Ref No. CE/2024/1708 Date 18/9/2024

Certificate

This is to certify that the scheme & syllabi of Computer Engg. (Spl. in Data Science) (Course name & Scheme) is duly approved by the competent body/authority and to the best of my knowledge the content of the same, are correct in all respect.

The scheme & syllabus has been updated & approved in 18th BOS held on 18/3/2024 and Applicable for the students admitted in the Session/Batch 2021-2022, w.e.f. for the Semester (s) 3rd to 8th sem [1st, 2nd Sem is common in all Engg. branches]

Date: 18/9/2024

Signature & Stamp of Chairperson
Name:
Deptt. Name: Comp Engg

Professor and Chairman
Dept. of Computer Engineering
J.C. Bose University of Science and Technology
YMCA, Faridabad

Dean Academic Affairs
J.C. Bose University of Science & Tech. YMCA
Faridabad, Haryana (India)

Dean Academic
Academic Branch

SCHEME AND SYLLABUS

for

BACHELOR OF TECHNOLOGY PROGRAMME

in

COMPUTER ENGINEERING

(Specialization in Data Science)

(w.e.f Session 2020-2021)

DEPARTMENT OF COMPUTER ENGINEERING

FACULTY OF INFORMATICS & COMPUTING

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA

FARIDABAD

Ref No. _____ Date_____

Certificate

This is to certify that the scheme & syllabi of _____ (Course name & Scheme) is duly approved by the competent body/authority and to the best of my knowledge the content of the same, are correct in all respect.

The scheme & syllabus has been updated & approved in _____BOS held on _____ and Applicable for the students admitted in the Session/Batch _____ w.e.f. for the Semester (s) _____.

Date: _____

Signature & Stamp of Chairperson
Name: _____
Deptt. Name: _____
_____

Dean Academic

Academic Branch

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA

VISION

J. C. Bose University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

DEPARTMENT OF COMPUTER ENGINEERING

VISION

The department aims to make a place at both national and international level by producing high quality ethically rich computer engineers conversant with the state-of-the-art technology with the ability to adapt the upcoming technologies to cater to the ever-changing industrial demands and societal needs. It endeavors to establish itself as a centre of excellence by contributing to research areas having IT impact on the people's life and nation's growth.

MISSION

- To provide the future leaders in the area of computer engineering and information technology through the development of human intellectual potential to its fullest extent.
- To enable the students to acquire globally competence through problem solving skills and exposure to latest developments in IT related technologies.
- To educate the students about their professional and ethical responsibilities.
- To ensure continuous interaction with the industry and academia through collaborative research projects.

ABOUT THE PROGRAM

The Bachelor of Technology (B. Tech.) program in Computer Engineering with specialization in Data Science has a strong flavor on design and hands-on experience. This is a 4- year undergraduate degree course in engineering. As a primary objective, the program aims to impart training to enrolled students with regard to existing and evolving techniques and theories related to Data Science which include statistics, data mining, artificial intelligence, big data and cloud computing and data visualization with strong focus on programming skills using Python and R. This course is oriented towards Data Science and related aspects. Big Data Analytics helps organization harness their data and use it to identify new opportunities. It leads to smarter business moves, more efficient operations, higher profits and more satisfied customers. The discipline's applications enable Data Scientists, Predictive Modelers, and other analytics professionals to analyze growing volumes of structured transaction data. Besides the theoretical and laboratory-based curriculum, students complete an advanced programming project in the final year of the program including one full semester in an industry.

This degree provides a solid foundation in core Computer Engineering disciplines with strong focus on Data Science aspects, critical thinking and problem-solving skills. Through the academic program, students also develop excellent written and oral communication skills, learn to work as a team and project management.

NOTE:

1. The scheme will be applicable from Academic Session 2020-21 onwards.
2. The syllabus for the theory and practical subjects is provided along with the scheme.
3. A student has to earn at least 12 credits during the duration of Degree subject to passing of at least one MOOC course of 12-week duration (carrying minimum 3 credits) per year through SWAYAM Platform. The *Credit Transfer/Mobility Policy for Online Courses* approved in 17th Academic Council Dated 11.06.2019 may be referred for the same.

B.TECH. PROGRAM

COMPUTERENGINEERING

(Specialization in Data Science)

PROGRAM EDUCATION OBJECTIVES

PEO1	To create knowledge about core areas related to the field of computer science and information technology.
PEO2	To enable students to apply mathematics, science and computer engineering principles to model, design and implement software projects to meet customers‟ business objectives.
PEO3	To develop the ability to evaluate the computing systems from view point of quality, security, privacy, cost effectiveness, utility and ethics.
PEO4	To inculcate lifelong learning by introducing principles of group dynamics, public policies, environmental and societal context

PROGRAM OUTCOMES

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1	Ability to design and develop analytic computing solutions using concepts of Mathematics, Computer Engineering and other related disciplines to meet customers‟ business objectives.
PSO2	Ability to test and analyze the quality of various subsystems and to integrate them in order to evolve a larger business computing system.

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM

S.No.	Category	Breakup of Credits (Total 180*)
1	Humanities and Social Sciences including Management Courses	9
2	Basic Science courses	35
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	16
4	Professional core courses and Specialization (Data Science Courses)	73
5	Professional Elective courses relevant to chosen specialization/branch	0
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or Else where	20
8	MOOCs	12
9	Audit Course (Message of Bhagwat Gita)	3
10	Value Added Course (Universal Human Values)	Non-Credit
11	Mandatory Courses [Environmental Sciences, Induction training, Constitution of India]	Non-credit
	Total	**180***

SEMESTER WISE SUMMARY OF THE PROGRAM

S.No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	25(A)/26(B)	650(A)/600(B)	19.5(A)/18.5(B)
2.	II	26(A)/25(B)	600(A)/650(B)	18.5(A)/19.5(B)
3.	III	35	800	25
4.	IV	34	850	24
5.	V	34	950	24
6.	VI	33	900	27
7.	VII	22	700	20
8.	VIII	One Semester	500	10
9.	MOOCs	-	-	12*
Total		**209**	**5950**	**180***

***Student has to earn at least 12 credits during the duration of Degree subject to passing of at least one MOOC course of 12 week duration (carrying minimum 3 credits) per year.

CREDIT DISTRIBUTION IN THE FIRST YEAR OF UNDERGRADUATE ENGINEERING PROGRAM

Subject	Lecture (L)	Tutorial (T)	Laboratory/ Practical(P)	Total credits(C)
Chemistry	3	1	3	5.5
Physics	3	1	3	5.5
Mathematics-1	3	1	0	4
Mathematics -2	3	1	0	4
Programming for Problem solving	3	0	4	5
English	2	0	2	3
Engineering Graphics & Design	0	0	4	2
Workshop	0	0	8	4
Basic Electrical Engg.	3	1	2	5
MOOC	-	-	-	3

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project
MOOC	Massive Open Online Course

MANDATORY INDUCTION PROGRAM (3-WEEKS DURATION)

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. A 3-week long induction program for the UG students entering the institution, right at the start, has to be planned. Normal classes will start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Tentative activities which can be planned in this Induction Programme are as follows:

- Physical Activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to Local Area
- Familiarization to Dept./Branch & Innovations

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

S.No.	Code No.	Course Title	Hours Per week			Total Credits	Semester
			L	T	P		
1	HSMC-101	English	2	-	-	2	1
2	HSMC-102	English Lab	-	-	2	1	1
3	HSMC- 01	Effective Technical Communication	3	0	0	3	3
4	HSMC-02	Economics for Engineers	3	0	0	3	4
					Total Credits	**9**	

BASIC SCIENCE COURSES (BSC)

S.No.	Code No.	Course	Hours Per Week			Total Credits	Semester
			L	T	P		
1	BSC101D	Physics (Semi Conductor Physics)	3	1	3	5.5	1 / 2
2	BSC103E	Mathematics –I (Calculus & Linear Algebra)	3	1	0	4	1
3	BSC106E	Mathematics –II (Probability & Statistics)	3	1	0	4	2
4	BSC102	Chemistry	3	1	3	5.5	½
5	BSC-DS-301	Mathematics for Data Science	3	-	-	3	3
6	BSC-DS-302 BSC-DS-303	Statistics -1 Statistics using MS-Excel lab	3	-	4	5	3
7	BSC-DS-401 BSC-DS-402	Statistics-II Statistics -II Lab using R/ SPSS	3	-	4	5	4
6	BSC-01	Biology	2	1	0	3	5
					Total Credits	**35**	

ENGINEERING SCIENCE COURSE (ESC)

S.No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	ESC101	Basic Electrical Engineering	3	1	-	4	½
2	ESC104	Workshop- I	-	-	4	2	½
3	ESC107	Basic Electrical Engineering Lab	-	-	2	1	½
4	ESC102	Engineering Graphics & Design	-	-	4	2	½
5	ESC103	Programming for Problem solving	3	-	-	3	½
6	ESC105	Programming for Problem solving Lab	-	-	4	2	½
7	ESC106	Workshop- II	-	-	4	2	½
					Total Credits	**16**	

PROFESSIONAL CORE COURSES (PCC)

S.No.	Code No.	Course Title	Hour Per Week			Total Credits	Semester
			L	T	P		
1	PCC-CS-301 PCC-CS-303	Data Structures & Algorithms Data Structure & Algorithms Lab	3	0	4	5	3
2	PCC-DS-301 PCC-DS-303	Fundamentals to Database Systems Database systems LAB	3	0	4	5	3
3	PCC-DS-302	IT Workshop **(Python)**	0	0	4	2	3
4	PCC-CS-602	Computer Networks	3	1	0	4	4
5	PCC-DS-402 PCC-DS-404	Object Oriented Programming with Java Object Oriented Programming using Java	3	0	4	5	4
6	PCC-CS-404	Design and Analysis of Algorithms	3	0	0	3	5
7	PCC-DS-502 PCC-DS-504	Soft Computing for Data Science Soft computing for Data Science lab	3	0	4	5	5
8	PCC-CS-403 PCC-CS-406	Operating System Operating system Programming LAB	3	0	4	5	5

9	PCC-DS-503	Computer Architecture	3	0	0	3	5
10	PCC-DS-603 PCC-DS-606	Big Data Fundamentals Big Data Lab	3	0	4	5	6
11	PEC-CS-A-702	Web and Internet Technology	3	0	0	3	6
12	PCC-DS-701	Cloud Computing	3	0	0	3	7
13	PEC-CS-D-701	Speech and Natural language Processing	3	0	0	3	7
14	PCC-DS-703	Deep Learning and Image Processing	3	0	0	3	7
					Total Credits	54	

OPEN ELECTIVE COURSES (OEC)

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	OEC-CS-601	Open Elective-I	3	0	0	3	6
2	OEC-CS-602	Open Elective-II	3	0	0	3	6
3	OEC-CS-701	Open Elective-III	3	0	0	3	7
4	OEC-CS-702	Open Elective-IV	3	0	0	3	7
					Total Credits	**12**	

