	**Course Assessment Method (100)** An internal evaluation is done by a committee of two teachers constituted by the Chairperson of the Department.The criteria for evaluation are given below. 1. Literature review: 20 2. Problem formulation: 20 3. Basic knowledge of the tools: 20 4. Organisation and presentation of synopsis: 20 5. Level of Ethics followed: 20

About the major project Part I:

Students start working on their project work in seventh semester. Student do the background research for identifying appropriate problems, methodology and tools for their respective project works to be culminated in eighth semester. They prepare a synopsis of the project work to be carried out. At the end of seventh semester, each student is required to prepare a synopsis in the format provided and present it in front of a committee constituted by the Chairperson of the Department. Students can carry out projects in groups of two. In case of group project, the size of the problem should be significant, and members of the group must specify their individual contribution.

Course Outcomes: After doing Major Project Part 1 students will be able to:

CO1. **evaluate** critically the existing solutions and methodologies through reviewingliterature. (LOTS: Level 5: Evaluate)
CO2. **formulate** suitable problems to be addressed. (LOTS: Level 6: Create)
CO3. **identify** tentative modern tools to solve the problem. (LOTS: Level 4: Analyse)
CO4. **organise** and communicate (written and oral) ideas effectively. (LOTS: Level 6: Create)
CO5. **develop** methodologies that meet ethical, societal and legal considerations. (LOTS: Level 6: Create)

CO-PO Articulation Matrix Major Project Part-I (EEC/CDS/71-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	3	3	_	_	_	_	_	_	_	3	_	_	_
CO2.	2	3	3	3	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	_	2	_	3	_	_	_	_	_	_	2	_	_	_
CO4.	_	_	_	_	_	_	_	_	_	3	3	_	_	_	_
CO5.	_	_	_	_	_	3	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Mini Project using Open- Source Tools

General Course Information

Course Code: EEC/CDS/72-P *Course Credits: 2 Mode: Design and development of mini-project in lab. No. of hours per week: -4	**Course Assessment Method (100)** An internal evaluation is done by the course coordinator. Significance and originality of the problem addressed andthe solution provided: 20 Knowledge of the problem domain and the tool used(VIVA-VOCE):25 Report Writing: 20 Judgement of the open-source tools learnt and quality ofthe solution developed: 20 Level of Ethics followed: 15

About the mini project:

Students do a mini project using open-source software after sixth semester. They are expectedto learn any opensource software and develop applications that can be completed within 4 to 6 weeks.

After doing mini-projects students will be able to

CO1. **identify** a suitable problem from the environment around. (LOTS: Level 4: Analyse)
CO2. **survey** the design of similar problems (LOTS: Level 5: Evaluate)
CO3. **select** suitable engineering specialization and modern IT tools. (LOTS: Level 3: Apply)
CO4. **address** the problem in an original and innovative manner. (LOTS: Level 6: Create)
CO5. **communicate** orally as well as in written (mini project report) about the applicationdeveloped. (LOTS: Level 6: Create)
CO6. **engage** in ethical practices, individual and team work, and lifelong learning. (LOTS: Level3: Apply)

CO-PO Articulation Matrix Mini Project using Open Source Tools Course (EEC/CDS/72-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	3	_	2	_	3	2	_	_	_	_	_	_	_	_
CO2.	_	3	2	3	_	_	_	_	_	_	_	_	_	_	_
CO3.	_	_	_	_	3	_	_	_	_	_	_	_	_	_	_
CO4.	3	3	3	3	_	2	_	_	_	_	_	_	_	_	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Detailed Syllabus of B.Tech. CSE(DS) VIII Semester

Information Retrieval

General Course Information

Course Code: PC/CDS/81-T Course Credits:3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures(L) ExaminationDuration:3hours	**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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt theremaining four questions by selecting one question from each of the four units.

Pre-requisites: Data Base Management Systems

About the Course:

This course involves studying various aspects of an Information retrieval system and its evaluation and to be able to design, techniques for hypermedia architectures, design and usability, document management and retrieval, metadata management, and searching the web.

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

CO 1. To apply IR principles to locate relevant information large collections of data.
CO 2. To design different document clustering algorithms
CO 3. To implement retrieval systems for web search tasks.
CO 4. To design an Information Retrieval System for web search tasks.
CO 5. To analyze and address ethical considerations and challenges

Course Content

Unit I

Goals and history of IR. The impact of the web on IR. Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.

Unit II

Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors Performance metrics: recall, precision, F-measure, and NDCG; Evaluations on benchmark text collections.

Unit III

Relevance feedback; Query expansion. Word statistics; Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. Search engines; spidering; meta crawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank); shopping agents.

Unit IV

Categorization algorithms: Rocchio, nearest neighbour, and naive Bayes. Applications to information filtering and organization. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM). Applications to web search and information organization

Text and reference books:

1. Information Storage and Retrieval Systems – Theory and Implementation, Second Edition, Gerald J. Kowalski, Mark T. Maybury, Springer
2. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008. http://nlp.stanford.edu/IR-book/information-retrievalbook.html Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016
3. Cheng Xiang Zhai, Statistical Language Models for Information Retrieval (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008. Yoshua Bengio, Learning Deep Architectures for AI, now Publishers Inc., 2009
4. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
5. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons.
6. Modern Information Retrieval By Yates and Neto Pearson Education.

CO-PO Articulation Matrix Information Retrieval Course (PC/CDS/81-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	_	_	_	_	_	_	_	_	_	_	_	_	_
CO2.	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3.	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO4.	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO5.	_	2	2	_	_	_	2	_	_	_	_	_	2	_	_
3 –High, 2-Medium, 1-Low															

Internet of Things

General Course Information

Course Code: PE/CDS/81-T Course Credits: 3 Type: Professional Elective Course 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: Fundamentals of Computer Networks

About the Course:

The field of Internet of Things is growing very fast. The purpose of this course is to impart theknowledge on basic concepts of IoT, its Architecture, various protocols and applications in real world scenarios.

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

CO1. **state** the basic concepts and key technologies of IoT. (LOTS: Level 1: Remember)
CO2. **discuss** the pros and cons of various protocols for IoT. (LOTS: Level 2: Understand)
CO3. **apply** the IOT models for business applications. (LOTS: Level 3: Apply)
CO4. **analyse** applications of IoT in real time scenario. (LOTS: Level 4: Analyse)
CO5. **design** business model scenarios (LOTS: Level 6: Create)

Course Content

Unit I

What is the Internet of Things? History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks: IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Basics Of Microcontroller, Microprocessor Vs Microcontroller, Typesof Sensor, Actuators and their Applications.

Unit II

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, Satellite Technology.

Unit III

IoT Access Technologies: Physical and MAC layers, Topology and Security of IEEE 802.15.4, 802.15.4g, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

Unit IV

Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Applications: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Smart Transportation and Smart Shopping.

Text and Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*, Cisco Press,1st Edition, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , *The Internet of Things – Key applications and Protocols*, Wiley, 2nd Edition, 2012.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), *Architecting the Internet of Things*, 1st Edition, Springer, 2011.
4. Michael Margolis, Arduino Cookbook, "*Recipes to Begin, Expand, and Enhance Your Projects*", 2nd Edition, O'Reilly Media, 2011.
5. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, 1st Edition, Universities Press, 2015.

CO-PO Articulation Matrix Introduction to Internet of Things Course (PE/CDS/81-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	–	–	2	–	–	–	–	–	–	–	–	–	2	–
CO2.	1	–	–	3	–	–	–	–	–	–	–	–	–	3	–
CO3.	2	2	2	3	3	–	–	–	–	–	–	–	2	3	–
CO4.	3	3	2	_	3	–	–	–	–	–	–	–	2	3	2
CO5.	3	3	2	_	3	_	_	_	_	_	_	_	_3	3	2
3 –High, 2-Medium, 1-Low															

Network Administration and Management

General Course Information

Course Code: PE/CDS/82-T Course Credits: 3 Type: Professional Elective Course 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: Networking, protocols defined in layered Architecture, programmingfundamentals**.**

About the Course:

Network Administration and Management is a Professional Elective course deemed to be necessary during the present era of Information Technology and Computer Science. This course deals with analyzing Network for statistics such as protocols, servers, memory, CPU etc. Network Monitoring and Management deals with different events in various types of platforms for response.

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

CO1. **define** Network Administration and its various components. (LOTS: Level 1: Remember)
CO2. **distinguish** Network Administration and its Management on various platforms. (LOTS: Level 2: Understand)
CO3. **classify** the output for different responses to events by interpreting Network Monitoring statistics. (LOTS: Level 3: Apply)
CO4. **separate** portions of Network for troubleshooting using various tools. (LOTS: Level 4: Analyse)
CO5. **combine** Network Administration, Network Management and Network Monitoring into a one scenario and compute the performance of the integrated environment. (LOTS: Level 6: Create)

Course Content

Unit I

Network Administration: Introduction to Network Administration Approaches, Addressing, Subnetting and Super netting, Fixed Vs Variable Masks, VLAN Principles and Configuration, Routing Concepts: Static and Dynamic Routing, Routing Protocols: RIP, OSPF, BGP. Network Address Translation (NAT), Configuring a Windows Box as a Router, Dial-up configuration and Authentication: PPP, Radius, RAS. Configuring a DNS Server in windows, Configuring Send mail Service, configuring a Web Server, configuring a ProxyServer, TCP/IP Troubleshooting: ping, traceroute, if config, netstat, ipconfig.

Unit II

Linux Network Administration: Setting up a file server, setting up samba server, configuring Network services: installing and configuring DHCP server, installing and configuring DNS server, setting up internal NTP server, hosting http content via Apache, sharing resources in a Network.

Unit III

Network management: Management Standards and models, Configuration Management and auto discovery, Fault Management, Fault identification and isolation, Event correlation techniques, SNMPv1, SNMPv2: Structure of Management Information, Standard Management Information Base (MIBs), MIB-II, Network Management Functions: Accounting Management, Performance Management, Network Usage, Metrics, and Quotas, SNMPv3: Protocol, MIB.

Unit IV

Network Monitoring: Network Performance Monitoring, Remote Network Monitoring (RMON1): Statistics Collection, Alarms and Filters, RMON2: Monitoring Network Protocol Traffic, Application-Layer Visibility, Management Tools, Systems and Applications: Test and Monitoring tools, Integrating tools, Development tools, Web-based Enterprise Management.

Text and Reference Books:

1. Mark Burgess, *Principles of Network and System Administration*, 2nd Edition,Wiley publications,2004.
2. Craig Hunt, *TCP/IP Network Administration*, 3rd Edition, O'Reilly Publications, 2002.
3. George Splading, *Windows 2000 Administration*, Tata McGraw-Hill, 2000.
4. Tony Bautts, Terry Dawson, and Gregor N. Purdy, *Linux Network Administrator'sGuide*, 3rd Edition,O'Reilly publications, 2005.

CO-PO Articulation Matrix Network Administration and Management Course (PE/CDS/82-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	2	2	2	3	3	_	_	_	_	_	_	_	_	3	_ __
CO4.	2	3	2	2	3	_	_	_	_	_	_	_	_	3	_
CO5.	3	3	2	3	3	_	_	_	_	_	_	_	_	3	__
3 –High, 2-Medium, 1-Low															

Software Testing and Quality Assurance

General Course Information

Course Code: PE/CDS/83-T Course Credits: 3 Type: Professional Elective Course 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: Software Engineering.