PROJECT AND INDUSTRIAL TRAINING

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	PROJ-CS-301	Project-I	-	-	4	2	3
2	PROJ-CS-401	Project-II	-	-	4	2	4
3	PROJ-CS-501	Project-III	-	-	4	2	5
4	PROJ-CS-601	Project-IV	-	-	4	2	6
5	PROJ-CS-701	Project-V	-	-	4	2	7
6	PROJ-CS-801	Industry Internship	-	-	-	10	8
					Total Credits	**20**	

SPECIALIZATION (DATA SCIENCE) SPECIFIC COURSES

S. No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	PCC-DS-401PCC-DS-403	Data Mining for Science Data Mining Lab using R/SPSS/Python	3	0	4	5	4
2	PCC-DS-501	Artificial Intelligence for Data Science	3	0	0	3	5
3	PCC-DS-601PCC-DS-605	Machine Learning for Data Science Machine Learning Lab	3	0	4	5	6
4	PCC-DS-602	Data Acquisition Analysis and Visualization	3	0	0	3	6

5	PCC-DS-704	Business Intelligence and Predictive Analysis	3	0	0	3	7
					Total Credits	**19**	

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (Computer Engineering Specialization in Data Science)
Scheme of Studies/Examination
Semester- 3

S. No	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	BSC	BSC-DS-301	Mathematics for Data Science	3	0	0	3	25	75	100
2	PCC	PCC-CS-301	Data Structures & Algorithms	3	0	0	3	25	75	100
3	PCC	PCC-DS-301	Fundamentals to Database Systems	3	0	0	3	25	75	100
4	BSC	BSC-DS-302	Statistics -1	3	0	0	3	25	75	100
5	HSMC	HSMC-01	Effective Technical Communication	3	0	0	3	25	75	100
6	Capstone Project	PROJ-CS-301	Project-I	0	0	4	2	25	75	100
7	PCC	PCC-DS-302	IT Workshop (Python)	0	0	4	2	15	35	50
8	BSC	BSC-DS-303	Statistics Lab MS-Excel	0	0	4	2	15	35	50
9	PCC	PCC-DS-303	Database systems Lab	0	0	4	2	15	35	50
10	PCC	PCC-CS-303	Data Structure & Algorithms Lab	0	0	4	2	15	35	50
Total				**15**	**0**	**20**	**25**	**210**	**590**	**800**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (Computer Engineering Specialization in Data Science)

Scheme of Studies/Examination

Semester- 4

S. No	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC	PCC-CS-602	Computer Networks	3	1	0	4	25	75	100
2	BSC	BSC-DS-401	Statistics-II	3	0	0	3	25	75	100
3	PCC	PCC-DS-401	Essentials of Data Mining	3	0	0	3	25	75	100
4	PCC	PCC-DS-402	Object Oriented Programming with Java	3	0	0	3	25	75	100
5	HSMC	HSMC-02	Economics for Engineers	3	0	0	3	25	75	100
6	MC	MC-03	Environmental Sciences	2	0	0	0	25	75	100
7	Capstone Project	PROJ-CS-401	Project-II	0	0	4	2	25	75	100
8	BSC	BSC-DS-402	Statistics -II Lab using R/ SPSS	0	0	4	2	15	35	50
9	PCC	PCC-DS-403	Data Mining Lab	0	0	4	2	15	35	50
10	PCC	PCC-DS-404	Object Oriented Programming using Java	0	0	4	2	15	35	50
Total				**17**	**1**	**16**	**24**	**220**	**630**	**850**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (Computer Engineering Specialization in Data Science)

Scheme of Studies/Examination

Semester- 5

S. No	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC	PCC-DS-501	Principles of Artificial Intelligence	3	0	0	3	25	75	100
2	PCC	PCC-CS-404	Design and Analysis of Algorithms	3	0	0	3	25	75	100
3	PCC	PCC-DS-502	Soft Computing Principles	3	0	0	3	25	75	100
4	PCC	PCC-CS-403	Operating System	3	0	0	3	25	75	100
5	BSC	BSC-01	Biology	2	1	0	3	25	75	100
6	PCC	PCC-DS-503	Computer Architecture	3	0	0	3	25	75	100
7	MC	MC-01	Constitution of India	2	0	0	0	25	75	100
8	Capstone Project	PROJ-CS-501	Project-III	0	0	4	2	25	75	100
9	PCC	PCC-DS-504	Soft Computing Principles lab	0	0	4	2	15	35	50
10	PCC	PCC-CS-406	Operating System Lab	0	0	4	2	15	35	50
11	VAC	H-102	Universal Human Values 2: Understanding Harmony	0	0	2	0	15	35	50
Total				**19**	**1**	**14**	**24**	**245**	**705**	**950**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (Computer Engineering Specialization in Data Science)

Scheme of Studies/Examination

Semester- 6

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC	PCC-DS-601	Machine Learning Principles	3	0	0	3	25	75	100
2	PCC	PCC-DS-602	Data Acquisition, Analysis and Visualization	3	0	0	3	25	75	100
3	PCC	PCC-DS-603	Big Data Fundamentals	3	0	0	3	25	75	100
4	PCC	PEC-CS-A-702	Web and Internet Technology	3	0	0	3	25	75	100
5	OEC	OEC-CS-601	Open Elective-I	3	0	0	3	25	75	100
6.	OEC	OEC-CS-602	Open Elective-II	3	0	0	3	25	75	100
7	AC	AC-02-23	Message of Bhagwat Gita	2	1	0	3	25	75	100
8	Capstone Project	PROJ-CS-601	Project-IV	0	0	4	2	25	75	100
9	PCC	PCC-DS-605	Machine Learning Lab	0	0	4	2	15	35	50
10	PCC	PCC-DS-606	Big Data Lab	0	0	4	2	15	35	50
Total				**20**	**1**	**12**	**27**	**230**	**670**	**900**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (Computer Engineering Specialization in Data Science)

Scheme of Studies/Examination

Semester- 7

S. No	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC	PCC-DS-701	Cloud Computing	3	0	0	3	25	75	100
2	PCC	PEC-CS-D-701	Speech and Natural language Processing	3	0	0	3	25	75	100
3	PCC	PCC-DS-703	Deep Learning and Image Processing	3	0	0	3	25	75	100
4	OEC	OEC-CS-701	Open Elective-III	3	0	0	3	25	75	100
5	OEC	OEC-CS-702	Open Elective-IV	3	0	0	3	25	75	100
6	PCC	PCC-DS-704	Business Intelligence and Predictive Analysis	3	0	0	3	25	75	100
7	Capstone Project	PROJ-CS-701	Project-V	0	0	4	2	25	75	100
Total				**18**	**0**	**4**	**20**	**175**	**525**	**700**

* The course contents of 7th Semester may be pursued by the students of UTDs/Departments of Affiliated colleges in 8th semester. In the case of pursuance of internship in 7th semester, the course contents of 7th semester will be taught in 8th semester and vice-versa. The approval of such interchangeability should be requested from the authority before the commencement of 7th semester.

Note: Exams duration will be as under

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

B.Tech. (Computer Engineering Specialization in Data Science)

Scheme of Studies/Examination

Semester- 8

S. No.	Category	Course Code	Course Title	Duration	Credits	Marks for Sessional	Marks for End Term Examination	Total
1.	Project	PROJ-CS-801	Industry Internship*	6 Months	10	200	300	500
Total					**10**	**200**	**300**	**500**

Note: Additional 3 credits per year to be earned through MOOCs

Procedure for Annual Examination and continuous Assessment

(A) Annual Exams Marks

1. Project Evaluation 100 Marks
2. Project Seminar 50 Marks
3. Project Viva 150 marks

(B) Continuous Assessment Marks

1. Assessment by Institute faculty 50 Marks
2. Assessment by Industrial Guide 100 Marks
3. Conduct Marks 50 Marks

* The Industry Internship may be pursued by UTDs/Departments of Affiliated colleges in 7th or 8th semester. In the case of pursuance of internship in 7th semester, the course contents of 7th semester will be taught in 8th semester and vice-versa. The approval of such interchangeability should be requested from the authority before the commencement of 7th semester.

OPEN ELECTIVE COURSES*

Open Elective-I	Open Elective-II	Open Elective-III	Open Elective-IV
Soft Skills and Interpersonal Communication (OEC-CS-601(I))	Human Resource Management (OEC-CS-602(I))	Financial Management (OEC-CS-701(I))	Economic Policies in India (OEC-CS-702(I))
Cyber Law and Ethics (OEC-CS-601(II))	ICT for Development (OEC-CS-602(II))	E-commerce and Entrepreneurship (OEC-CS-701(II))	Basics of Cloud Computing(PEC-IT-I-703)
Data Analytics using Python (PCC-IT-601)	Intellectual Property Rights (OEC-CS-602(III))	R programming (OEC-CS-701(III))	Optical Network Design (OEC-CS-702(III))
Electronic Devices (OEC-CS-601(IV))	International Business Environment (OEC-CS-602(IV))	Non-Conventional Energy Sources (OEC-CS-701(IV))	High Speed Network (OEC-CS-702(IV))
Digital System Design (OEC-CS-601(V))	Basics of Operations Research (OEC-CS-602(V))	-	-

*** The list is non-exhaustive and may be appended with new courses time to time with the approval of Board of Studies.**

VALUE ADDED COURSE [VAC]*

S.No.	Code	Course Title	Hours Per Week			Semester
			L	T	P	
1.	HSMC (H-102)	Universal Human Values2: Understanding Harmony	0	0	2	V

AUDIT COURSE [AC]*

S.No.	Code	Course Title	Hours Per Week			Semester	Credits	Marks for Sessional	Marks for End-term Examination	Total
			L	T	P					
1.	AC-02-23	Message of Bhagwat Gita	2	1	0	VI	3	25	75	100
Total							3	25	75	100

***As approved in 20th Meeting of Academic Council, the above subjects are to be included in the curriculum.**

ADDITIONAL REQUIREMENTS FOR B.TECH (Hons.)

A student will be eligible to get Under-Graduate (B.Tech) with Honours if he/she completes additional credits through MOOC"s. (AICTE Model Curriculum, Chapter1(B)). Following pattern will be followed for earning additional credits for the award of Honours degree:

Program	**Ration**	**credits to be earned***	**minimum CGPA**
B.Tech	Semester I to VIII		

Note: From session 2019-20 onwards, for B.Tech program, a student has to earn at least 12 credits during the duration of the Degree subject to the passing of at least one MOOC course (carrying minimum 3 credits) per year. The MOOC chosen by the student should not be on offer/scheme of the degree.

The *Credit Transfer/Mobility Policy for Online Courses* approved in 17th Academic Council Dated 11.06.2019 may be referred for the same.