About the Course:

This course introduces students to software testing process and describes the quality assurance process and its role in software development. During the course students learns about the testing methods and tools, creating good test cases to improve the quality of software.

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

CO1. **recall** the process of software testing life cycle and quality assurance. (LOTS: Level1: Remember)

CO2. **demonstrate** reusability testing on software applications. (LOTS: Level 2:Understand)

CO3. **apply** software testing tools for predicting the behavior of software applications.(LOTS: Level 3: Apply)

CO4. **identify** the test cases for software applications. (LOTS: Level 4: Analyse)

CO5. **plan** test cases and quality management activities. (LOTS: Level 6: Create)

CO6. **predict** software quality based on quality parameters and quality models. (LOTS:Level 6: Create)

Course Content

Unit I

Introduction to Basic of software testing & Terminology, Software Development & Software Testing Life Cycle- role and activities, Necessity and Objectives of testing; Quality Concepts, Quality Control, Different Software Development Model; Object– oriented testing, Web testing, GUI testing; Elements of Software quality assurance; Quality Assurance Activities, Statistical Quality Assurance; Software Reliability.

Unit II

Testing Concepts, Issues and Techniques, Levels of Testing, Verification and Validation Model ; Unit testing, Integration testing, Function Testing ; System testing, Installation Testing, Usability Testing, Regression testing, ; Performance testing:-Load Testing, Stress Testing, Security testing, Volume testing ; Acceptance testing:-Alpha testing, Beta testing, Gamma testing.

Unit III

Black Box Testing Methods: Equivalence partitioning, Boundary-value analysis, Error guessing, graph-based testing methods, Decision Table Testing; White Box Testing Methods: Statement coverage, Decision coverage, Condition coverage, Path testing, Data flow testing.

Test Planning & Documentation: Development plan and quality plan objectives; Testing Strategy.

Unit IV

Testing Tools, Features of test tool; Guidelines for selecting a tool; Tools and skills of tester; Static testing tools, Dynamic testing tools, Advantages and disadvantages of using tools, Introduction to open source testing tool.

Text and reference books:

1. M. G. Limaye, *Software Testing Principles, Techniques and Tools*, TMH, 2009.
2. Yogesh Singh, *Software Testing*, Cambridge University Press, 2016.
3. Ron Pattorn, *Software Testing*, 2nd edition, Sams, 2005.
4. Roger S. Pressman, Software Engineering- a Practitioners approach, 8th edition,McGraw Hill, 2014
5. Jeff Tian, *Software Quality Engineering: Testing, Quality Assurance and Quantifiable Improvement*,Wiley, 2005.
6. Stephan H. Kan, *Metrics and Models in Software Quality Engineering*, 2nd edition,Addison-Wesley,2009.
7. William E. Perry, *Effective Methods of Software Testing*, 2nd edition, Wiley, 2000.

CO-PO Articulation Matrix Software Testing and Quality Assurance Course (PE/CDS/83-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	2	2	2	3	_	_	_	_	_	_	_	3	_	_
CO4.	2	3	2	3	_	_	_	_	_	_	_	_	3	_	_
CO5.	3	3	3	3	3	_	_	_	_	_	_	_	3	_	_
CO6.	3	3	2	3	3	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Artificial Neural Network

General Course Information

Course Code: PE/CDS/84-T Course Credits: 3 Type: Professional Elective Course 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: Artificial Intelligence

About the Course:

Artificial Neural network is the study of neural networks in engineering, acquire the knowledge of artificial intelligence, and cognitive modeling, implement the concept of types of neural networks and analyze of computation and dynamical systems using neural networks.

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

CO1. Identify the neural network algorithms.(LOTS: Level 1: Remember)
CO2. **interpret** the results of neural network algorithms. (LOTS: Level 2:Understand)
CO3. **apply** a variety of neural network algorithm on the available dataset. (LOTS:Level 3: Apply)
CO4. Implement the neural network algorithms and solve real-world problems. ((LOTS: Level 4: Analyse)
CO5. Perform evaluation of neural network algorithms. (LOTS: Level 5:Evaluate)

Course Content

Unit I

General characteristics of the human brain, Introduction to Biological Neural Networks, Nerve structure and synapse, Basic concepts of Neural Networks, Characteristics of Neural Networks, Terminologies, Applications of the artificial neural networks.

Unit II

Structure of a neural net (topology), Directed graphs, Models of Neuron, Neural Network Architectures, Artificial Neuron, Activation functions, Threshold function, Piecewise linear function, Sigmoidal function, Supervised learning, Unsupervised learning, Re-enforcement Learning.

Unit III

Knowledge Representation, Artificial Intelligence, learning rules, Error correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, single layer perceptron,

Multilayer perceptron, Back propagation, Recurrent networks, Network pruning. Adaptive networks, Supervised Learning Neural Networks, Decision-based neural networks, Hierarchical neural networks,

Unit IV

Multilayer perceptron. Support vector machines, Self-organization maps, Genetic Algorithms, Optimization, Prediction Systems, speech and decision-making.

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 Tibshi rani, 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. Rajesh karan, G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications*, PHI, 2003.
5. 5.E. Perry, *Effective Methods of Software Testing*, 2nd edition, Wiley, 2000.

CO-PO Articulation Matrix Artificial Neural Network Course (PE/CDS/84-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	1	_	_	_	_	_	_	_	_	_	_	3
CO2	2	2	2	3	_	_	_	_	_	_	_	_	_	_	3
CO3.	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO4.	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO5.	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
3 –High, 2-Medium, 1-Low															

Deep Learning

General Course Information:

Course Code: PE/CDS/85-T Course Credits: 3 Type: Professional Elective 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: knowledge of linear algebra, calculus, programming skills, probability, and Statistics. Students also must have fundamental knowledge of Machine Learning.

About the Course:

Students can understand the theoretical foundations, algorithms and methodologies of Neural Network, application using specific deep learning models and analysing real world applications.

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

CO1. To recognizes the characteristics of deep learning models that are useful to solve real-world problems.
CO2. To differentiates different methodologies to create application using deep nets.
CO3. To identifies and applies appropriate deep learning algorithms for analyzing the data for variety of problems.
CO4. To implements different deep learning algorithms.
CO5. To designs the test procedures to assess the efficacy of the developed model.
CO 6. To applies deep learning techniques to solve real-world problems in various domains.

Course Content

Unit I

Introduction: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Unit - II

Feed Forward Network: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders.

Unit-III

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.
Newer optimization methods for neural networks (Ada grad, ada delta, rms prop, adam, NAG), second Order methods for training, Saddle point problem in neural networks, Regularization methods (dropout , drop connect, batch normalization).

Unit - IV

Recurrent Neural Networks: Back propagation through time, Long ShortTerm Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs

Text and Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Ian Good fellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016
3. Michael A. Nielsen, Neural Networks and Deep Learning, Determination Press, 2015
4. Yoshua Bengio, Learning Deep Architectures for AI, now Publishers Inc., 2009
5. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
6. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” A press, 2018 .

CO-PO Articulation Matrix Deep Learning Course (PE/CDS/85-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	2	_	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO3.	2	1	_	_	_	_	_	_	_	_	_	_	3	_	_
CO4.	2	2	1		2	_	_	_	_	_	_	_	3	_	_
CO5.	2	2	1		2	_	_	_	_	_	_	_	3	_	_
CO6.	3	3	2	2	3	_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Big Data Analytics

General Course Information

Course Code: PE/CDS/86-T Course Credits: 3 Type: Professional Elective Course Contact Hours: 3 hours/weekMode: 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 statistics and data mining.

About the Course:

This course aims to provide students with the knowledge of current challenges, methodologies and technologies in processing big data. Emphasis will be placed on the students' understanding of the rationales behind the technologies and the students' ability to analyse big data using professional packages and tools.

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

CO1. **recall** the concepts of big data analysis. (LOTS: Level 1: Remember)
CO2. **interpret** the outcomes of big data analysis. (LOTS: Level 2: Understand)
CO3. **apply** technical skills and modern tools for descriptive and predicative modelling.(LOTS: Level 3: Apply)
CO4. **analyse** a framework for visualization of big data analytics for business user.(LOTS: Level 4: Analyse)
CO5. **examine** critically the results of mining to support business decision-making.(LOTS: Level 5: Evaluate)
CO6. **design** schemes for big data analytics for solving big data problems in efficientmanner. (LOTS: Level 6: Create)

Course Content

Unit I

Introduction: Overviews of Big Data, State of the Practice in Analytics, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle Challenges of Conventional Systems, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error, Regression Modelling, Multivariate Analysis, Bayesian Modelling.

Unit II

Mining Data Streams: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics, Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis, Stock Market Prediction

Unit III

Frequent Itemset and Clustering**:** Mining Frequent Item sets, Market Based Model: A priori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent Item sets in a Stream, clustering based Techniques: Hierarchical, K-Means etc., Clustering High Dimensional Data, CLIQUE And PROCLUS, Frequent Pattern based ClusteringMethods, Clustering in Non-Euclidean Space,

Clustering for Streams and Parallelism.

Unit IV

Frameworks and Visualization: Overview of MapReduce, Hadoop, Hive, Map R, Sharding, NoSQL Databases, S3, HADOOP, Distributed File System (HDFS), Visualizations: Visual Data Analysis Techniques, Interaction Technique and Applications.

Text and Reference Books:

1. Michael Berthold, David J. Hand, *Intelligent Data Analysis*, Springer, 2007.
2. A. Rajaraman, J.D. Ullman, *Mining of Massive Datasets*, Cambridge University Press,2012.
3. Bill Franks, *Taming the Big Data Tidal Wave: Finding Opportunities in HugeData Streams with Advanced Analytics*, John Wiley & sons, 2012.
4. Glenn J. Myatt, *Making Sense of Data*, John Wiley & Sons, 2007
5. Pete Warden, *Big Data Glossary*, O'Reilly, 2011.

CO-PO Articulation Matrix Big Data Analytics Course (PE/CDS/86-T)

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	_	1	_	_	_	_	_	_	_	_	_	_	2
CO2.	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO3.	3	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO4.	3	2	2	3	_	_	_	_	_	_	_	_	_	_	3
CO5.	3	2	2	3	_	_	_	_	_	_	_	_	_	_	3
CO6.	3	2	2	3	_	_	_	_	_	_	_	_	_	_	3
3 –High, 2-Medium, 1-Low															

Web Development

General Course Information

Course Code: PE/CDS/87-T Course Credits: 3 Type: Professional Elective Course 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: knowledge of Computer Basics

About the Course:
Web development is a management of information. Web Development is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces web designing tools like HTML, XML, Java Script and ASP/JSP etc. and various web site will be designed with the help of these tools for solving real world problems. It includes various types of website. Further, It is more useful for dynamic programming as well.

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

CO 1. **Enlist** principles of Information Architecture for Web design. (LOTS: Level1: Remember)
CO 2. **explain** navigational systems, labeling systems, and taxonomies for websites.(LOTS: Level 2: Understand)
CO 3. **apply** basic web designing tools (HTML, XML, ASP/JSP, J Query, Java Script).(LOTS: Level 3: Apply)
CO 4. **evaluate** critically design of webpages based on various technologies. (LOTS: Level5: Evaluate)
CO 5. **create** a report describing or making recommendations for a website design. (LOTS:Level 6: Create)

Course Content

Unit I

Information Architecture, Role of Information Architect, Collaboration and Communication, Organizing Information, Organizational Challenges, Organizing Web Sites and Intranets, Creating Cohesive Organization Systems Designing, Navigation Systems, Types of Navigation Systems, Integrated Navigation Elements, Remote Navigation Elements, Designing Elegant Navigation Systems, Searching Systems, Designing the Search Interface, Indexing the Right Stuff, What to Search or not to Search, Grouping Content, Conceptual Design, Architecture Blueprints, Architectural Page Mockups, Design Sketches.

Unit – II

Structured Information, Design and Documentation, XML Web 6.0, JDBC, Metadata, Unstructured Information, Techniques for Unstructured Information, HTML Basic Concepts, Good Web Design, Process of Web Publishing, Phases of Web Site Development, Structure of Html Documents, Html Elements for

Designing Pages. Text Level Events, Linking Basics, Linking In Html, Images and Anchors Attributes, Image Maps, Semantic Linking Meta Information, Image Preliminaries, Images, Layout Design, Advanced Layout. Audio Support in Browsers, Video Support, Other Binary Formats. Style Sheets, Positioning With Style Sheets. Basic Interactivity and Html: Forms, Forms Control, Advance HTML and Web Designing.

Unit – III

Alternative Technologies for Designing, The Hypertext Transport Protocol, URLs, HTTP, Browser Requests, Server Responses, Proxies, Content Negotiation, The Common Gateway Interface, The CGI Environment Variables. CGI Output, Forms and CGI, Sending Data to the Server, Form Tags, Decoding Form Input, Architectural Guidelines, Coding Guidelines, Efficiency and Optimization. JSP Basics, Integrating Scripts in JSPs, ASP Objects and Components, JSP: Request and Response Objects, Retrieving the Contents of a HTML form, retrieving a Query String, Cookies, Creating and Reading Cookies.

Unit – IV

XML basics, Relationship between HTML, SGML, and XML, Valid Documents. Ways to use XML, XML for Data Files, Embedding XML into HTML documents, Converting XML to HTML for DISPLAY, Displaying XML using CSS and XSL, Rewriting HTML as XML, Basics of Advance Web Development Tools.

Text and Reference Books:

1. Thomas A Powell, *HTML-The Complete Reference*, Tata McGraw Hill, 2003.
2. Scott Guelich, Shishir Gunda varam, Gunther Bernie, *CGI Programming withPerl* 2nd edition, O'Reilly, 2000.
3. Doug Tidwell, James Snell, Pavel Kulchenko, *Programming Web Services with SOAP*,O'Reilly, 2009.
4. Young, *XML Step by Step*, 2nd edition, PHI.
5. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, *Internet & World Wide WebHow to Program*, 5thedition, 2008.

CO-PO Articulation Matrix Web Development Course (PE/CDS/87-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2.	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3.	2	2	2	2	3	3	–	–	–	–	–	–	3	2	–
CO4.	3	3	2	3	3	3	–	–	–	–	–	–	3	2	–
CO5.	–	–	–	3	3	–	–	3	3	3	2	–	3	–	–
3 –High, 2-Medium, 1-Low															

Quantum Computing

General Course Information

Course Code: PE/CDS/88-T Course Credits: 3 Type: Professional Elective Course 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 and Algorithm, Programming in Python/C

About the Course:

To impart necessary knowledge to the learner so that he/she can develop and implement algorithm and write programs using these algorithms.

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

CO1. To interpret working of a Quantum Computing program, its architecture and program model

CO 2. To develop quantum logic gate circuits

CO 3. To develop quantum algorithm

CO4. To implement quantum algorithm on major tool kits ions

CO5. To apply quantum computing principles and algorithms to solve machine learning problems.

CO6. To understand the applications and limitations of quantum machine learning techniques.

Course Content

Unit I

Fundamental Concepts : Global Perspectives–Quantum Bits–Quantum Computation–Quantum Algorithms-Experimental Quantum Information Processing – Quantum Information.

Unit II

Feature identification, selection and extraction. Distance measures, clustering transformation and feature ordering, clustering in feature selection, feature selection through maximization and approximations.

Unit III

Pattern classification by distance functions. Clusters and cluster seeking algorithms. Pattern classification by likelihood functions. Baye's classifier and performance measures. Applications of statistical and neural network–based pattern classifiers in speech recognition, image recognition and target recognition.

Unit IV

Introduction to Quantum Machine Learning, Quantum Neural Networks , Quantum Support Vector Machines, Quantum k-means Clustering, Quantum Dimensionality Reduction, Quantum Generative Models.

Text and Reference Books:

1. Michael A. Nielsen, IssacL.Chuang , “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010.

2. "Quantum Machine Learning: What Quantum Computing Means to Data Mining" by Peter Witten

CO-PO Articulation Matrix Quantum Computing Course (PE/CDS/88-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	-	-	-	-	-	-	-	-	1	1	2
CO2.	1	2	-	2	-	-	-	-	-	-	-	-	1	2	-
CO3.	2	1	2	1	-	-	-	-	-	-	-	-	2	1	2
CO4.	1	2	-	2	-	-	-	-	-	-	-	-	1	2	-
CO5.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
CO6.	-	2	1	2	-	-	-	-	-	-	-	-	-	2	1
3 –High, 2-Medium, 1-Low															

Digital Forensics

General Course Information

Course Code: PE/CDS/89-T Course Credits: 3 Type: Professional Elective Course 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: working knowledge of Windows/Macintosh/Linux, Network security.

About the Course:

The course on Digital Forensics is an inevitable study in this information era. Computer crimesare on a hike by the hackers and cyber criminals. The need to recover the deleted, hidden and corrupted files on Windows/Macintosh/Linux platforms give an opportunity to offer digital forensics automating features. This will give students a chance to study laws of court against computer crimes committed intentionally or inadvertently.

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

CO1. **determine** the hardware and operating system requirements for digital forensics.(LOTS: Level 1:Remember)

CO2. **represent** digital forensics by organization of data and metadata in computersystems. (LOTS: Level2: Understand)

CO3. **analyze** file recovery and hidden file extraction techniques. (LOTS: Level 4: Analyze)

CO4. **identify** various types of forensics in the arena of information technology. (LOTS: Level 4:Analyze)

CO5. **critic** the computer crimes by studying the security Laws and legal Landscape around the world.(LOTS: Level 5: Evaluate)

CO6. **integrate** security of computer systems with digital forensics and evaluate its performance. (LOTS: Level 6: create)

Course Content

Unit I

Introduction to Digital Forensics: digital crimes, digital investigation, evidence, extraction, preservation etc.; overview of hardware and operating systems: structure of storage media/devices, Windows/Macintosh/Linux- registry, boot process; disk and file system analysis,data acquisition of physical storage devices.

Unit II

Data recovery: identifying hidden data, recovering deleted files; digital evidence controls: uncovering attacks that evade detection by event viewer, task manager and other windows GUI tools; disk imaging, recovering swap files, temporary and cache files; automating analysis and extending capabilities.

Unit III

Network Forensics: collecting and analyzing network-based evidence, reconstructing web browsing, email activity, intrusion detection, tracking offenders, windows registry changes, etc.; Mobile Network

forensics: introduction, investigations, collecting evidences, where to seek digital data for further investigations; Email and database forensics; memory acquisition.

Unit IV

Computer crime and legal issues: intellectual property, privacy issues, criminal justice systemfor forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation and deposition of legal evidence in a court oflaw.

Text and Reference Books:

1. Thomas J Holt, Adam M Bossler, Kathryn C Seigfried-Spellar, *Cybercrime and Digital Forensics: An Introduction*, Routledge, 2015.
2. Cory Altheide and Harlan Carvey, *Digital Forensics with Open-Source Tools*, Elsevier publication, April2011.
3. B. Nelson, A. Phillips, F. Enfinger, C. Steuart, *Guide to Computer Forensics and Investigations* 4thedition, Thomson, 2009.
4. Michael Hale Ligh, Andrew Case, Jamie Levy, A Aron Walters, *The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory*, july 2014.

CO-PO Articulation Matrix Digital Forensics Course (PE/CDS/89-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	2	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	2	2	_	_	3	_	_	_	_	_	_	_	_	3	_
CO4.	2	2	2	2	3	_	_	_	_	_	_	_	_	3	2
CO5.	3	3	3	3	_	3	_	3	_	3	_	_	_	3	_
CO6.	3	3	2	3	3	_	_	_	_	_	_	_	_	3	—
3 –High, 2-Medium, 1-Low															

Internet of Things Lab.

General Course Information

Course Code: PE/CDS/81-P Course Credits: 1 Type: Professional Elective 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: Basic knowledge of C/C++ language, Basics of Electronics.

About the Course:

This course focuses on significant components of Internet of Things. The objective of this labcourse is to make the students familiar with prototype and key components of networking for development of application based on Internet of Things.

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

CO1. S**olve** the existing problems of traditional sensor networks and wirelesscommunication using the concepts of Internet of Things. (LOTS: Level 3: Apply)
CO2. **analyse** the working of controllers and sensors. (LOTS: Level 4: Analyse)
CO3. **compare** and contrast the existing solutions related to IOT. (LOTS: Level 5:Evaluate)
CO4. **design** solutions for practical assignments by using Internet of Things technologies.(LOTS: Level 6: Create)
CO5. **create** lab reports by presenting the ideas regarding solutions in an effectivemanner. (LOTS: Level6: Create)
CO6. **demonstrate** independent enquiry, team spirit and ethical practices while solvingproblems. (LOTS: Level 3: Apply)

List of experiments/assignments:

1. In order to implement IoT practical assignments one needs the following:
   - Hardware Setup- device capable of storage and network, e.g. Raspberry Pi,Intel Galileo, Intel, Edison, Multiple sensors etc.
   - Software- Wiring Pi (C++ for Raspberry Pi), Wiring x86 (Python for IntelEdison)
   - API to connect hardware to web server
   - Web Interface
2. Two assignments to figure out input and output devices.
3. Two assignments to interface digital and analogue devices with microcontroller unit.
4. Two assignments for calibration of sensors.
5. Two assignments for receiving data from sensors serially.
6. Two assignments to read the values from sensors.
7. Two assignments based on testing of temperature sensor , integrating of temperature sensor with microcontroller ,temperature control over internet

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 Internet of Things Lab. Course (PE/CDS/81-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	2	3	–	–	–	–	–	–	–	–	3	2
CO2.	2	2	2	3	3	–	–	–	–	–	–	–	–	3	2
CO3.	3	2	2	3	2	–	–	–	–	–	–	–	–	3	2
CO4.	3	3	2	3	3	–	–	–	–	–	–	–	–	3	3
CO5.	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO6.	–	–	–	–	–	–	–	3	3	–	3	–	–	–	–
3 –High, 2-Medium, 1-Low															

Network Administration and Management Lab.

General Course Information

Course Code: PE/CDS/82-P Course Credits: 1 Type: Professional Elective 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 Computer Networks, System Administration, Unix/Linux Command line.

About the Course:

This lab. course on Network Administration and Management involves configuration of servers for different platforms. It incorporates setting up of ones' machine to be connected to a Network and checking its status frequently for any intrusion. The objective of the lab. course is to equip the students to solve the practical Administration, Management and Monitoring related problems.