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTERENGINEERING

(Specialization in Data Science)

Second year (Third semester onwards)

PROFESSIONAL CORE COURSES

B.TECH. 3RD SEMESTER
CODE: BSC-DS-301
SUBJECT NAME: MATHEMATICS FOR DATA SCIENCE
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

To acquaint the students with concepts relating to

1. Mathematical logic, functions and relations
2. Graph theory and algebraic structures
3. State machines and formal language
4. Numerical Methods in solving the problems of Polynomial, definite integrals and differential equations

Course Contents:

Unit I

Counting Techniques, Permutation & Combination, Pigeonhole Principle, Basic Proof Techniques, Induction, Propositional Logic, Quantifiers, Equivalences and Normal Forms, Sets, Functions and Relations, Equivalence Relation, Partial Order Relation, Hasse Diagram, Posets, Concept of Lattice.

Unit II

Graphs and Relations, Directed Graphs, Undirected Graphs, Connectivity, Trees, Tree Traversal Minimum spanning tree, Graph Coloring, Hamiltonian and Eulers Graph, Planar Graph, Shortest Path algorithm

Unit III

Generating function, Algebraic Structure, Group, Abelian Group, Cyclic Group, permutation group, Cosets, Langrange's Theorem, Normal Subgroup

Unit IV

Formal definition of a language, Discussion on grammar, Terminal, Non-Terminal, Production System, Chomsky Hierarchy of Grammar and associated machines

Unit V

Solution of polynomial using Bisection, RegulaFalsi and Newton Raphson Method, Solving the definite integrals using Trapozoidal method and Simpson Rule, Solving differential equation using RungaKutta Method

Course Outcomes

After completing this course, the students should have developed a clear understanding of

1. Mathematical logic, functions and relations
2. Graph theory and algebraic structures
3. State machines and formal language
4. Numerical Methods for solving Polynomials, definite integrals and differential equations

Reference Books*:*

1. C.L.Liu: Elements of Discrete Mathematics McGraw Hill.

2. Lipschutz, Seymour: Discrete Mathematics, Schaum's Series.
3. Babu Ram: Discrete Mathematics, Vinayek Publishers, New Delhi.
4. Trembley, J.P. & R. Manohar: Discrete Mathematical Structure with Application to Computer Science, TMH.
5. Kenneth H. Rosen : Discrete Mathematics and its applications, TMH
6. Doerr Alan &Levasseur Kenneth; Applied Discrete Structures for Computer Science, Galgotia Pub. Pvt. Ltd.
7. Theory of Computer Science; K.L.P. Mishra. N. Chandrasekaran
8. Introductory Methods of Numerical Analysis, S SSastri, PHI
9. Numerical Methods: Problems and Solutions, Jain Iyenger Jain, New Age International Publishers

CODE: PCC-CS-301
SUBJECT NAME: DATA STRUCTURES & ALGORITHMS
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Course Contents:

MODULE 1: INTRODUCTION

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

MODULE 2: STACKS AND QUEUES

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

MODULE 3: LINKED LISTS

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

MODULE 4: SORTING AND HASHING

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods. Hashing and collision resolution.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Course Outcomes:

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues, linked list and Tree, student will able to implement it and analyze the same to determine the time and computation complexity.

4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

References:

1. A. M. Tenenbaum, Langsam, Moshe J. Augentem , "Data Structures using C," PHI Pub.
2. A.V. Aho, J.E. Hopcroft and T.D. Ullman, "Data Structures and Algorithms" Original edition, Addison-Wesley, 1999, Low Priced Edition.
3. Ellis Horowitz &SartajSahni, "Fundamentals of Data structures" Pub, 1983,AW

CODE: PCC-DS-301
SUBJECT NAME: FUNDAMENTALS TO DATABASE SYSTEMS
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

COURSE OBJECTIVES

1. To make the students able to understand basic terminology used in database systems, basic concepts, the applications of database systems.
2. To understand role of Database administrator in DBMS. Teaching them various data model like Hierarchical model, Network Model, Relational model, E-R model , E-R diagram from data given by user and table from E-R diagram,.
3. Make the students familiar with relational database theory and be able to write relational algebra expressions for query, the logical design guidelines for databases, normalization approach, primary key, super key, foreign key concepts.

Course Contents:

UNIT-I

Database: Introduction to database, relational data model, DBMS architecture, data independence, DBA, database users, end users, front end tools**.**

UNIT-II

Modelling: Entity types, entity set, attribute and key, relationships, relation types, E- R diagrams, database design using ER diagrams.

UNIT-III

Relational Data Model: Relational model concepts, relational constraints, primary and foreign key, normalization: 1NF, 2NF,3NF.

UNIT-IV

Transaction management and Concurrency control: Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.

UNIT-V

Structured Query Language: SQL queries, create a database table, create relationships between database tables, modify and manage tables, queries, forms, reports, modify, filter and view data.

COURSE OUTCOMES

1. To understand the basic concepts, applications and architecture of database systems.
2. To master the basics of ER diagram.
3. To understand relational database algebra expressions and construct queries using SQL.
4. To implement design principles for logical design of databases.

Reference Books

1. Fundamentals of Database Systems by R. Elmasri and S.B. Navathe, 3rd edition, Addision-Wesley, Low PricedEdition,2000.
2. An Introduction to Database Systems by C.J. Date, 7th edition, Addison-Wesley, Low Priced Edition, 2000.
3. Database Management and Design by G.W. Hansen and J.V. Hansen, 2nd edition, Prentice- Hall of India, Eastern EconomyEdition,1999.
4. Database Management Systems by A.K. Majumdar and P. Bhattacharyya, 5thedition, Tata McGraw-Hill Publishing.,1999.
5. A Guide to the SQL Standard, Date, C. and Darwen,H. 3rd edition, Reading, MA:, Addison- Wesley,1994.
6. Data Management & file Structure by Loomis, PHI, 1989.
7. P. Rob, C. Coronel, Database System Concepts by, Cengage Learning India,2008.
8. R. Elmsasri,S. Navathe Fundamentals of Database Systems, Pearson Education, Fifth Edition,2007.
9. MySQL : Reference Manual

CODE: BSC-DS-302
SUBJECT NAME: STATISTICS -1
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives

1. How to summarize the data and to obtain its salient features from the vast mass of original data.
2. Concepts of probability and its applications.
3. Concept of index numbers
4. Concept of regression analysis

Course Contents:

UNIT I

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical representation of data. Consistency and independence of data with special reference to attributes.

UNIT II

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard‟s corrections.

UNIT III

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

UNIT IV

Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers. Fixed based index numbers and chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers.

UNIT V

Probability: Introduction, random experiments, sample space, events and algebra of events. Definition of Probability: classical, statistical and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes‟ theorem and its applications. Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f.

Course Outcomes

1. Tabular and graphical representation of data based on variables and curve fitting
2. Measures of central tendency, Dispersion, Skewness and Kurtosis.
3. Important theorems on probability and their use in solving problems.

4. Index numbers and their creation

Reference Books

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8thEdn. The World Press, Kolkata.

2. Miller, Irwin and Miller, Marylees (2006): John E. Freund‟s Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

4. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.

CODE: HSMC-01
SUBJECT NAME: EFFECTIVE TECHNICAL COMMUNICATION
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. Learning to structure content following recognized patterns of technical and creative writing with the ability to define, describe, classify and compare products and processes; fostering clear conceptualization.
2. Undertake guided exercises for better drafts that show familiarity with editing techniques like hedging and generalization.
3. Guiding self-appraisal through SWOC analysis and goal setting aided by basic problem solving and critical thinking.
4. Learning skills of corporate communication.

Course Contents:

MODULE 1: INFORMATION DESIGN AND DEVELOPMENT

Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

MODULE 2: TECHNICAL WRITING, GRAMMAR AND EDITING

Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

MODULE 3: SELF DEVELOPMENT AND ASSESSMENT

Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

MODULE 4: COMMUNICATION AND TECHNICAL WRITING

Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

MODULE 5: ETHICS

Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Course Outcomes:

1. Students will have learnt to structure content following recognized patterns of technical and creative writing and acquired the ability to define, describe, classify and compare products and processes with clear conceptualization.
2. Will be able to draft and edit better demonstrating familiarity with editing techniques like hedging and generalization.
3. Demonstrate ability for self-appraisal through SWOC analysis and goal setting aided by basic problem solving and critical thinking.
4. Will have learnt skills of corporate communication.

References:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)

CODE: PCC-DS-302
SUBJECT NAME: IT WORKSHOP (PYTHON)
CREDITS: 2

SESSIONAL:	**25**	**L T P**
THEORY EXAM:	**75**	**0 0 4**
TOTAL:	**100**	

Course Objectives:

1. Fundamentals and Data structures of pythons programming language.
2. Use collections of Python
3. Basics of functions and Files of Python
4. Concepts of classes and objects in Python

Course Contents:

Unit 1: Basic concepts of Python

Installation and Working with Python, Understanding Python variables, Python basic Operators, Understanding python blocks, standard Python library, Declaring and using Numeric data types: int, float, complex,User interaction: standard input output ; Control structures : selection constructs- using if, else and elif, Repetition constructs- simple for loops in python, for loop using ranges, Use of while loops in python, Loop manipulation usingpass, continue, break and else. Programming using Python conditional and loops block.

Unit 2: Collections

Understanding String in build methods List –methods to process lists, Shallow & Deep copy, Nested lists, lists as matrices, lists as stacks, Queues, De queues.Tuples - basic operations on tuples, nested tuples,Dictionaries – operations on dictionary, ordered dictionary, iteration on dictionary, conversion of lists & strings into dictionary, Sets & frozen sets, looping techniques on lists & dictionaries

Unit3 : Functions and Files in Python

Functions – basics of functions, functions as objects, recursive functions, Lamda, filter, reduce, map, list comprehension, iterators and generators. Files - reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Unit 4: Classes

The Class Definition, Constructors, Operations, using Modules, Hiding Attributes, Overloading Operators, Inheritance, Deriving Child Classes, Creating Class Instances, Invoking Methods, Polymorphism. The Basics of NumPy: NumPy Array Basics , Boolean Selection, Helpful Methods and Shortcuts

Course Outcomes:

1. Write programs efficiently in python
2. Effectively use functions and files in python
3. Carry out basic data science operations like retrieving, processing and visualizing using python.
4. Use the concept of classes and objects in Python

Reference Books:

1. Martin C. Brown , “Python, The Complete Reference” , Mc-Graw Hill, 2002
2. Wesley J Chun, “Core Python Programming”, Prentice Hall, Second Edition,2006
3. Dr. M. Shubhakantasingh, “Programming with Python and its applications to Physical Systems” Manakin Press.

CODE: BSCC-DS-303
SUBJECT NAME: STATISTICS USING MS-EXCEL LAB
CREDITS: 2

		L	T	P
SESSIONAL:	**15**			
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

Course Contents:

Exercises relating to

1. Basic Tables
2. Graphs
3. Data Validation
4. Central Tendency finding
5. Advance IFs
6. Box and Whisker Plots
7. Correlation & Regression
8. Lookup functions
9. Advance Lookup functions
10. Pivot Tables
11. Advance Pivot Tables
12. Using Advanced Filters in Tables with multiple criteria and extract ranges.
13. Writing macros in EXCEL

Reference Books:

1. Excel 2016: Formulas And Functions by Paul McFedries, Pearson
2. Excel 2016 Formulas by Michael Alexander and Dick Kusleika, John Wiley

CODE: PCC-DS-303
SUBJECT NAME: DATABASE SYSTEM (LAB)
CREDITS: 2

		L	T	P
SESSIONAL:	**15**			
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

Course Contents:

1) Create a database having two tables with the specified fields, to computerize alibrary system of a Delhi University College.

LibraryBooks (Accession number, Title, Author, Department, PurchaseDate, Price)
IssuedBooks (Accession number, Borrower)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in eachtable.
b) Delete the record of book titled "Database System Concepts".
c) Change the Department of the book titled "Discrete Maths" to"CS".
d) List all books that belong to "CS"department.
e) List all books that belong to "CS" department and are written by author"Navathe".
f) List all computer (Department="CS") that have been issued.
g) List all books which have a price less than 500 or purchased between"01/01/1999" and"01/01/2004".

2) Create a database having three tables to store the details of students of Computer Department in your college.

Personal information about Student (College roll number, Name of student, Date of birth, Address, Marks(rounded off to whole number) in percentage at 10 + 2, Phone number)
Paper Details (Paper code, Name of the Paper)

Student's Academic and Attendance details (College roll number, Paper code, Attendance, Marks in home examination).

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) Design a query that will return the records (from the second table) along with the name of student from the first table, related to students who have more than 75% attendance and more than 60% marks in paper2.
c) List all students who live in "Delhi" and have marks greater than 60 in paper1.
d) Find the total attendance and total marks obtained by each student.
e) List the name of student who has got the highest marks in paper2

3) Create the following tables and answer the queries given below:

Customer (CustID, email, Name, Phone, ReferrerID)

Bicycle (BicycleID, DatePurchased, Color, CustID, ModelNo)
BicycleModel (ModelNo, Manufacturer, Style)

Service (StartDate, BicycleID, EndDate)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) List all the customers who have the bicycles manufactured by manufacturer"Honda".
c) List the bicycles purchased by the customers who have been referred by customer"C1".
d) List the manufacturer of red colored bicycles.
e) List the models of the bicycles given for service.

4) Create the following tables, enter at least 5 records in each table and answer the queries given below.

EMPLOYEE (Person_Name, Street, City)
WORKS (Person_Name, Company_Name, Salary)
COMPANY (Company_Name, City)
MANAGES (Person_Name, Manager_Name)

a) Identify primary and foreign keys.
b) Alter table employee, add a column "email" of type varchar(20).
c) Find the name of all managers who work for both Samba Bank and NCB Bank.
d) Find the names, street address and cities of residence and salary of all employees who work for "Samba Bank" and earn more than$10,000.
e) Find the names of all employees who live in the same city as the company for which they work.
f) Find the highest salary, lowest salary and average salary paid by each company.
g) Find the sum of salary and number of employees in each company.
h) Find the name of the company that pays highest salary.

5) Create the following tables, enter at least 5 records in each table and answer the queries given below.

Suppliers (SNo, Sname, Status, SCity)
Parts (PNo, Pname, Colour, Weight, City)
Project (JNo, Jname,Jcity)
Shipment (Sno, Pno, Jno, Qunatity)

a) Identify primary and foreign keys.
b) Get supplier numbers for suppliers in Paris with status>20.
c) Get suppliers details for suppliers who supply part P2. Display the supplier listin increasing order of supplier numbers.
d) Get suppliers names for suppliers who do not supply partP2.
e) For each shipment get full shipment details, including total shipment weights.
f) Get all the shipments where the quantity is in the range 300 to 750inclusive.

g) Get part nos. for parts that either weigh more than 16 pounds or are supplied by suppliers S2, or both.
h) Get the names of cities that store more than five red parts.
i) Get full details of parts supplied by a supplier in London.
j) Get part numbers for part supplied by a supplier in London to a project in London.
k) Get the total number of project supplied by a supplier (say,S1).
l) Get the total quantity of a part (say, P1) supplied by a supplier (say,S1)

Course Outcomes:

After the completion of the course

- Create Database efficiently in SQL.
- Effectively use SQL functions.
- Carry out basic SQL operations on Tables.
- Use the concept of primary key and foreign key in SQL.

CODE: PCC-CS-303
SUBJECT NAME: DATA STRUCTURES AND ALGORITHMS (LAB)
CREDITS: 2

SESSIONAL: 15
END SEMESTER: 35
TOTAL: 50

L T P
0 0 4

S.No.	Experiment
1	Programs on String
2	Programs on Array
3	Programs on Pointer
4	Write a program to search an element from an array using Linear Search
5	Write a program to search an element from an array using Binary Search
6	Write a program to sort elements of an array using selection sort
7	Write a program to sort elements of an array using insertion sort
8	Write a program to sort elements of an array using bubble sort
9	Write a program to sort elements of an array using Quick sort
10	Write a program to sort elements of an array using Merge sort
11	Write a program to push , pop and display the elements in a stack using array
12	Write a program to convert infix into postfix notation using stack using array
13	Write a program to evaluate postfix notation using stack
14	Write a program to insert, delete and display the elements in a queue using Array
15	Write a program to insert, delete and display the elements in a circular queue
16	Write a program to insert, delete and display the elements in a one way linked list at beginning, at end and at certain point
17	Write a program to insert, delete and display the elements in a two way linked list at beginning, at end and at certain point
18	Write a program to push , pop and display the elements in a stack using linked list
19	Write a program to convert infix into postfix notation using stack using linked List
20	Write a program to insert, delete and display the elements in a queue using linked list
21	Write a program to insert, delete and display the elements in a binary tree
22	Write a program to insert, delete and display the elements in a binary search Tree
23	Write a program to sort elements using heap sort
24	Write a program to insert, delete and display elements in a graph

4TH SEMESTER
CODE: PCC-CS-602
SUBJECT NAME: COMPUTER NETWORKS
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do network programming
4. To provide a WLAN measurement ideas.

Course Contents:

MODULE-1: DATA COMMUNICATION COMPONENTS

Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

MODULE-2: DATA LINK LAYER AND MEDIUM ACCESS SUB LAYER

Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

MODULE-3: NETWORK LAYER

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

MODULE-4: TRANSPORT LAYER

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

MODULE-5: APPLICATION LAYER

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Course Outcomes:

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
3. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component

4. For a given problem related TCP/IP protocol developed the network programming.
5.Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Reference Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America

CODE: BSC-DS-401
SUBJECT NAME: STATISTICS-II
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives

1. Probability distributions and their expectation.
2. Estimation of population parameters using sample statistics and draw appropriate conclusions from the analysis.
3. Null and alternative hypothesis
4. Regression Analysis and models

Course Contents:

UNIT I

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting / approximation cases.

UNIT II

Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination.

UNIT III

Methods of Estimation: Method of moments, method of maximum likelihood estimation, method of minimum Chi-square, basic idea of Bayes estimators.

UNIT IV

Principles of test of significance: Null and alternative hypotheses (simple and composite), Type-I and Type-II errors, critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test.

UNIT V

Regression analysis: Simple regression analysis, Estimation and hypothesis testing in case of simple and multiple regression models, Concept of model matrix and its use in estimation. Analysis of variance: Definitions of fixed, random and mixed effect models, analysis of variance and covariance in one-way and two way classified data for fixed effect models.

Course Outcomes

1. Concept of random variables and its probability distributions.
2. Sampling Techniques
3. Basic concepts of hypothesis testing, including framing of null and alternative hypothesis.

4. Regression analysis and models.

Reference Books:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8thEdn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund‟s Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
5. A.M. Goon, M.K. Gupta and Das Gupta: Fundamentals of Statistics, Vol. 1, The World Press Pvt. Ltd., Kolkata, 1966.
6. Mukhopadhyay, P. : Mathematical Statistics, New Central Book Agency, Calcutta,1996.

CODE:PCC-DS-401
SUBJECT NAME: DATA MINING
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Pre-requisites: Database Management System

Course Objectives:

1. To familiarize the students with the basic roadmap of data mining and various data mining techniques.
2. To introduce the techniques of frequent pattern mining and Clustering
3. To acquaint students with classification and prediction techniques in data mining.
4. To introduce students with time series data, data streams, advance mining applications areas like web mining, social network analysis etc.

MODULE-1: INTRODUCTION

Introduction to Data Warehousing, Architecture, Data warehouse schemas, OLAP servers, OLAP operations, KDD process, Data Mining: Architecture, Predictive and Descriptive models, Data Preprocessing: Data cleaning & Discretization, Data Mining primitives and Applications, Major issues in data mining

MODULE-2: FREQUENT PATTERN MINING AND CLUSTERING

Mining frequent patterns, association and correlations; Association Rule Mining: support & confidence, a-priori algorithm, FP Growth algorithm; Advanced Pattern Mining; Sequential Pattern Mining concepts, Cluster Analysis – Types of Data in Cluster Analysis, Similarityand Distance Measures, Partitioning methods: k-means & k-medoids, Hierarchical Methods: agglomerative and divisive methods; Density-Based Methods, Clustering with Constraints, Outlier Detection

MODULE-3: CLASSIFICATION AND PREDICTION

Classification: Basic Concepts, Decision tree induction, Bayesian classification, Bayesian Belief Networks; Lazy Learners, Rule based classification, Model Evaluation and Selection, improve classifier accuracy, back propagation through Neural Networks, Genetic Algorithm, Support Vector Machines, Prediction: linear and non-linear regression techniques.

MODULE-4: ADVANCED MINING APPLICATIONS

Mining Complex Data Types: Mining Data Streams: Stream Data Processing and Stream Data Systems, Mining Time series Data: Periodicity Analysis for time related sequence data, Similarity search in Time-series analysis; Web Mining, Web page layout structure; mining web

link structure, content and usage patterns; Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

Course Outcomes:

After completion of course, students would be able to:

1. Understand and interpret the contribution of data warehousing and data mining to the decision-support level of organizations.
2. Categorize and carefully differentiate between situations for applying different data-mining techniques: frequent pattern mining, associations and correlations.
3. Design and deploy appropriate classification techniques for different applications.
4. Evaluate various mining techniques on complex data objects and ability to solve real world problems in business and scientific information using data mining.