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

CO1.C**onfigure** a server to work as a DNS/DHCP/FTP/Web/Mail/Print server (LOTS: Level3: Apply)
CO2. **detect** the trends in attacks through in depth attack analysis. (LOTS: Level 4: Analyse)
CO3. **formulate** solutions for Monitoring assignments by using principles of Networkstatistics. (LOTS: Level 6: Create)
CO4. **plan** solutions for overall security of Computer/Network systems. (LOTS: Level 6:Create)
CO5. **create** file records of solutions of assignments. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3:Apply)

List of experiments/assignments:

1. Management (creation, modification and deletion of left users) of the users & theirdomain.
2. Setting up the local security policy for the system, software.
3. Maintaining your system in Linux Networking and Setup Linux for firewall and IPfiltering.
4. Configure the kernel for IP Accounting and IP Masquerade.
5. Install send mail distribution and create send mail configuration files.
6. Start and stop services from user window and command prompt.
7. Use of event viewer and performance monitor.
8. Management of the IIS and FTP server.
9. Setting up of router in Window 2000 server and Linux server.
10. Use of utilities (a) Ping(b) Tracert (c) netstat(d) net(e) IP configuration (f) Path ping
11. Monitor the Network using performance monitoring tools such as RMON, tcpdump etc.
12. Setting up of a DNS server.
13. Setting up and use "Terminal Client Services".

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 Network Administration and Management Lab. Course (PE/CDS/82-P)

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_ _	2	_	3	_	_	_	_	_	_	_	_	3	_ _
CO2.	2	2	2	2	3	_	_	_	_	_	_	_	_	3	_
CO3.	3	3	3	3	3	_	_	_	_	_	_	_	_	3	_
CO4.	3	3	3	3	3	2	_	_	_	_	_	_	_	3	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Software Testing and Quality Assurance Lab.

General Course Information

Course Code: PE/CDS/83-P Course Credits: 1 Type: Professional Elective 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 Software Engineering along with Programming in C/C++/Java or /MATLAB.

About the Course:

In this lab. Course, students learn to design, generate, minimize, and prioritize test cases of a software application using programming language or with the help of software testing tools. The lab experiments involve designing testing datasets by taking case studies and applying software testing techniques on these datasets. The course has a special focus on understanding and implementation of test results of software testing techniques to improve software quality.

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

CO1. **implement** software testing using testing tools. (LOTS: Level 3: Apply)
CO2. **apply** software testing techniques for the classification of test cases. (LOTS: Level 3: Apply)
CO3. **interpret** the results of various software testing techniques. (LOTS: Level 4: Analyse)
CO4. **plan** test case activities. (LOTS: Level 6: Create)
CO5. **prepare** lab reports for software quality testing assignments. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Write a program to count the number of digits in a number. Its input is any number from interval [0,9999]. Design the boundary value analysis test cases and robustness test cases.
2. Write a program to calculate cyclomatic complexity.
3. Consider a program to perform binary search and generate the test cases usingequivalence class testing and decision table based testing.
4. Write a program to determine whether a number is even or odd. Draw the programgraph and DD path graph. Find the independent paths.
5. Consider the program for classification of a triangle. Consider all variables andgenerate possible program slices. Design at least one test case from every slice.
6. Consider the problem statement of a University Student Registration System. Prepare the software requirement checklist with the details of faults in the given SRS.
7. Write a program to generate, minimize and prioritize test cases using anyprogramming language/MATLAB Tool/Software Testing tool.
8. Write the outline of test plan document as per IEEE Std 829-1998.
9. 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 Software Taesting and Quality Assurance Lab. Course (PE/CDS/83-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	_	_	_	_	_	_	_	3	_	_
CO2.	2	2	2	2	3	_	_	_	_	_	_	_	3	_	_
CO3.	3	2	3	3		_	_	_	_	_	_	_	3	_	_
CO4.	3	3	3	3	3	_	_	_	_	_	3	_	3	_	_
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Artificial Neural Network Lab

General Course Information

Course Code: PE/CDS/84-P Course Credits: 1 Type: Professional Elective 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 Artificial Intelligence

About the Course:

In this lab. Course, students learn to design, generate, minimize, and prioritize test cases of a software application using programming language or with the help of software testing tools. The lab experiments involve designing testing datasets by taking case studies and applying software testing techniques on these datasets. The course has a special focus on understanding and implementation of test results of software testing techniques to improve software quality.

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

CO1. **implement** different neural network models. (LOTS: Level 3: Apply)
CO2. **apply** optimization techniques. (LOTS: Level 3: Apply)
CO3. **interpret** the results of various problems solved through neural network. (LOTS: Level 4: Analyse)CO4. **plan** pattern storage task activities. (LOTS: Level 6: Create)
CO5. **prepare** lab reports for ANN assignments. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Parallel and distributed processing - I: Interactive activation and competition models
2. Parallel and distributed processing - II: Constraint satisfaction neural network models
3. Perceptron learning
4. Multi layer feed forward neural networks
5. Hopfield model for pattern storage task
6. Hopfield model with stochastic update
7. Competitive learning neural networks for pattern clustering
8. Solution to travelling salesman problem using self organizing maps
9. Solution to optimization problems using Hopfield models
10. Weighted matching problem: Deterministic, stochastic and mean-field annealing of an Hopfield model
    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 Artificial Neural Network Lab. (PE/CDS/84-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	2	3	_	_	_	_	_	_	_	3	_	_
CO2.	2	2	2	2	3	_	_	_	_	_	_	_	3	_	_
CO3.	3	2	3	3		_	_	_	_	_	_	_	3	_	_
CO4.	3	3	3	3	3	_	_	_	_	_	3	_	3	_	_
CO5.	2	2	2	2	3	_	_	_	_	_	_	_	3	_	_
CO6.	3	2	3	3		_	_	_	_	_	_	_	3	_	_
3 –High, 2-Medium, 1-Low															

Deep Learning Lab.

General Course Information

Course Code: PE/CDS/85-P Course Credits: 1 Type: Professional Elective 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: Programming knowledge AI/ML basics

About the Course:

This lab course involves implementation of basic and advanced programs of deep learning. The objective of the lab. course is to train the students to solve the problems related to deep learning using Python/R.

Course Outcomes: By the end of the lab course a student would be able to:

CO1. **implement** deep learning programs in. TensorFlow, Keras, Theano and PyTorch. (LOTS: Level 3: Apply)

CO2. **apply** deep learning concept for developing database applications. (LOTS: Level 3: Apply)

CO3. **analyse** given programs for their correctness and efficiency for given inputs andexpected outputs. (LOTS: Level 4: Analysis)

CO4. **integrate** Time Series Prediction using RNN.(LOTS: Level 6: Create)

CO5. **create** written records for the given assignments with problem definition, design ofsolution and conclusions. (LOTS: Level 6: Create)

CO6. **demonstrate** ethical practices while solving problems individually or in groups(LOTS: Level 3: Apply).

List of experiments/assignments

1. Classification with Multilayer Perceptron using Scikit-learn (MNIST Dataset)
2. Hyper-Parameter Tuning in Multilayer Perceptron
3. Deep learning Packages Basics: Tensor flow, Keras, Theano and PyTorch
4. Classification of MNIST Dataset using CNN
5. Face recognition using CNN
6. Object detection using Transfer Learning of CNN architectures
7. Recommendation system using Deep Learning
8. Dimensionality Reduction using Deep learning
9. Time Series Prediction using RNN
10. Language Modeling using RNN
11. Sentiment Analysis using LSTM
12. Image generation using GAN

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 Deep Learning Lab. (PE/CDS/85-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	1	-	-	3	_	_	_	_	_	_	_	_	_	2
CO2.	2	2	-	3	3	_	_	_	_	_	_	_	_	_	3
CO3.	3	3	-	3	3	_	_	_	_	_	_	_	_	_	3
CO4.	3	3	1	3	3	_	_	_	_	_	_	_	_	_	3
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Big Data Analytics Lab.

General Course Information

Course Code: PE/CDS/86-P Course Credits: 1 Type: Professional Elective 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: Some basic knowledge and experience of Java (JARS, Array, Classes, Objects,etc.)

About the Course:

This lab course provides an overview of key technology used in manipulating, storing, andanalyzing big data. This incorporates big data analytics and use of Hadoop.

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

CO1. **implement** solutions for big data problem. (LOTS: Level 3: Apply)
CO2. **apply** Hadoop ecosystem components. (LOTS: Level 3: Apply)
CO3. **Analyse** the results of big data algorithms. (LOTS: Level 4: Analyse)
CO4. **build** and maintain reliable, scalable, distributed systems. (LOTS: Level 6: Create)
CO5. **create** lab record of the lab assignments that contains problem definitions, their solutions in big data perspective and the interpretation of the results. (LOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Installing and configuring Hadoop cluster.
2. Manipulating files in HDFS using Hadoop fs commands.
3. Hadoop File Systems: IBM GPFS, Map R-FS, Lustre, Amazon S3 etc.
4. Writing an Inverted Index MapReduce Application.
5. Distributed Cache MapReduce Design Patterns Sorting Joins.
6. Writing a streaming MapReduce job in Hadoop.
7. Big Data and R: Clustering, Simple Linear Regression, Decision Trees, Naïve Bayesian Classification
8. Big Data Interactions: Big Data and Cloud: Big Data and Web Services /SOA:BigData and Internet of Things (IoT)
9. Big Data Case Study: Healthcare Data: Web Click stream Data: Social Media Data [RSS, Tweets]

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 Big Data Analytics Lab. Course (PE/CDS/86-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	2	3	_	_	_	_	_	_	_	_	_	3
CO2.	2	2	2	2	3	_	_	_	_	_	_	_	_	_	3
CO3.	3	2	2	3	3	_	_	_	_	_	_	_	_	_	3
CO4	2	3	3	3	3	_	_	_	_	_	_	_	_	_	3
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Web Development Lab.

General Course Information

Course Code: PE/CDS/87-P Course Credits: 1 Type: Professional Elective 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: Basic programming skills and knowledge of surfing internet.

About the Course:

This lab. course on web development involves learning web-based programming languages. It incorporates the development of web pages by structuring information provided for the website design. The objective of the lab course is to equip the students to design web pages using modernweb development tools.

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

CO1. **implement** object models for website design using modern tools like HTML,XMLand JAVA scripting etc. (LOTS: Level 3: Apply)
CO2. **Analyse** the design of websites. (LOTS: Level 4: Analyse)
CO3. **test** the design of websites. (LOTS: Level 5: Evaluate)
CO4. **design** websites that consider socio-cultural values. (LOTS: Level 6: Create)
CO5. **create** a written report for website designed. (LOTS: Level 6: Create)
CO6. **use** ethical practices and socio-cultural values while designing websites. (LOTS: Level3: Apply)

List of experiments/assignments

1. Create a simple webpage using HTML.
2. Designing of registration form with table and use of hyperlink.
3. Design a page with frames to include Images and Videos.
4. Add a cascading style sheet for designing the web page.
5. Use user defined function to get array of values and sort them in ascending order on webpage
6. Design a dyna mic web page with validation of form field using JavaScript.
7. Design a catalogue in ASP.
8. Event Handling Validation of registration form.
9. Open a Window from the current window on Mouse Over event.
10. Create a simple application to demonstrate Servlets Request and Response object.
11. Demonstrate Array Objects and Date Object's predefined methods
12. Display calendar for the month and year selected from combo box
13. Create a welcome Cookie (Hit for a page) and display different image and textcontent each time when the user hit the page
14. Demonstrate Request and Response object using HTML Form.
15. Database Connection to display all the values in the table.