REFERENCES

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
2. Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Addison Wesley, 2006. 3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.
3. Alex Berson, Stephen J. Smith “Data Warehousing, Data-Mining & OLAP”, TMH
4. Margaret H. Dunham, S. Sridhar,” Data Mining: Introductory and Advanced Topics”Pearson Education

CODE: PCC-DS-402
SUBJECT NAME: OBJECT ORIENTED PROGRAMMING
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

The course will introduce standard tools and techniques for software development, using object-oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.

Course Contents:

UNIT - I

Object Oriented Methodology: Paradigms of Programming Languages, Evolution of OO Methodology, Basic Concepts of OO Approach, Comparison of Object Oriented and Procedure Oriented Approaches, Benefits of OOPs, Introduction to Common OO Language, Applications of OOPs, Decomposition & Abstraction, Abstraction Mechanisms – parameterization, specification, Kind of Abstractions.

UNIT – II

Java Language Basics: Introduction to Java, Basic Features, Java Virtual Machine Concepts, Primitive Data Type and Variables, Java Operators, Expressions, Statements and Arrays.

Object Oriented Concepts: Class and Objects--Class Fundamentals, Creating objects, Assigning object reference variables; Introducing Methods, Static methods, Constructors, Overloading constructors; This Keyword; Using Objects as Parameters, Argument passing, Returning objects, Method overloading, Garbage Collection, The Finalize ( ) Method.

Inheritance and Polymorphism: Inheritance Basics, Access Control, Multilevel Inheritance, Method Overriding, Abstract Classes, Polymorphism, Final Keyword

UNIT - III

Packages: Defining Package, CLASSPATH, Package naming, Accessibility of Packages, using Package Members. Interfaces: Implementing Interfaces, Interface, and Abstract Classes, Exceptions Handling: Exception, Handling of Exception, using try-catch, Catching Multiple Exceptions, using finally clause, Types of Exceptions, Throwing Exceptions, and Writing Exception Subclasses. Multithreading: Introduction, The Main Thread, Java Thread Model, Thread Priorities, Synchronization in Java, Interthread Communication.

UNIT - IV

I/O in Java: I/O Basics, Streams and Stream Classes, The Predefined Streams, reading from, and writing to, Console, Reading and Writing Files, The Transient and Volatile Modifiers, Using Instance of Native Methods.

Strings and characters: Fundamentals of Characters and Strings, the String Class, String Operations, Data Conversion using Value Of ( ) Methods, String Buffer Class and Methods.

Graphical programming with swing: Swing components, laying out components in a container, Panels, Look & Feel, Event listener, concurrency in swing.

Course Outcomes:

After taking the course, students will be able to:

1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognize features of object-oriented design such as encapsulation, polymorphis m, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.
4. Design applications with an event-driven graphical user interface.

Reference Books:

1. E Balagurusamy: Programming in Java.
2. Herbert Schildt: The Complete Reference JAVA, TMH Publication.
3. Beginning JAVA, Ivor Horton, WROX Public.
4. Stephen Potts: JAVA 2 UNLEASHED, Tech Media Publications.
5. Patrick Naughton and Herbertz Schildt, "Java-2 The Complete Reference", 1999, TMH.

Note: Latest and additional good books may be suggested and added from time to time.

CODE: HSMC-02
SUBJECT NAME: ECONOMICS FOR ENGINEERS
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

The students should be able to**:**

1. Understand the supply and demand forces.
2. Build an ability to be an efficient engineer by utilizing limited resources to satisfy unlimited wants.
3. Get knowledge about the market environment and take decisions regarding price determination.
4. Develop awareness about the economic forces influencing an organisation.

Course Contents:

MODULE-1:

Introduction to the subject: Micro and Macro Economics, Relationship between Science, Engineering, Technology and Economic Development. Production Possibility Curve, Nature of Economic Laws.

MODULE-2:

Time Value of Money: concepts and application. Capital budgeting; Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI (with the help of case studies)

MODULE-3:

Meaning of Demand. Law of Demand, Elasticity of Demand; meaning, factors effecting it and its practical application and importance. Demand forecasting (a brief explanation)

MODULE-4:

Meaning of Production and factors of production, Law of variable proportions and returns to scale. Internal and external economies and diseconomies of scale. Concepts of cost of production, different types of costs; accounting cost, sunk cost, marginal cost, and Opportunity cost. Break even analysis, Make or Buy decision (case study). Relevance of Depreciation towards industry.

MODULE-5:

Meaning of market, types of market, perfect competition, Monopoly, Monopolistic, Oligopoly. (main features). Supply and law of supply, Role of demand and supply in price determination.

MODULE-6:

Indian Economy, nature and characteristics. Basic concepts; fiscal and monetary policy, LPG, Inflation, Sensex, GATT, WTO and IMF. Difference between Central bank and Commercial banks

Course Outcomes:

After the successful completion of the course, students will be able to:

1. Utilise the understanding of economic forces for different aspects of an organisation.
2. Take decisions about optimum use of different resources.
3. Apply decisions methodologies to decide the different aspects of the product of an organisation

in different market conditions.

4. Utilise the different aspects of economics for understanding the organisational problems and manage it in the best possible way.

Reference Books:

1. Jain T.R., Economics for Engineers, VK Publication
2. Chopra P. N., Principle of Economics, Kalyani Publishers
3. Dewett K. K., Modern economic theory, S. Chand
4. H. L. Ahuja., Modern economic theory, S. Chand
5. DuttRudar&Sundhram K. P. M., Indian Economy
6. Mishra S. K., Modern Micro Economics, Pragati Publications
7. Pandey I.M., Financial Management; Vikas Publishing House
8. Gupta Shashi K., Management Accounting, Kalyani Publication

CODE: MC-03

SUBJECT NAME: ENVIRONMENTAL SCIENCES

CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. The prime objective of the course is to provide the students a detailed knowledge on the threats and challenges to the environment due to developmental activities.
2. The students will be able to identify the natural resources and suitable methods for their conservation and sustainable development.
3. The focus will be on awareness of the students about the importance of ecosystem and biodiversity for maintaining ecological balance.
4. The students will learn about various attributes of pollution management and waste management practices. The course will also describe the social issues both rural and urban environment and environmental legislation

Course Contents:

MODULE-1: The Multidisciplinary Nature of Environmental Studies

Definition, scope and importance. Need for public awareness.

MODULE-2: Natural Resources: 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, drought, conflicts over water, dams-benefits and problems.
- Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources, case studies.
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- 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, man induced landslides, soil erosion and desertification.
- Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

MODULE-3: Ecosystems

- Concept of an ecosystem. 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, characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

MODULE-4: Biodiversity and its Conservation

- Introduction – Definition: genetic, species and ecosystem diversity.

- Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels.
- India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: insitu and ex-situ conservation of biodiversity

MODULE-5: Environmental Pollution Definition

- Causes, effects and control measures of: Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban andindustrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

MODULE-6: 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 problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products.
- 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.

MODULE-7: Human Population and the Environment

Population growth, variation among nations. 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.

MODULE-8: Field Work

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

Course Outcomes (COs):

At the end of the program the students acquired knowledge about:

1) Understand / evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn help in sustainable development. The students will also be able to introduce the thinking about environmental issues from an interdisciplinary perspective.
2) Identify and relate about the renewable and non-renewable resources, their importance and ways of conservation to sustain human life on earth.
3) Know about the concepts of ecosystem and its function in the environment, the need for protecting the producers and consumers in various ecosystems and their role inthe food web.

4) Recognize, relate and become sensitive to the effects of pollution and will be able to contribute his learning‟s towards their prevention or mitigation. The students will also be able to describe the social issues along with the trends of human population growth and the possible means to combat the challenges.

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela 2008PHI Learning Pvt Ltd.
3. Environmental Science by Daniel B. Botkin& Edwards A. Keller, Wiley INDIA edition.

CODE: BSC-DS-402
SUBJECT NAME: STATISTICS -II LAB USING R/ SPSS
CREDITS: 2

		L	T	P
SESSIONAL:	**15**			
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

R/ SPSS Lab

1. Basic fundamentals, installation and use of software, data editing
2. Use of R as a calculator, functions and assignments.
3. Use of R for matrix operations, missing data and logical operators.
4. Conditional executions and loops, data management with sequences.
5. Data management with repeats, sorting, ordering, and lists.
6. Vector indexing, factors, Data management with strings, display and formatting.
7. Data management with display paste, split and replacement, manipulations with alphabets, evaluation of strings, data frames.
8. Data frames, import of external data in various le formats, statistical functions, compilation of data.
9. Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis.
10. Handling of bivariate data through graphics, correlations, programming and illustration with examples.
11. Parametric and Non Parametric testing of Statistical Hypothesis, t-test
12. One way ANOVA, two way ANOVA
13. Simple Correlation, Linear Regression, Multiple Linear Regression,
14. Testing for overall significance of Model Coefficients,
15. Testing for Individual Regression Coefficients, Outliers Detection, Dealing with multi-collinearity

Reference Books

1. Learning Statistics using R ByRndall, E.Schumacker, Sage Publication
2. R for Everyone By Jared P.Lander, Pearson Education

CODE: PCC-DS-403
SUBJECT NAME: DATA MINING LAB USING R/SPSS/PYTHON
CREDITS: 2

		L	T	P
SESSIONAL:	**15**			
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

Course Objectives:

1. To familiarize the students with the basics of Python and SPSS modeler.
2. To introduce Python Libraries: Numpy, Pandas, Matplotlib, Scipy, Seaborn and SKLearn
3. To acquaint students with implementation of various data mining and visualization techniques in Python.
4. To get them understand SPSS modeler working environment, creation of streams and collecting data.
5. To acquaint students about modeling in SPSS.

Outline:

1. Basic fundamentals, installation and use of software (Python/SPSS Modeler)
2. Python/SPSS Fundamentals and working environment
3. Introduction to Python Libraries: Numpy, Pandas, Matplotlib, Scipy, Seaborn and SKLearn
4. Data Wrangling - Numpy and Pandas
5. Data Cleaning using Pandas
6. Data Visualization using matplotlib and Seaborn
7. Learn Applied Statistics - Descriptive Statistics in Python
8. Learn Statistics - Statistical Inference in Python
9. Implementation of Supervised ML - Linear Regression in Python
10. Implementation of Supervised ML - Logistic regression in Python
11. Implementation of Supervised ML - Decision Tree Model in Python
12. Implementation of Ensemble Techniques - Random Forest in Python
13. Implementation of Ensemble Techniques - Boosting Techniques in Python
14. Implementation of Unsupervised ML - Clustering and Principal Component Analysis in Python
15. Implementation of NLP - Text Processing and Sentimental Analysis techniques in Python
16. Creation of data streams in SPSS Modeler
17. Data visualization techniques in IBM SPSS Modeler
18. Implementation of clustering techniques in SPSS Modeler on sample datasets
19. Implementation of a-priori algorithm in SPSS Modeler on sample datasets
20. Implementation of classification techniques: Decision tree (CART) and Regression Techniques: Linear regression in SPSS Modeler

Course Outcomes:

After completion of course, students would be able to:

1. Understand the basic concepts and roadmap of Python and IBM SPSS Modeler.

2. Understand and implement various data mining techniques like clustering, association rule discovery, classification and regression
3. Categorize and carefully differentiate between situations for applying different data-mining techniques: frequent pattern mining, associations, classification and regression using learned software
4. Build models for trending real world data analytical problems like sentiment analysis, text analysis etc.

REFERENCES

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.
2. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
3. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial

CODE: PCC-DS-404
SUBJECT NAME: OBJECT ORIENTED PROGRAMMING USING JAVA LAB

CREDITS: 2

SESSIONAL:	**15**	**L**	**T**	**P**
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

List of Programs

1. Write a program to take a string and copy some of the characters of the string in to character array.
2. Write a program for splitting a string into pieces wherever a space is found.
3. Write a program to initialize the instance variables of a class, using parameters constructor.
4. Write a program to test whether a static variable can access the instance variable or not.
5. Write a program to test whether a static variable can access the static variable or not.
6. Write a program to create a package with the name pack and store the addition class in it.
7. Write a program to shows how a package is import a package and use the class of the imported package
8. Write a program which tell us the use of try, catch and finally block.
9. Write a program which shows how to write and read a data from the file.
10. Write a program to improve the efficiency to write and read a data from the file.
11. Write a program to show the serialization and de- serialization of object
12. Write a program to synchronize the threads acting on a single object. The synchronized block on the program can be executed by only thread at a time
13. Write a program depicting a situation in which deadlock can occur.
14. Write a program to implement the producer – consumer problem using thread communication.

5TH SEMESTER

PCC-DS-501
SUBJECT NAME: ARTIFICIAL INTELLIGENCE
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course objectives:

1. To understand achievements of AI and the theory underlying those achievements and review "conventional" searching methods including breadth-first, depth-first, best-first search any many more heuristic techniques. Heuristic functions and their effect on performance of search algorithms.
2. To represent the knowledge in different forms in AI.
3. To understand and apply reasoning in Different areas of AI.
4. To learn the different methods of Planning and learning, Neural network and genetic algorithms. Architecture of Rule based and Non Rule based expert system

Course Contents:

Unit-I **BASICS OF AI:** Definition of AI, History, Domains AI, Proposing and evaluating AI applications, AI problems & State space, Some examples problems representations like Travelling Salespersons, Syntax analysis Problem, Basic issues to solve AI problems, Underlying assumptions, AI techniques, Level of model, Criteria for success

Unit II **SEARCH AND PLANNING**: Control strategies, Uninformed Search (DFS, BFS, IDDFS), Heuristic Search Techniques**:** Generate & Test: Hill Climbing(simple & steepest), Best first search/A*, Problem Reduction/AO*, Constraint satisfaction, MEA, Simulated annealing, Constraint Satisfaction Problems

Unit-III **KNOWLEDGE REPRESENTATION TECHNIQUES AND REASONING:** Syntax & Semantic for Propositional logic, Syntax & Semantic for Predicate Logic, Problems with FOPL, Resolution of proposition logic, Semantic nets, Frames, Conceptual Graphs, Scripts, Baye‟sTheorm, Demster Shafer Theory of Evidence, Fuzzy Reasoning, Temporal Reasoning

Unit-IV **PLANNING & LEARNING:** Planning, Planning in Situational calculus, Representation for planning, Partial order planning, Partial order planning algorithm, Learning by Examples, Learning by Analogy, Explanation based learning, Neural nets, Genetics algorithms, Architecture of expert system(Rule Based and Non-Rule Based)

Course outcomes:

After undergoing the course, Students will be able to:

a. Understand the importance, the basic concepts and the Applications of AI and Apply various search techniques used for Intelligent systems
b. Efficiently represent the various knowledge representation schemes used for intelligent systems.
c. Apply Reasoning in different areas of AI
d. Apply Soft computing techniques (like ANN and GA) to solve the AI problem. Also understand the phases and the architecture of various advanced system like NLP based system and Expert System.

Reference Books:

1. David W. Rolston: Principles of Artificial Intelligence and Expert System Development, McGraw Hill Book Company.
2. Artificial Intelligence by Elain Rich & Kevin Knight, TMH
3. Principals of AI(Nills .J.Nilsson)
4. DAN. W.Petterson
5. AI by Russel and Norvig, Pearson education
6. Petrick Henry Winston(AI)

CODE: PCC-CS-404
SUBJECT NAME: Design and Analysis of Algorithms

CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

Course Contents:

MODULE-1: INTRODUCTION

Characteristics of algorithm, Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters‟ theorem.

MODULE-2: FUNDAMENTAL ALGORITHMIC STRATEGIES

Brute-Force, Greedy, Dynamic Programming, Branch and-Bound and backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Job sequencing with deadline, Optimal Binary Search tree, N-Queen problem, Hamiltonian Cycle, TSP, Heuristics – characteristics and their application domains.

MODULE-3: GRAPH AND TREE TRAVERSAL ALGORITHMS

Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

MODULE-4: TRACTABLE AND INTRACTABLE PROBLEMS

Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard, Cook's theorem, Standard NP-complete problems and Reduction techniques.

MODULE-5: ADVANCED TOPICS

Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Course Outcomes:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design

situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

Reference Books :

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "*Introduction to Algorithms",* MIT Press/McGraw-Hill; 3rd edition, [ISBN: 978-0262533058], 2009.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "*Fundamentals of Algorithms",* Universities Press; 2nd edition [ISBN:978-8173716126],2008.
3. Jon Kleinberg and ÉvaTardos, "*Algorithm Design",* Pearson Publisher; 1st edition [ISBN:978-0321295354],2012.
4. Michael T Goodrich and Roberto Tamassia, "*Fundamentals of Algorithms"* Wiley Press; 1st edition [ISBN:978-8126509867],2006.

CODE: PCC-DS-502
SUBJECT NAME: SOFT COMPUTING
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives

1. Basic techniques related to Soft Computing and their roles in building intelligent machines
2. How to identify and select the suitable soft computing technology for solving the real world problem
3. How to design the suitable soft computing based framework for solving the real world problem
4. How to implement soft computing based solutions for real-world problems.

Unit I

Introduction to Soft Computing, Requirement of Soft computing, Soft computing Vs Hard Computing, Major domains covered under Soft Computing

Unit II

Biological neural network, Artificial Neural Network, Learning rules and various activation functions, Single layer Perceptrons , AND OR and NOT type classifiers, XOR problem, Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Gradient Descent Method, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map.

Unit III

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, s-norm, t-norm, complement norm, aggregation norms, concept of fuzzy numbers, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Fuzzy Decision Making, Fuzzy Control Systems. K means clustering, fuzzy c means clustering.

UNIT IV

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization. Solving Knapsack and Travelling Salesman Problem using GA.

Course Outcomes

1. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems
2. Apply Genetic algorithms in solving combinatorial optimization problems.
3. Apply Neural networks in classification, regression, clustering and other problems related to inductive learning

Reference Books:

1. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J Klir and Bo Yuan, PHI
2. Neural Networks, A Classroom Approach, Satish Kumar, Tata McGraw Hill
3. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
4. Genetic Algorithms: Search and Optimization, E. Goldberg.

CODE: PCC-CS-403
SUBJECT NAME: OPERATING SYSTEM
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. To understand evolution and types of OS and to understand the structure, components and functions of OS.
2. To learn about Processes, threads and various Scheduling policies.
3. To understand process concurrency and synchronization.
4. To understand the principles of concurrency and Deadlocks.
5. To understand various memory management schemes.
6. To understand virtual memory management, Disk management, I/O management and File systems

Course Contents:

MODULE-1: Introduction: Concept of Operating Systems, Generations of Operating systems,

Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems and Hybrid architecture.

MODULE-2: Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching, Concept of multithreads.

Process Scheduling: Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR, Multilevel.

MODULE-3: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware solution, Strict Alternation, Peterson's Solution, Semaphores. Classical IPC Problems: The Producer/Consumer Problem, Reader's & Writer Problem etc.

MODULE-4: Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock

MODULE-5: Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation Fixed and variable partition Internal and External fragmentation and Compaction; Paging: Principle of operation Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging, segmentation.

Virtual Memory: Basics of Virtual Memory, Locality of reference, Page fault, Working Set, Dirty page/Dirty bit Demand paging, Page Replacement algorithms: Optimal, First in First out (FIFO) and Least Recently used (LRU).

MODULE-6: I/O Hardware: I/O devices, Device controllers, Direct memory access, Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms.

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Learn the basic concepts of operating system, its various types and architecture
2. Learn and implement process management issues including process life cycle, scheduling, synchronization and deadlocks
3. Learn and implement memory management issues including memory partitioning, memory allocation and virtual memory concept
4. Learn and implement files systems and I/O systems including file management and disk management

Reference Books:

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, “Operating System Concepts Essentials”, 9th Edition, Wiley Asia Student Edition.
2. Naresh Chauhan, "Principles of Operating Systems,", Oxford University Press India, 2014.
3. William Stallings, “Operating Systems: Internals and Design Principles”, 5th Edition, Prentice Hall of India

CODE: BSC-01

SUBJECT NAME: BIOLOGY
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

At the end of this course, students will be able to understand:

1) Biology is an important scientific discipline as Mathematics, Physics and Chemistry.
2) "Genetics" is to Biology what Newton‟s Laws are to physical sciences.
3) All forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
4) Without catalysis, life would not have exist on earth .
5) Molecular basis of coding and decoding (genetic information) is universal
6) Fundamental principles of chemical and physical energy transactions are the same in physical/chemical and biological world

Course Contents:

MODULE 1: INTRODUCTION

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observationof Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

MODULE 2: CLASSIFICATION

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b)ultrastructure-prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs,heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A.Thaliana, M. Musculus.

MODULE 3: Genetics

Purpose: To convey that "Genetics is to biology what Newton‟s laws are to Physical Sciences" Mendel‟s laws, Concept of segregation and independent assortment. Concept of allele. Genemapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics.Emphasis to be give not to the mechanics of cell division nor the phases but how genetic

material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of

Mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

MODULE 4: BIOMOLECULES

Purpose: To convey that all forms of life has the same building blocks and yet them anifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

MODULE 5: ENZYMES

Purpose: To convey that without catalysis life would not have existed on earth.Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples.Enzyme kinetics and kinetic parameters. Why should we know these parameters to understandbiology? RNA catalysis.

MODULE 6: INFORMATION TRANSFER

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

MODULE 7: MACROMOLECULAR ANALYSIS

Purpose: How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

MODULE 8: METABOLISM

Purpose: The fundamental principles of energy transactions are the same in physical andbiological world.Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 +H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis).Energy yielding and energy consuming reactions. Concept of Energy Charge.