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 Web Development Lab. Course (PE/CDS/87-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	_ __	3	–	–	–	–	–	–	–	3	–	–
CO2	3	3	2	2	3	_	_	_	_	_	_	_	3	_	_
CO3	2	3	2	2	3	_	_	_	_	_	_	_	3	_	_
CO4	3	3	3	3	3	3	_	_	_	_	_	_	3	_	_
CO5	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Quantum Computing Lab.

General Course Information

Course Code: PE/CDS/88-P Course Credits: 1 Type: Professional Elective 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: Basic Statistics and Programming in Python, R

About the Course:

In this lab. Course, students learn to solve statistical computing problems using R or Python. Thelab experiments involve applying statistical tools for analyzing and inferring information from real world datasets. The course has a special focus on interpreting, evaluating and concluding from the results of statistical analysis.

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

CO1. **implement** quantum computing tools for data encoding. (LOTS: Level 3: Apply)
CO2. **explore** the trends in datasets using descriptive statistics. (LOTS: Level 4: Analyse)
CO3. **apply** Linear Regression, K-Means Clustering and regression for solving research questions. (LOTS: Level 3: Apply)
CO4.**Judge** different problem situations for applying appropriate Quantum tests (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 R and R studio.
2. Install and using Qis kit.
3. Two assignments related to HHL Algorithm
4. Two assignments related to Quantum Linear Regression.
5. Three assignments related to Quantum Euclidean Distance Calculation.
6. Four assignments on Quantum K-Means Clustering.
7. Two assignments on Hybrid Quantum-Classical Neural Networks.
8. Two assignments on Quantum Neural Network for Classification on Near-Term Processor.
9. 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 Quantum Computing Lab Course (PE/CDS/88-P)

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	2	3	3	_	_	_	_	_	_	_	_	_	3
CO2.	2	2	2	2	3	_	_	_	_	_	_	_	_	_	3
CO3.	2	3	2	3	3	_	_	_	_	_	_	_	_	_	3
CO4.	3	3	3	3	3	_	_	_	_	_	_	_	_	_	3
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Digital Forensics Lab.

General Course Information

Course Code: PE/CDS/89-P Course Credits: 1 Type: Professional Elective 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: The students are expected to have a knowledge of components of computer system, operating systems like Windows, Macintosh, Linux.

About the Course:

This course on Digital Forensics is a developmental laboratory work. It incorporates file system recovery related to various operating systems. The objective of the lab course is to equip the students to solve the practical digital forensics issues.

Course outcomes: By the end of the lab course student will be able to:

CO1. **employ** the digital forensics tools for file system analysis. (LOTS: level 3: Apply)
CO2. **test** ethical practices while solving the problems at hand. (LOTS: level 4: Analyze)
CO3. **select** open-source tools for imaging various types of media by wiping a target drive.(LOTS: level 5: evaluate)
CO4. **develop** solutions for disk imaging and like problems in different hardware conditionsand for various operating systems. (LOTS: level 6: create)
CO5. **design** Lab record for the assignments including aim, hardware and softwarerequirements and solutions to given problems. (LOTS: Level 6: Create)
CO6. **demonstrate** independent enquiry, use of ethical practices and self-learning to solveunseen problems. (LOTS: level 2: understand)

List of experiments/assignments:

1. Two assignments on forensically examining Window registry for evidences located init.
2. Two assignments on wiping a target drive and ensure that it is wiped, imagingvarious types of media such as hard drives, USB flash drives, optical drives, ZIP disks.
3. Two assignments on system restore points and how they are valuable in a forensic investigation.
4. Two assignments on open-source tool autopsy for timeline analysis, hash filteringand file system analysis.
5. Two-three assignments on open-source tool Caine for mobile forensics, Networkforensics, data recovery.
6. Two-three assignments on Helix3 for incident response and computer forensics.

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 Digital Forensics lab. Course (PE/CDS/89-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	2	2	_	3	3	_	_	_	_	_	_	_	_	3	_
CO2.	2	3	2	2	3	_	_	_	_	_	_	_	_	3	_
CO3.	2	2	3	3	3	_	_	_	_	_	_	_	_	3	_
CO4.	3	3	3	3	3	_	_	_	_	_	_	_	_	3	_ _
CO5.	_	_	_	_	_	_	_	_	_	3	_	_	_	_	_
CO6.	_	_	_	_	_	_	_	3	3	_	_	3	_	_	_
3 –High, 2-Medium, 1-Low															

Major Project-II

General Project Information

Course Code: EEC/CDS/81-P Course Credits: 6 Contact Hours: 12 hours/week	**Course Assessment Methods (Internal evaluation: 50 marks; External Evaluation marks: 50)** Evaluation is done by the internal examiner (project guide) andexternal examiner appointed by Controller of Examination. The criteria for evaluation are given below. 1. Review of literature related to problem domain: 15 2. Significance and originality of the solution presented: 15 3. Application of software engineering principles and project management: 15 4. Significance and Scope of results: 20 5. Organisation and presentation of major project report: 20 6. Level of Ethics and societal issues covered: 15

About the major project II:

Students continue working on their project work and they are required to complete their project work by the end of VIII semester. Students carry out implementation of their respective projects based on the problem identified, methodology and tools suggested in the synopsis prepared during seventh semester. They prepare the final project reports according to the format provided. At the end of eighth semester, each student is required to present his/her project work in front of internal project guide and external examiner appointed by Controller of Examination.

Course Outcomes: After doing major Project students will be able to:

CO1. **review** information critically for solving complex engineering problems. (LOTS: Level 4: Analyse)

CO2. **plan** the project according to principles of project management.(LOTS: Level 6: Create)

CO3. **devise** original solutions to complex engineering problems using modernengineering tools. (LOTS: Level 6: Create)

CO4. **justify** the outcomes of the project work. (LOTS: Level 5: Evaluate)

CO5. **organize** and communicate (written and oral) ideas effectively. (LOTS: Level 6: Create)

CO6. **develop** solutions that meet ethical, societal and legal considerations. (LOTS: Level 6: Create)

CO-PO Articulation Matrix Course Major Project-II (EEC/CDS/81)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.	2	2	2	3	-	-	-	-	-	-	-	-	-	-
CO2.	1	1	1	-	-	-	-	-	-	-	3	3		
CO3.	3	2	3	3	3	2	-	-	-	-	-	-	-	-
CO4.	3	3	3	3		2	-	-	-	-	-	-	-	-
CO5.	-	-	-	-	-	-	-	-	-	3	3	-	-	-
CO6.	-	-	-	-	-	-	-	3	3	-	-	3	-	-
3 –High, 2-Medium, 1-Low														

LIST OF OPEN ELECTIVES COURSES TO BE OFFERED BY CSE BRANCH / DEPARTMENT TO THE STUDENTS OF OTHER BRANCH/ DEPARTMENT

OE-I: List of Open electives (For V semester):

1. OE/CDS/51-T: Internet & ApplicationOE/CDS/52-T:
2. Introduction to Software Engineering
3. OE/CDS/53-T: Fundamental of Computer Networks
4. OE/CDS/54-T: Fundamentals of Python Programming

OE-II: List of Open electives (For VI semester):

1. OE/CDS/61-T: Basics of Digital MarketingOE/CDS/62-T:
2. Cyber Laws and IPR
3. OE/CDS/63-T: Fundamentals of Information Security
4. OE/CDS/64-T: Big Data
5. OE/CDS/65-T: Introduction to Data Science

OE-III: List of Open electives (For VII semester):

1. OE/CDS/71-T: Basics of Cloud computing
2. OE/CDS/72-T: Introduction to Software Project Management
3. OE/CDS/73-T: Cyber security
4. OE/CDS/74-T: Intelligent Systems
5. OE/CDS/75-T: Basics of Machine Learning

Internet & Application

General Course Information

Course Code: OE/CDS/51-T Course Credits:3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures(L) ExaminationDuration:3hours	**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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 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: Mathematics and Programming language.

About the Course:

This is an introductory course for students covering the clear idea of using the Internet, audio and video conferencing concepts easily, associate the principles of web browser and Web applicationsand learn concepts of ISDN, ADSL and Intranet.

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

CO1. Understand the concept relating to Internet and Web. (LOTS: Level1: Remember)
CO2: Compare different high speed connective device. (LOTS: Level 4: Analyze)
CO3: Analyze the connection of LAN to internet. (LOTS:Level3:Apply)
CO4: Construct an environment for chat, channel and Web Conference. (LOTS: Level 4: Create)
CO5: Describe all concept related to Email. (LOTS: Level 2: Understand)

Course Content

Unit I

Overview: Computer Security Concepts, Security Attacks, Security Services, Security Mechanism, A Model for Network Security, Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Ciphers and the DataEncryption, Euclid's Algorithm, Placement of Encryption Function, Traffic Confidentiality, keydistribution

Unit II

Public Key Crypto System and RSA: Prime Numbers, Fermat's and Euler's Theorems, Principles of Public-Key Cryptography, the RSA Algorithm, Key Management, Diffie- Hellman Key Exchange, Cryptographic Hash Function: Applications, Requirements & Security, SHA-3, Authentication Requirements, Authentication Functions

Unit III

Digital Signatures, Digital Signature Standards, Authentication Application & Electronic Mail Security: Kerberos, X.509 Authentication Service, Pretty Good Privacy, S/MIME.

Unit IV

IP Security and Web Security: IP Security overview, IP Security Policy, Encapsulating SecurityPayload,

Transport Level Security, Wireless Network Security

Text and reference books:

- Cryptography and Network Security: Principals & Practice: by William Stallings
- Cryptography and Network Security: Atul kahate

CO-PO Articulation Matrix Software Engineering Course (OE/CDS/51-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	1	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	_	2	2	_	_	_	2	_	3	_	_	_	_	_	_
CO4	_	2	2	_	_	_	2	_	_	2	_	_	2	_	_
CO5	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
3-High 2-Medium 1-Low															

Introduction to Software Engineering

General Course Information

Course Code: OE/CDS/52-T Course Credits:3 Type: Open Elective Contact Hours: 3 hours/weekMode: Lectures(L) ExaminationDuration:3hours	**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 studentin 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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 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: Fundamental of computer and programming language

About the Course:

This is an introductory course for students specify software requirements, design the software using tools, different testing techniques, planning and scheduling techniques and application of computing-based solutions.

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

CO1. **Understand** the concept relating to Software and Software tool. (LOTS: Level1:Remember)
CO2: Compare different testing techniques. (LOTS: Level 4: Analyze)
CO3: Analyze the planning and scheduling techniques. (LOTS: Level3: Apply)
CO4: Construct an application of computing-based solutions. (LOTS: Level 4: Create)
CO5: Describe all concept related to structured and object-oriented analysis & design. (LOTS:Level 2: Understand)

Course Content

Unit I
The Product-The Process-Project Management Concepts-Software Projects And Project Metrics-Software Project Planning-Risk Analysis And Management

Unit II
Project Scheduling And Tracking-Software Quality Assurance- Software ConfigurationManagement-System Engineering-Analysis Concepts And Principles-Analysis Modeling .

Unit III
Design Concepts And Principles – Architectural Designs-User Interface Design.

Unit IV
Component level Design-Software Testing Techniques-Software Testing Strategies- TechnicalMetrics For Software.

Text and reference books:

- RogerS.Pressman-SoftwareEngineeringAPractitioner'sapproach–5th edition- McGrawHill.
- Ian Sommerville– SoftwareEngineering-5th Edition –Addison Wesley

CO-PO Articulation Matrix Introduction to
Software Engineering Course (OE/CDS/52-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	1	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	_	2	2	_	_	_	2	_	3	_	_	_	_	_	_
CO4	_	2	2	_	_	_	2	_	_	2	_	_	2	_	_
CO5	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
3-High 2-Medium 1-Low															

Fundamental of Computer Networks

General Course Information

Course Code: OE/CDS/53-T Course Credits:3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures(L) Examination Duration:3hours	**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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 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: Fundamental of Internet

About the Course:

This is an introductory course for students to understand the concept of Computer network, knowledge about networking and internetworking devices, topologies and protocols, moderntechnologies and their application, OSI model and TCP/IP.

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

CO1. **Understand** the concept relating to Computer Networks. (LOTS: Level1: Remember)
CO2: **Compare** different networking protocols and their hierarchical relationship in the conceptual model (LOTS: Level 4: Analyze)
CO3: **Analyze** the different network models. (LOTS: Level3: Apply)
CO4: **Construct** a classless addressing scheme. (LOTS: Level 4: Create)
CO5: **Describe** how computer networks are organized with the concept of layered approach.(LOTS: Level 2: Understand)

Course Content

Unit 1

Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models-Example Networks: Internet, ATM, Ethernet and Wireless LANs -Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.

Unit II

Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues - Error Detection and Correction.

Unit III

Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet-Medium Access Layer-Channel Allocation Problem –Multiple Access Protocols - Bluetooth.

Unit IV

Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IPProtocol - IP Addresses - Internet Control Protocols. Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection- Simple Transport Protocol-Internet Transport Protocols (ITP)- Network Security: Cryptography.

Text and reference books:

- A.S. Tanenbaum, "Computer Networks", Prentice-Hall of India2008, 4thEdition.
- Stallings, "Data and Computer Communications", Pearson Education 2012,7thEdition.
- B.A. Forouzan, "Data Communications and Networking", Tata McGraw Hill 2007,4thEdition.
- F. Halsall, "Data Communications, Computer Networks and Open System PearsonEducation 2008

CO-PO Articulation Matrix of Fundamental of Computer Networks Course (OE/CDS/53-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	1	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	_	2	2	_	_	_	2	_	3	_	_	_	_	_	_
CO4	_	2	2	_	_	_	2	_	_	2	_	_	2	_	_
CO5	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
3-High 2-Medium 1-Low															

Fundamentals of Python Programming

General Course Information

Course Code: OE/CDE/54-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. **analyse** the results of data analysis or machine learning programs (LOTS: level 4: Analyse)
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, 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.

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 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 andDDL 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

Text and Reference Books:

- Ashok Namdev Kamthane, *Programming and Problem Solving with Python*, Mc GrawHill EducationPublication, 2018.
- John Guttag, *Introduction to Computation and Programming using Python*, Springer,Revised andExpanded 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 Structuresand Algorithmsin Python*, Wiley, 2016.
- Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2013.
- Reema Thareja, *Python Programming Using Problem Solving Approach* , OxfordPublications, 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 (OE/CDE/54-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	_	_	_	_	_	_	_	_	_	_	_	_	_	2
CO2	1	_	_	_	_	_	_	_	_	_	_	_	_	_	3
CO3	3	2		2	_	3	_	_	_	_	_	_	_	_	3
CO4	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO5	2	3	2	2	_	_	_	_	_	_	_	_	_	_	3
CO6	3	3	2	3		3	_	_	_	_	_	_	3		3
3-High 2-Medium 1-Low															

Basics of Digital Marketing

General Course Information

Course Code: OE/CDS/61-T Course Credits: 3 Type: Open 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: Computer Fundamental

About the Course:

To understand digital marketing, important conceptual insights and perspectives.to demonstrate the use of tools required for effective digital marketing. To analyze the market impact from digital marketing, and apply the tools of digital marketing to get best visibility in market.

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

CO1. **Understanding** digital marketing along with technical acumen will be an added toolas a problem solver and solution provider. (LOTS: Level 1: Remember)

CO2. **Demonstrate** the use of search engine optimization keyword planner Tools. (LOTS:Level 2: Understand)

CO3. **Assist** and advice the marketer to take right decision. (LOTS: Level 3: Apply)

CO4. **Apply** various social media platform for marketing such as Facebook,Twitter,LinkedIn etc. (LOTS: Level 4: Analyse).

CO5. **Assess** real time digital marketing services. (LOTS: Level 5:Evaluate)

Course Content

U**nit I**

Introduction to Digital Marketing and its Significance Traditional Marketing Vs Digital Marketing Digital Marketing Process. Website Planning and Development: Types of websites Website Planning and Development, Understanding Domain and Webhosting Building Website/Blog using CMS Word Press, Using Word Press Plug-ins

Unit II

Introduction to Search Engine Optimization Keyword Planner Tools on Page SEO Techniques-Indexing and Key Word Placement, On Page SEO Techniques- Content Optimization on Page SEO: Yoast, SEO Plug-in, Off –Page SEO Techniques, Email Marketing- Introduction and Significance, Designing e-mail marketing campaigns using Mail Chimp

Unit III

Building E-mail List and Signup Forms, Email Marketing Strategy and Monitoring Email – Atomization. Pay Per Click Advertising: Introduction Pay Per Click Advertising: Google Ad word, Types of Bidding strategies, Designing and Monitoring search campaigns, Designing and Monitoring Display campaigns

Unit IV

Designing and Monitoring Video campaigns Designing and Monitoring Universal App Campaigns. Google Analytics: Introduction and Significance Google Analytics Interface and Setup Understanding Goals and Conversions. Monitoring Traffic Behavior and preparing Reports Social Media Marketing: Introduction and Significance Facebook Marketing, Types of Various Ad Formats

Text and Reference Books:

1 The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns by Ian Dodson, Wiley; 1st edition (2016)

2 Digital Marketing for Dummies by Ryan Deiss and Russ Henneberry, For Dummies.

3 Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation Damian Ryan, Kogan Page Publisher.

4 Digital Marketing by Seema Gupta, McGraw Hill Education.

CO-PO Articulation Basics of Digital Marketing Matrix Course (OE/CDS/61-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	_	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	_	_	_	1	_	1	_	_	1	_	_	_	_	_	_
CO4	1	_	2	_	2	_	3	_	_	2	_	_	_	_	_
CO5	_	3	2	_	2	_	1	_	_	2	_	_	2	_	_
3-High 2-Medium 1-Low															

Cyber Laws and IPR

General Course Information

Course Code: OE/CDS/62-T Course Credits:3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures(L) ExaminationDuration:3hours	**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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 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 Computer Network

About the Course:
This course involves studying cyber Investigation that is admissible by the Courtroom, a clearidea on International Law and Regulation of Cyberspace, concept of Intellectual Property Rights and Copyright.
Course Outcomes: By the end of the course students will be able to:

CO1. **Understand** the concept relating to E-Governance and E- Commerce. (LOTS: Level1:Remember)
CO2. **Describe** legal issue relating to courtroom practices. (LOTS: Level 2: Understand)
CO3. **Apply** the laws dealing with the cyber crimes related to Patents and Trade Mark..(LOTS: Level 3: Apply)
CO4. **Use** the concept of Trademark, copyright and IPR. (LOTS: Level3: Apply)
CO5. **Compare** international Laws and Regulation of Cyberspace. (LOTS: Level 4: Analyze)

Course Content

Unit 1
Fundamentals of Cyber Law Introduction on cyber space - Jurisprudence of Cyber Law - Scope of Cyber Law - Cyber law in India with special reference to Information Technology Act, 2000 (as amended) and Information Technology Act, 2008

Unit-II
E- Governance and E – Commerce Electronic Governance - Procedures in India - Essentials& System of Digital Signatures - The Role and Function of Certifying Authorities - Digital contracts - UNCITRAL Model law on Electronic Commerce - Cryptography – Encryption and decryption

Unit-III
Cyber Crimes Investigation related issues - Issues relating to Jurisdiction - Relevant provisions under Information Technology Act, Evidence Act - Indian Penal Code -Cyber forensics - Case studies

Unit-IV
Trademark, IPR and Patent laws Definitions and concepts Trademark: Introduction to Trademarks, Functions and types of Trademarks, Madrid Agreements, Trademarks Law Treaty (Geneva), Indian Trademark Act, Registration of Trademarks, IPR infringements - Secrecy and Confidentiality in IPR - Civil and Criminal liabilities in IPR - International Applications and its advantages - Geneva convention on Patent Law - Software and Business Method Patents - Indian Patent Act - Infringement - Defenses

Text and reference books:

- Raman Mittal.(2004).Legal Dimension on Cyber Space, Indian Law Institute, NewDelhi
- Anupa P Kumar.(2009).Cyber Law, Volume 1.Create space Independent Publishers
- Vakul Sharma.(2017).Information Technology -Law and Practice.5th Edition,Universal Law

Publishing, New Delhi
- Laws on Cyber Crime: P.K. Singh (2007), Book Enclave Jaipur, Page 131
- Dr. Gupta & Agrawal.(2016). Cyber Laws. Premier Publishing Company
- Seth Kamika.(2013).Computers Internet and New Technology Law
- Cyber law by Nandan kamath, Fifth Edition, Universal law Publication, 01 Jan 2012
- intellectual property by Robert P Merges, 3rd Edition, Aspen Publication, 2003

CO-PO Articulation Mapping with Programme Outcomes (OE/CDS/62-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	_	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	2	2	_	_	_	_	_	_	_	_	_	_	_	_	_
CO4	_	_	_	1	_	1	_	_	1	_	_	_	_	_	_
CO5	_	_	2	_	2	_	_	_	_	2	2	2	2	_	_
3-High 2-Medium 1-Low															

Fundamentals of Information Security

General Course Information

Course Code: OE/CDS/63-T Course Credits:3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures(L) ExaminationDuration:3hours	**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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 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: Fundamental of computer and Software engineering

About the Course:
This course involves studying information security, asset classification in the organization,risk management process, knowledge about emerging technology.