MODULE 9: MICROBIOLOGY

Concept of single celled organisms. Concept of species and strains. Identification andclassification of microorganisms. Microscopy. Ecological aspects of single celled organisms.

Sterilization and media compositions. Growth kinetics.

Course Outcomes:

At the end of this course, students are able to:

1) Classify enzymes and distinguish between different mechanisms of enzyme action.
2) Identify DNA as genetic material in the molecular basis if information transfer.
3) Analyse biological processes at the reductionist level.
4) Apply the thermodynamic principles to biological systems.
5) Identify and classify microorganisms.

Reference Books:

1. "Biology: A global approach" Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. "Outlines of Biochemistry" , Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H.John Wiley and Sons
3. "Principles of Biochemistry (V Edition)", By Nelson, D. L.; and Cox, M. M.W.H.Freeman and Company
4. "Molecular Genetics (Second edition)", Stent, G. S.; and Calender, R. W.H. Freemanand company, Distributed by Satish Kumar Jain for CBS Publisher
5. "Microbiology" , Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers

CODE: PCC-DS-503

SUBJECT NAME: COMPUTER ARCHITECTURE
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives

1. To discuss the basic concepts of Computer Architecture and organization.
2. To give a clear view of how computer systems work.
3. To familiarize the students with concepts of parallel and pipelined implementations.
4. To introduce them to the state of art in this field

Course Contents:

Unit-I

INTRODUCTION AND GENERAL SYSTEM ARCHITECTURE:

CPU, memory, input-output subsystems, control unit. stored program control concept, Flynn‟s classification of computers (SISD, MISD, MIMD)

Register Transfer Language (concept of Register Transfers, Performing of arithmetic or logical operations, Fetching a word from memory, storing a word in memory), Bus and Memory Transfers, Bus Architecture, Bus Arbitration, Register Transfer Operations: Arithmetic, Logical and Shift micro operation, : Data Representation: Fixed Point, Floating Point, (IEEE standard for Floating point numbers)

Unit-II

CONTROL DESIGN (Hardwired, Microprogrammed):

Hardwired Control Unit - computer instructions‟ Execution of a complete instruction (FetchDecode-Execute cycle), type of instructions, memory reference, register reference, I/O reference, design of Hardwired CU.

Micro Programmed Control Unit : Microinstruction, Micro-program sequencing in control memory, Wide-Branch addressing, Microinstruction with Next-address field, Prefetching Microinstruction).

Unit-III

PROCESSOR DESIGN:

Processor Organization: General register organization, Stack organization, Addressing modes, Instruction format, Data transfer and manipulations, Program Control, ReducedInstruction Set and Complex Instruction Set Computer.

Unit –IV

INPUT-OUTPUT ORGANIZATION:

I/O Interface, Modes of transfer, Interrupts and Interrupt handling, Direct Memory access, Input-Output processor.

Unit-V

MEMORY ORGANIZATION:

Memory Hierarchy, Main Memory (RAM and ROM Chips), Auxiliary memory, Associative memory, matching logic, Cache memory: locality of reference, mapping functions and write policies, Virtual Memory, Memory management hardware.

UNIT-VI

ADVANCED CONCEPTS :

Pipelined processors: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction, Concurrent access, memory and cache coherence.

Course Outcomes:

At the end of the course, the students will be able to

1. Explain the functional capabilities of a stored program device and its various processing units.
2. Express the micro-operations needed to design the Arithmetic and logical unit of a computer system.
3. Specify the different types of instructions and their formats needed in the design of various functional units of the processor.
4. Analyze the performance measurement, data representation and memory Hierarchy of the computer system.

Reference Books

1. Computer System Architecture, M. Mano(PHI), Seventh edition 2007
2. Stallings, William : Computer Organization & Architecture(PHI), Seventh edition 2005
3. Computer Architecture and Organization", 3rd Edition by John P. Hayes WCB/McGraw-Hill

CODE: MC-01

SUBJECT NAME: CONSTITUTION OF INDIA/ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

CREDITS: 3

SESSIONAL: 25
THEORY EXAM: 75
TOTAL: 100

L	T	P
3	0	0

Course Objectives:

1) To enable the student understand the importance of constitution.
2) To understand the structure of executive, legislature and judiciary
3) To understand philosophy of fundamental rights and duties.
4) To understand the autonomous nature of constitutional bodies.
5) To understand the central and state relation, financial and administrative.

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however,it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India‟s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values.

No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role asthe guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course Contents

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy – Its importance and implementation.
7. Federal structure and distribution of legislative and financial powers between theUnion and the States.
8. Parliamentary Form of Government in India – The constitution powers and status ofthe President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

Course Outcomes:

1) Able to understand the historical background of the constitutional making and its importance for building democratic India.
2) Able to apply the knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission.
3) Able to analyse the history, features of Indian Constitution, the role of governors and chief ministers of state, role of state election commissioner, the decentralization of

power between central, state and local self-government.

4) Level organizations, various commissions viz SC/ST/OBC and women.

REFERENCES:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

CODE: PCC-DS-504
SUBJECT NAME: SOFT COMPUTING LAB
CREDITS: 2

SESSIONAL:	**15**	**L**	**T**	**P**
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

List of Experiments

Programming in Matlab for the following problems.

1. Classification of water temperature into appropriate fuzzy set (chilled, cool, normal, warm, hot, very hot) with membership.
2. Taking the human age from 1-100 years and classifying it into appropriate fuzzy sets (child, young, middle age, old, very old) with membership and plotting the graph.
3. Union of fuzzy sets using different s-norm formula and plotting the graph.
4. Intersection of fuzzy sets using different t-norm formula and plotting the graph.
5. Complement of fuzzy sets complement -norm formula and plotting the graph.
6. Design of a washing machine in the neural tool of Matlab.
7. Training of single perceptron as AND,OR and NOT type classifier using threshold activation.
8. Training of single perceptron as AND,OR and NOT type regression using sigmoidal activation and backpropagation.
9. Implementation of auto associative memory.
10. Implementation of hetero associative memory.
11. Implementation of ART network.
12. Solving knapsack using GA.
13. Solving TSP using GA.
14. Introduction to curve fitting in MATLAB using neural Tool

CODE: PCC-CS-406
SUBJECT NAME: OPERATING SYSTEM LAB
CREDITS: 2

SESSIONAL: 15
END SEMESTER: 35
TOTAL: 50

L	**T**	**P**
0	**0**	**4**

S.No.	Title
1	Study of **General UNIX commands** with their meaning, syntax and usage.
2	Study of **Directory Related UNIX** commands with their meaning, syntax and usage.
3	Study of **File related UNIX commands** with their meaning, syntax and usage.
4	Study of **Process Related UNIX Commands** with their meaning, syntax and usage.
5	Study of **User Communication UNIX commands** with their meaning, syntax and usage.
6	Study of **Simple Filter UNIX commands** with their meaning, syntax and usage.
7	Study of **Advanced filters UNIX Commands** with their meaning, syntax and usage.
8	Study of **System Administrative UNIX commands** with their meaning, syntax and usage.
9	Working with vi Editor
10	Write a shell program to calculate overtime pay of 5 employees; overtime is paid at the rate of Rs. 12/Hr for every hour worked above 40 hrs per week. Assume that no employee works for fraction of an hour.
11	Write a shell program to generate all combinations of „1“ , „2“ ,“3“ using for loop
12	Write a shell program that receives an argument & a string from the user. If the argument is 1 display the string in bold letters, for 2 display it in underline form; if 3 display it like blinking characters, if 4 then display it in reverse video character.

	13	Implementation of **CPU scheduling algorithms** First Come First Serve (FCFS), Priority scheduling-Priority Number Based, Shortest Process Next (SPN), Shortest Remaining time Next (SRN), Modified Round Robin, Highest response ratio Next (HRRN), Multi-Level Queue, Multi-Level Feedback Queue Scheduling).	

14	Implementation of **Page Replacement Algorithms** First in First out (FIFO), Least Recently Used (LRU), Optimal, Clock page replacement algorithms.
15	Implementation of **Banker's algorithm** for deadlock avoidance in multiple instances of resources.
16	Implementation of **disk scheduling algorithms** (First Come First Serve (FCFS), Shortest Seek Time First (SSTF), SCAN, Circular-SCAN (C-SCAN), F-Scan, N-step Scan, LOOK, C-LOOK).

6th SEMESTER

CODE: PCC-DS-601
SUBJECT NAME: MACHINE LEARNING
CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. To learn the concept of patterns in data and how to extract these patterns from data without being explicitly programmed in various domains in the context of applying different Supervised and Un-supervised learning techniques.
2. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. To explore the time series data and techniques available to deal with it.
4. Explore and learn probabilistic and statistical techniques such as Bayesian learning.
5. To explore Deep learning techniques and the problem where these techniques can be applied.

Course Contents:

MODULE-1: SUPERVISED LEARNING (REGRESSION/CLASSIFICATION)

- Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes
- Linear models: Linear Regression, Logistic Regression, Generalized LinearModels
- Support Vector Machines, Nonlinearity and Kernel Methods
- Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

MODULE-2: UNSUPERVISED LEARNING

- Clustering: K-means/Kernel K-means
- Dimensionality Reduction: PCA and kernel PCA
- Matrix Factorization and Matrix Completion

MODULE-3:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests). Introduction to Bayesian Learning and Inference

MODULE-4:

Scalable Machine Learning (Online and Distributed Learning), Semi-supervised Learning, Active Learning, Reinforcement Learning.

Modelling Sequence/Time-Series Data, Introduction to Deep Learning and Feature Representation Learning

Course Outcomes:

1. Analyse the nature of the data associated with a machine learning problem and formulate various kind of machine learning approaches and paradigms in the mathematical terms.
2. Apply and evaluate the various machine learning approach/techniques for a given problem.
3. Compare the nature of non-time series and time series data and the techniques available to deal with such data.
4. Evaluate and formulate a given problem in terms of various probabilistic and statistical methods and solve them using suitable technique.

5. Get the understanding of the various problem where deep learning techniques are to be applied.

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007

CODE: PCC-DS-602
SUBJECT NAME: DATA ACQUISITION, ANALYSIS AND VISUALIZATION
CREDITS: 3

SESSIONAL:	25	L	T	P
THEORY EXAM:	75	3	0	0
TOTAL:	100			

Course Objectives:

1. Understand the fundamental concepts of data science in relation with Big Data
2. To understand the data acquisition process through instrumentation system
3. To derive insights from data through data analysis techniques
4. To explore and visualize data with the help of various graphs and plots

MODULE-1

Data Science: Getting Value out of Big Data, Building a Big Data Strategy, Five Components of Data Science, Five P's of Data Science, Steps in the Data Science Process
Big Data Modeling and Management: Data Ingestion, Data Storage, Data Quality, Data Operations, Data Scalability and Security, Real Big Data Management Applications.