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

CO1. **Understand** the concept relating to basic information security concepts. (LOTS:Level1: Remember)
CO2. **Describe** asset classification. (LOTS: Level 2: Understand)
CO3.**apply** risk analysis and management process.(LOTS: Level 3: Apply)
CO4.**use** the concept of critically assess in access control and privilege management. (LOTS: Level3: Apply)
CO5. **Compare** emerging technologies. (LOTS: Level 4: Analyze)

Course Content

Unit I
Overview of Information Security What is Information and why should be protect it? - Information Security: Threats, Frauds, Thefts, Malicious Hackers, Malicious Code, Denial of Services Attacks, Social Engineering - Vulnerability – Risk: Risk definition, Types Risk – an introduction Business Requirements Information Security - Definitions Security Policies: Tier1 (Origination Level), Tier2 (Function Level), Tier3 (Application/Device Level), Procedures, Standards, Guidelines

Unit II
Information Asset Classification Why should we classify information? - Information Asset:Owner, Custodian, User - Information Classification: Secret, Confidential, Private, Public, Declassification, Reclassification, Retention and Disposal of Information Assets, Provide Authorization for Access - Owner Custodian User

Unit III
Risk Analysis & Risk Management Risk Analysis Process - Asset Definition - Threat Identification - Determine Probability of Occurrence - Determine the Impact of the Threat - Controls Recommended Risk Mitigation - Control Types – Categories - Cost/Benefit Analysis

Unit IV
Emerging Technologies Introduction to Cloud Computing: Concepts - Fundamentals of Cloud Computing -

Types of clouds - Security Design and Architecture -Concerns Internet of Things: Overview of IoT - Key Features of IoT - IoT Architecture - Impact of IoT on Business - Examples of IoT - Advantages and Disadvantages of IoT - IoT Hardware: IoT Sensors, Wearable Electronics, Standard Devices - IoT Software - IoT technology and Protocols - IoT Common Issues - IoT applications Domains - IoT Liability -IoT Security and Threats: Mitigation

Text and reference books:

- CISSP All-in-One Exam Guide by Shon Harris and Fernando Maymi, 7th Edition,McGraw-Hill Education, 1 June 2016
- Information Security Management handbook, 6th Edition, Harold F Tipton, MickiKrause, Auerbach Publications, 5 April 2012
- The CISSP Prep Guide: Gold Edition by Ronald L. Krutz, Russel Dean Vines, Gold Edition Wiley Publication, 31 Oct 2002
- Certified Information Systems Security Professional,Study Guide by Ed Tittel, Mike Chapple James Michael Stewart, 6th Edition, Sybex Publication, 06 July 2012

CO-PO Articulation Mapping with Programme Outcomes (OE/CDS/63-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	_	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO4	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO5	_	2	2	_	_	_	2	_	_	_	_	_	2	_	_
3-High 2-Medium 1-Low															

Big Data

General Course Information

Course Code: OE/CDS/64-T Course Credits:3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures(L) ExaminationDuration:3hours	**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 studentin 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 weight age of 06 marks. For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5questions in all. All questions carry equal marks. Question number1will be compulsory and based on the entire syllabus. It will contain even parts of 2marks each. Question numbers 2to 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: Fundamental of Database and Mobile Computing

About the Course:
This course involves studying basic technologies related to Big Data, cloud computing with a view to rapid prototyping of complex applications, big data application, and big data analytics.

Course Outcomes: By the end of the course students will be able to:
CO1. **Understand** the concept of Big data and challenges in processing Big data. (LOTS:Level1: Remember)
CO2. **Describe** Hadoop architecture and eco-system. (LOTS: Level 2: Understand)
CO3.**apply** research trends related to Hadoop File System, Map Reduce and Google File Systemetc. (LOTS: Level 3: Apply)
CO4.**use** the concept of critically assess in access control and privilegemanagement. (LOTS:Level3:Apply)
CO5. **Compare** appropriate techniques and tools to solve actual Big Data problems. (LOTS:Level 4: Analyze)

Course Content

Unit I
Introduction to Big Data and Hadoop: What is Big Data, What are Challenges in processing Bigdata? What is hadoop, Data Storage and Analysis, Comparison with Other Systems: RDBMS, Grid Computing, Volunteer Computing; A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem.

Unit II
HDFS: Hadoop Distributed File System: Significance of HDFS in Hadoop, Features of HDFS,The Design of HDFS, HDFS Concepts: Blocks, Data replication, Name nodes and Data nodes; Accessing HDFS

Unit III
Map Reduce: Map Reduce Architecture, How map reduce works: Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion.Failures, Job Scheduling.

Unit IV
Pig: Introduction to Apache Pig, Map-Reduce vs Pig, Pig Latin, Data Processing Operators. Hive: Hive introduction, Architecture, Comparison with Traditional Databases, HiveQL, Tables.HBase: Basics, Concepts, HBase Versus RDBMS. Zoo Keeper : The Zoo Keeper Service. Case Studies: Hadoop and Hive at Facebook, Log Processing at Rackspace.

Text and reference books:

- Big Data Analytics in Cyber Security, Edited by Onur Savas and Julia Deng.
- Tom White, “Hadoop: The Definitive Guide”, Second Edition, O’Reilly Yahoo Press.
- Robert D. Schneider, “Hadoop for Dummies”, Wiley. 3.
- Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packet Publishing.

CO-PO Articulation Mapping with Programme Outcomes (OE/CDS/64-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	_	_	_	_	_	_	1	_	_	_	_	_	_
CO2	_	2	2	_	_	_	2	_	_	_	_	_	_	_	_
CO3	_	2	2	_	_	_	2	_	3	_	_	_	_	_	_
CO4	_	2	2	_	_	_	2	_	_	2	_	_	_	_	_
CO5	_	2	2	_	_	_	2	_	_	_	_	_	2	_	_
3-High 2-Medium 1-Low															

Introduction to Data Science

General Course Information

Course Code: OE/CDS/65-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: Student should have a fundamental understanding of Fundamentals of Programming Languages (C, C++, and Java & Python) and a strong mathematical foundation.

About the Course:
This course involves studying the concept of data science and data science life cycle. Moreover, students learn about the techniques for generating quality data inputs.

Course Outcomes: By the end of the course students will be able to:
CO1. To understand the concept of data science and data science life cycle (LOTS: Level 1: Remember)
CO2. To apply the pre-processing techniques for generating quality data inputs (LOTS: Level 2: Understand)
CO3. To analyse the concept and parameters of exploratory data analytics (LOTS: Level 3: Apply)
CO4. To develop the regression models using data science and analytics process (LOTS: Level 3: Apply)
CO5. To analyse various tools and techniques of data visualization (LOTS: Level 4: Analyse)
CO6. handling data, encoding, tools apply, and types of data visualization (LOTS: Level 6: Create)

Course Content

Unit I

Evolution of Data Science, Introduction to Data Science – Types of Data, Data Science Vs Big Data, Concept of Big Data, Concept of Data Warehousing, Introduction to Data Mining, Role of Data Scientist, Data Science Life Cycle, Data Science Roles – Data Science Project Stages – Data Science Applications in Various Fields – Data Security Issues, thinking in a structured way to solve data science problem statements.

Unit II
Need of Data Pre-processing, Pre-processing of data and data collection, Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization, Data Storage, and management, Data preparation with Sandbox for analytics.

Unit III
Simple and Linear Regression – Visual Model Evaluation – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – In-sample Evaluation Measures – Prediction and Decision Making

Unit IV
Metrics for Out-of-Sample Evaluation Error – Cross Validation – Overfitting – Under fitting and Model Selection – Ridge Regression Prediction – Grid Search Testing Multiple Parameters

Data handling /Data wrangling using Python Definition.

Text and reference books:

1.G. Strang . Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA, 2016.

2. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA, 2010

3. Montgomery, D. C. and G. C. Runger. Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011.

4. David G. Luenberger . Optimization by Vector Space Methods, John Wiley & Sons (NY), 1969.

5. Cathy O'Neil and Rachel Schutt . Doing Data Science, O'Reilly Media, 2013.

6.Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.

7.Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.

8. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

CO-PO Articulation Matrix Foundations of Data Science Course (OE/CDE/65-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO2	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO3.	2	1	2	1	_	_	_	_	_	_	_	_	_	_	_
CO4.	1	2	_	2	_	_	_	_	_	_	_	_	_	_	_
CO5.	_	_	2	_	_	_	_	_	_	_	_	_	_	_	_
CO6.	_	2	1	2	_	_	_	_	_	_	-	_	_	_	_
3 –High, 2-Medium, 1-Low															

Basics of Cloud Computing

General Course Information

Course Code: OE/CDS/71-T Course Credits: 3 Type: Open 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: Basics of Computer Network, Distributed System.

About the Course:

The objective of the course is to give students a comprehensive view of storage and networking infrastructures for highly virtualized cloud ready deployments. To familiarize the students with basics of Cloud Computing and its Applications.

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

CO1. **define** concepts related to cloud computing. (LOTS: Level 1: Remember)
CO2. **express** deployment models for clouds. (LOTS: Level 2: Understand)
CO3. **apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)
CO4. **analyse** cloud computing services used at various levels. (LOTS: Level 4: Analyse)
CO5. **assess** real time cloud services. (LOTS: Level 5: Evaluate)

Course Content

Unit I

Cloud Computing: Introduction to client server computing, Peer to Peer computing, Distributed computing, collaborative computing and cloud computing, Importance of cloud computing in current era, Characteristics, advantages and disadvantages of cloud computing.

Unit II

Cloud Services: Functioning of cloud computing, Classification of cloud on the basis of services: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (Iaas): Definition, characteristics and their benefits.

Unit III

Cloud Architecture: Cloud computing Logical and service architecture, Types of clouds: Private cloud, Public cloud and Hybrid cloud, Comparison of a Private, public and hybrid clouds, migrating to a cloud, seven step model to migrate.

Unit IV

Applications: Business opportunities using cloud, Managing Desktop and devices in cloud, cloud as a type

of distributed infrastructure, Application of cloud computing for centralizing. Email communication, collaboration on schedules, calendars. Overview of major cloud service providers - Amazon Ec2, Google App Engine.

Text and Reference Books:

1. Srinivasan, A. Cloud Computing: A Practical Approach for Learning andImplementation. Pearson Education India, 2014.
2. Cloud Computing, A Practical Approach-McGraw-Hill Osborne Media by "Toby Velte,Anthony Velte, Robert Elsenpeter- (2009)".
3. Cloud Computing Bible, Author: "Barrie Sosinsky", Publisher: "Wiley" (2011)
4. Rajkumar Buyya, Christian Vecchiola and S ThamaraiSelvi, *Mastering CloudComputing*, Tata McGraw Hill Education Pvt. Ltd., 2013.

CO-PO Articulation Matrix Basics of Cloud Computing Course (OE/CDS/71-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	_	_	_	_	_	_	_	_	_	_	_	_	2	_
CO2.	1	_	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3.	2	2	2	_	2	_	_	_	_	_	_	_	_	3	_
CO4.	3	3	2	3	2	_	_	_	_	_	_	_	_	3	_
CO5.	3	3	3	3	3	2	_	_	_	_	_	2	_	3	_
3 –High, 2-Medium, 1-Low															

Introduction to Software Project Management

General Course Information

Course Code: OE/CDS/72-T Course Credits: 3 Type: Open 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: Preliminary knowledge of Software Engineering.

About the Course:

The course recognizes basic concepts and issues of software project management, Emphasize successful software projects that support organization's strategic goals, Comprehend software quality issues, Comprehend software risk issues.

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

CO1. **maintain** software projects and monitor software project. (LOTS: Level 1: Remember)
CO2. **demonstrate** the design and develop project modules and assign resources (LOTS: Level2: Understand)
CO3. **illustrate** Comprehend, assess, and calculate the cost of risk involved in a projectmanagement. (LOTS: Level 2: Understand)
CO4. **apply** tools and methods for identifying risk management. (LOTS: Level 3: Apply)
CO5. **analyse** the tools for risk management. (LOTS: Level 4: Analyse)
CO6. **plan** a Case study using SPM tools. (LOTS: Level 6: Create)

Course Content

Unit I

SPM Concepts Definition: components of SPM - challenges and opportunities - tools and techniques - managing human resource and technical resource - costing and pricing of projects -training and development - project management techniques.

Unit II

Software Measurements: Monitoring & measurement of SW development - cost - size andtime metrics - methods and tools for metrics - issues of metrics in multiple projects.

Unit III

Software Quality: Quality in SW development - quality assurance - quality standards and certifications - the process and issues in obtaining certifications - the benefits and implications for the organization and its customers - change management.

Unit IV

Risk Issues and SPM Tools The risk issues in SW development and implementation - identification of risks - resolving and avoiding risks - tools and methods for identifying risk management. Tools Software project

management using Primavera & Redmine - case study on SPM tools.

Text & Reference Books

1. Richard H. Thayer, “Software Engineering Project Management”, Second Edition, JohnWiley & Sons, 2001.
2. Royce, Walker, “Software Project Management”, Pearson Education, 2002.
3. Kelker S. A., “Software Project Management”, Prentice Hall, 2003.
4. Kan, Stephen H., “Metrics and Models in Software Quality Engineering”, Addison-WesleyLongman Publishing Co. Inc., 2002.
5. Galin, Daniel, “Software Quality Assurance: From Theory to Implementation”, Pearson
6. Education India, 2004.
7. Charette, Robert N., “Software Engineering Risk Analysis and Management”, New York:McGraw Hill, 1989.

CO-PO Articulation Matrix Introduction to Software Project Management Course (OE/CDS/72-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–
CO2.	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–
CO3.	2	–	–	–	1	–	–	–	–	–	–	–	3	–	–
CO4.	_	2	_	_	2	–	–	2	–	–	–	–	2	–	–
CO5.	_	_	3	2	_	3	_	2	– —		2	_	2	–	–
CO6.	3	3	_	3	3	–	–	–	–	2	3	2	3	–	–
3 –High, 2-Medium, 1-Low															

Cyber Security

General Course Information

Course Code: OE/CDS/73-T Course Credits: 3 Type: Open 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 course has been designed to give students an extensive overview of cyber security issues,tools and techniques that are critical in solving problems in cyber security domains.

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

CO1. Define the various challenges and constraints in cyber security. (LOTS: Level 1:Remember)
CO2. Discuss IT ACT (Cyber law) to the given case/problem and Analyse it.(LOTS: Level 2: Understand)
CO3.Understand the need for Computer Cyber forensics. (LOTS: Level 3: Apply)
CO4.Analyse the design of Intellectual Property Law. (LOTS: Level 4: Analyse)
CO5. Demonstrate the network Defense tools to provide security of information. (LOTS:Level 5: Evaluate)

Course content

Unit- I

Introduction to Cyber Security**:** Overview of Cyber Security, Internet Governance: Challenges and Constraints, Cyber Threats, Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, International convention on Cyberspace.

Unit – II

Introduction to Cybercrime and Laws: Origins of Cybercrime, Classifications of Cybercrimes, information Security, Cybercriminals, Criminals Plan for Attacks, Cybercafe, Botnets, Attack Vector, The Indian IT ACT 2000 and amendments. Tools and Methods used in Cybercrime: Introduction, Proxy Server and Anonymizers, Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, DOS and DDOS attack, SQL injection.

Unit – III

Phishing and Identity Theft: Introduction to Phishing, Methods of Phishing, Phishing Techniques, Phishing Toolkits and Spy Phishing. Identity Theft: PII, Types of Identity Theft, Techniques of ID Theft. Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle.
Introduction to Intellectual Property Law – The Evolutionary Past - The IPR Tool Kit- Para
-Legal Tasks in Intellectual Property Law – Ethical obligations in Para Legal Tasks in Intellectual Property Law –types of intellectual property rights.

Unit – IV

Network Defence tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs. Firewall, Packet Characteristic to Filter, Stateless Vs. Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, Virtual Private Networks, Snort Detection System, Introduction to block chain technology and its

applications.

Text and Reference Books:

1. Mike Shema, Anti-Hacker Tool Kit (Indian Edition), McGraw Hill.
2. Nina Godbole and Sunit Belpure, Cyber Security: Understanding Cyber Crimes, ComputerForensics and Legal Perspectives, Wiley.
3. Marjie T. Britz, Computer Forensics and Cyber Crime: An Introduction, Pearson Education
4.Chwan -Hwa (John) Wu.J. David Irwin, Introduction to Computer Networks and Cybersecurity, CRC Press
4. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics andInvestigations, Cengage Learning
5. Debirag E. Bouchoux, Intellectual Property, Cengage Learning.

CO-PO Articulation Matrix Cyber Security Course (OE/CDS/73-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	–	–	–	–	–	–	–	–	–	–	–	–	2	–
CO2	1	–	–	–	–	–	–	–	–	–	–	–	–	3	–
CO3	2	2	2	_	2	–	–	–	–	–	–	–	–	3	–
CO4.	3	3	2	3	2	–	–	–	–	–	–	–	–	3	–
CO5.	3	3	3	3	3	2	_	_	_	_	_	2	_	3	_
3 –High, 2-Medium, 1-Low															

Intelligent Systems

General Course Information

Course Code: OE/CDS/74-T Course Credits: 3 Type: Open 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 beset 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 Algorithms and probability.

About the Course:

To introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach and to explore the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

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

CO1. **outline** the concepts of neural networks and fuzzy logic. (LOTS: Level 1: Remember)

CO2. **illustrate** the concepts of artificial intelligence in state space search. (LOTS: Level 2: Understand)

CO3. **apply** search and knowledge representation techniques to solve AI problems. (LOTS:Level 3: Apply)

CO4.**compare** strengths and weaknesses of AI algorithms (LOTS: Level 4: Analyse).

CO5. **understand** and use the concepts of reasoning in artificial intelligence. (LOTS:Level 6: Create)

Course Content

Unit – I

Biological foundations to intelligent systems: Artificial neural networks, Back-Propagation networks, Radial basis function networks, and recurrent networks. Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit – II

Search Methods: Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill-climbing search. Optimization and searchsuch as stochastic annealing and genetic algorithm.

Unit – III

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

Unit – IV

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning. Recent trends in Fuzzy logic,

Knowledge Representation

Text and Reference Books:

2. Luger G.F. and Stubblefield W.A., Artificial Intelligence: Structures and strategies forComplex Problem Solving. Addison Wesley.

3. Russell S. and Norvig P., Artificial Intelligence: A Modern Approach. Prentice-Hall.

CO-PO Articulation Intelligent Systems Matrix Course (OE/CDS/74-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	1	3	3	1	3	1	3	2	3	3	1	2	_	_	_
CO2.	2	3	2	1	3	1	3	2	3	3	1	2	_	_	_
CO3.	3	3	3	1	3	3	3	2	3	3	1	3	_	_	_
CO4.	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO5.	4	3	2	1	3	3	3	2	3	3	1	3	_	_	_
3 –High, 2-Medium, 1-Low															

Basics of Machine Learning

General Course Information

Course Code: OE/CDS/75-T CourseCredits:3 Type: Professional Elective Contact Hours: 3 Mode: Lectures (L) ExaminationDuration:3hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4marks), assignments (6marks), and the end-semester examination (70marks). For the end semester examination, nine questions are to beset by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number1 will be compulsory and based on the entire syllabus. It will contain even 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:

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: Level1: 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: Analyze)
CO5. **Compare and contrast** different machine learning algorithms. (LOTS: Level5: 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, 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, Inductive bias in decision tree learning, Issues in decision tree learning.

Unit-III

Unsupervised Learning: About clustering, type of data in clustering analysis, DB SCAN density-based clustering method, Performance analysis of clustering algorithms,

Artificial Neural networks: Neural Network representations, Appropriate problems for neural network learning, Perceptron, perceptron training 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.

Text and Reference Books:

1. TomM.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: DataMining, Inference and Prediction, Springer, 2nd edition, 2009.
4. J.Hanand M.Kamber, Data Mining Concepts and Techniques, 3rdEdition, Elsevier, 2012.
5. S.Rajeshkaran, G.A.VijayalakshmiPai, NeuralNetworks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI, 2003.

CO-PO Articulation Matrix Machine Learning Course (OE/CDE/75-T)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	–	–	1	–	–	–	–	–	–	–	–	–	–	3
CO2	2	2	2	3	_	_	_	_	_	_	_	_	_	_	3
CO3	2	2	2	2	_	_	_	_	_	_	_	_	_	_	3
CO4	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO5	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
CO6	3	3	2	3	_	_	_	_	_	_	_	_	_	_	3
3-High 2-Medium 1-Low															

List of Common Courses:

BSC

Course Code	Definition / Category
BSC	Basics Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences Including Management Courses
MC	Mandatory Courses
PC	Program Courses
PE	Program Core
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project Work/ Summer Training/ Industrial Training/ Practical Training/ Internship/ Seminar, etc.)

#	Course Title	Course Code (T)	Course Code(P)	Credit
1.	Physic	BSC/1-T(i-vii)	BSC/1-P	
2.	Chemistry	BSC/2-T	BSC/2-P	
3.	Mathematics-I	BSC/3-T		
4.	Mathematics-II	BSC/4-T		
5.	Mathematics-I (CSE/IT)	BSC/5-T		
6.	Mathematics-II (CSE/IT)	BSC/6-T		
7.	Mathematics-III	BSC/7-T		
8.	Introduction to Food Biotechnology	BSC/8-T	BSC/8-P	

ESC

#	Course Title	Course Code (T)	Course Code(P)	Credit
1.	Basics Electrical Engineering	ESC/1-T	ESC/1-P	
2.	Engineering Graphics and Design Lab	-	ESC/2-P	
3.	Programming for Problem Solving	ESC/3-T	ESC/3-P	
4.	Workshop/ Manufacturing Practices	ESC/4-T	ESC/4-P	
5.	Analog Electronics Circuit	ESC/5-T		
6.	Engineering Properties of Food	ESC/6-T		
7.	Civil Engineering Mats Testing Evaluation-I Lab	-	ESC/7-P	
8.	Civil Engineering Mats Testing Evaluation-II Lab	-	ESC/8-P	
9.	Engineering Mechanics	ESC/9-T		
10.	Workshop Technology-II Lab		ESC/10-P	
11.	Basics of Machine Drawing		ESC/11-P	

HSMC

#	Course Title	Course Code (T)	Course Code(P)	Credit
1.	English	HSMC/1-T	HSMC/1-P	
2.	Human Values & Personality Development	HSMC/2-T		
3.	Fundamentals of Management for Engineers	HSMC/3-T		
4.	Economics for Engineers	HSMC/4-T		
5.	Industrial Physiology	HSMC/5-T		

MC

#	Course Title	Course Code (T)	Course Code(P)	Credit
1.	Induction Training	MC/1		
2.	Environmental Sciences	MC/2-T		
3.	Indian Constitution	MC/3-T		
4.	Essence of Indian Traditional Knowledge	MC/4-T		
5.	Technical Presentation		MC/5-P	
6.	Entrepreneurship	MC/6-T		
7.	Disaster Preparedness & Planning Management	MC/7-T		
8.	General Proficiency		MC/8-P	