MODULE -2

Data Acquisition: Real time data acquisition, Review of transducer, Introduction about Instrumentation system, Types of Instrumentation system, Data acquisition system and its uses in intelligent Instrumentation system, Detail study of each block involved in making of DAS, Signal conditioners as DA, IA, signal converters (ADC), Sample and hold, designing application for Pressure, Temperature measurement system using DAS, Data logger

MODULE -3

Data Analysis: Introduction, various analysis techniques like classification, regression, clustering, association analysis, and graph analysis, Introduction to NoSQL, aggregate data models

MODULE -4

Data Visualization: Plotting and Visualization: subplots, markers, labels, legends, saving plots to file, Plotting functions: line plots, bar plots, histogram, density plots, scatter plots.
Case Study: Stock Market Analysis/ Electricity Consumption Analysis.

Course Outcomes:

1. Understand the relevance of big data in data science
2. Get the understanding of various data acquisition systems to collect data
3. Apply and evaluate the various data analytics techniques for a given problem
4. Explore and represent a given problem through visualization techniques

Reference Books:

1. Tom White ‘Hadoop: The Definitive Guide’ Third Edition, O’Reily Media, 2012
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. Wes McKinney, Python for Data Analysis, O’Reilly, 2012
4. AK Sawhney, A course in electrical and electronic measurements and instrumentation,

Dhanpat Rai & Co, 2021

CODE: PCC-DS-603
SUBJECT NAME: BIG DATA FUNDAMENTALS
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs
5. Provide hands on Hodoop Eco System
6. Apply analytics on Structured, Unstructured Data.

Course Contents

UNIT I: INTRODUCTION TO BIG DATA AND HADOOP

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Ecosystem, IBM Big Data Strategy, Introduction to Infosphere Big Insights and Big Sheets.

UNIT II: HDFS (Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Sqoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III: Map Reduce

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit IV: Hadoop Ecosystem

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Dataand User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbaseversus RDBMS. Big SQL: Introduction

Course Outcomes:

The students will be able to:

1. Identify Big Data tools to handle Big Dataand its Business Implications.
2. Access and Process Data on Distributed File System.
3. Manage Job Execution in Hadoop Environment.
4. Develop Big Data Solutions using Hadoop Eco System.

References Books:

1. Tom White “Hadoop: The Definitive Guide” Third Edit on, O‟reily Media, 2012.

2. SeemaAcharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
5. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.

CODE: PEC-CS-A-702
SUBJECT NAME: WEB AND INTERNET TECHNOLOGY
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Pre-requisites: Computer Networks

Course Objectives:

1. To familiarize the students with the basic concepts of internet, its history, ways to connect to internet and basics of world wide web and search engines.
2. To familiarize the student with the fundamental language of internet i.e. HTML
3. To teach the student aware of the concepts of cascading style sheets
4. To teach the student the students the basics of client side and Server side scripting

MODULE-1: INTRODUCTION TO NETWORKS AND WWW

Introduction to internet, history, Working of Internet, Modes of Connecting to Internet, Internet Address, standard address, classful and classless ip addressing, subnetting, supernetting, w3c consortium, searching the www: Directories search engines and Meta search engines, search fundamentals, search strategies, Architecture of the search engines, Crawlers and its types, Delivering multimedia over web pages, VRML.

MODULE-2:HYPERTEXT MARKUP LANGUAGE

The anatomy of an HTML document: Marking up for structure and style: basic page markup, absolute and relative links, ordered and unordered lists, embedding images and controlling appearance, table creation and use, frames, nesting and targeting.

MODULE-3:STYLE SHEETS

Separating style from structure with style sheets, Internal style specifications within HTML, External linked style specification using CSS, page and site design considerations.

MODULE-4: CLIENT-SIDE PROGRAMMING

Introduction to Client side programming, Java Script syntax, the Document object model, Event handling, Output in JavaScript, Forms handling, cookies, Introduction to VBScript, Form Handling.

MODULE 5: SERVER SIDE SCRIPTING

CGI, Server Environment, Servlets, Servlet Architecture, Java Server Pages, JSP Engines, Beans, Introduction to J2EE.

Course Outcomes:

At the end of the course/session the student would be

1. Acquainted with the basics of internet &search engines.
2. Have a hands on HTML
3. Learned the need and basics of CSS

4. Learned the concepts of client side and server side scripting.

REFERENCES

1. **Fundamentals of the Internet and the World Wide Web, Raymond Greenlaw and Ellen Hepp 2001, TMH .**
2. **Internet & World Wide Programming, Deitel,Deitel& Nieto, 2000, Pearson Education**
3. **Complete idiots guide to java script,. Aron Weiss, QUE, 1997.**
4. **Network firewalls, Kironjeetsyan - New Rider Pub.**

CODE: PCC-IT-601

SUBJECTNAME: DATA ANALYTICS USING PYTHON

CREDITS: 3

SESSIONAL: **25** **L T P**

THEORYEXAM: 75 **3 0 0**

TOTAL: **100**

Course Objectives:

1. Understand the fundamentals of data analytics and its importance in various domains.
2. Learn about the role of Python programming language in data analytics.
3. Understand descriptive statistics, data visualization, and summarization techniques to gain insights into datasets.
4. Learn how to conduct hypothesis testing and regression analysis using Python.

MODULE-1

Python Fundamentals and Objects in Python: Lists, dictionaries, Functions, Files, class and instance attributes, inheritance, multiple inheritance, methods resolution order, magic methods and operator overloading, metaclasses, abstract and inner classes, exception handling, modular programs and packages.

MODULE-2

Numerical Analysis in Python: Introduction to NumPy, NumPy array object, Creating a multidimensional array, NumPy numerical types - Data type objects, Character codes, dtype constructors. dtype attributes. One-dimensional slicing and indexing. Manipulating array shapes -- Stacking arrays, Splitting NumPy arrays, NumPy array attributes, Converting arrays, Creating array views and copies. Indexing with a list of locations. Indexing NumPy arrays with Booleans. Broadcasting NumPy arrays.

MODULE-3

Introduction to Data Analytics: Descriptive Statistics Probability Distributions Inferential Statistics through hypothesis tests, two sample testing and Introduction to ANOVA, Two-way ANOVA Permutation & Randomization Test, Chi square test

MODULE-4

Data Manipulation: Data frames in panda, Creating data frames from .csv and excel files, Lists of tuples, Data frames aggregation and concatenation

MODULE-5

Data Analysis& Visualization: Introduction to various analysis techniques like classification, regression, clustering, Estimation and prediction of Regression model and Visualization: subplots, markers, labels, legends, saving plots to file

Course Outcomes:

After completion of course, students will be able to:

1. The students will be able to understand the fundamental concepts and principles of data analytics, including data manipulation, exploration, and visualization.
2. The students will be able to Write Python scripts to manipulate, analyze, and visualize data.
3. The students will be able to Conduct hypothesis testing and perform regression analysis using Python libraries.
4. The students will be able to Identify and define data analytics problems, formulate solutions, and interpret results in the context of real-world applications.

ReferenceBooks:

1. McKinney,W.(2012).Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
2. Swaroop, C.H.(2003).A Byte of Python. Python Tutorial.
3. Ken Black, sixth Editing .Business Statistics for Contemporary Decision Making.“John Wiley & Sons, Inc”.
4. Anderson Sweeney Williams (2011). Statistics for Business and Economics. “Cengage Learning”.
5. Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. “John Wiley & Sons, Inc”

CODE: PCC-DS-606
SUBJECT NAME: BIG DATA LAB
CREDITS: 2

SESSIONAL:	**15**	**L**	**T**	**P**
END SEMESTER:	**35**	**0**	**0**	**4**
TOTAL:	**50**			

1. Install and Configure Cloudera QuickStart with VirtualBox VM.
2. Perform the following File Management tasks in Hadoop:
    a. Create a directory and adding files.
    b. List the contents of directory.
    c. Upload and Download a file in HDFS.
    d. Copy and Move a file from source to destination in HDFS and from/To Local file system to HDFS.
    e. Remove a file or directory in HDFS.
3. Implement word count program in Java and Hadoop Map Reduce.
4. Analyze weather data and generate the output with maximum and minimum temperature of each day along with time using Java and Map Reduce.
5. Write a program to implement Matrix Multiplication with Map Reduce.
6. Perform the following tasks using Apache Pig:
    a. Load and Store data into Apache Pig from the file system (HDFS/ Local).
    b. Run the Diagnostic Operators to verify the execution of Load Statement.
    c. Run the Group and Join operators on the relations.
    d. Select the required tuples and remove unwanted tuples from the relations using FILTER operator.
    e. Run Pig Latin Built-In Functions.
7. Run the Pig Latin scripts to find word count in a given file.
8. Write a Pig Latin script to find the Number of Products Sold in Each Country. [Download Sales Data Set (.CSV) from Internet for Input]
9. Perform the following tasks using Hive:
    a. Create, Alter and Drop Databases, Tables, Views, Functions and Indexes.
    b. Process and Analyze structured data in a Metastore using Hive Query Language (HiveQL).

10. Improve Query Performance by using Dynamic and Static Partitioningin Apache Hive.

11. Perform the following tasks using HBase:

a. Run general commands like status, version, table_help, and whoami.
b. Create, Alter and Drop Tables.
c. Create Update, Read and Delete data in HBase table.
d. Grant and Revoke permissions to users in HBase.

12. Recording and Storing Logs about customer search history and perform analytics for better business using HBase.

CODE: PCC-DS-605
SUBJECT NAME: MACHINE LEARNING LAB
CREDITS: 2

SESSIONAL: 15
END SEMESTER: 35
TOTAL: 50

L	**T**	**P**
0	**0**	**4**

S.NO	PRACTICAL
1.	Write a program for using different data types and file handling techniques in python.
2.	Write a program to implement Linear Regression algorithm using Python.
3.	Write a program to implement Logistic Regression algorithm using Python.
4.	Write a program to implement Support Vector Machine using Python.
5.	Write a program to implement K-Nearest Neighbour using Python.
6.	Write a program to implement the naïve Bayesian classifier for a sample training data set stored in a file. Compute the accuracy of the classifier, considering few test data sets.
7.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
8.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
9.	Write a program to implement K-means clustering using Python.
10.	Write a program for making different types of plots (e.g. Scatter plot, Box Plot, Bar Chart etc.) for a given dataset.
11.	Write a program to implement different morphological operations on an image.
12.	Write a program to implement CNN for handwritten digit classification using appropriate dataset (e.g. MNIST).

7th SEMESTER

CODE: PEC-IT-I-703
SUBJECT NAME: BASICS OF CLOUD COMPUTING
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

COURSE OBJECTIVES

1. Trust-based security model to real-world security problems.
2. An overview of the concepts, processes, and best practices needed to successfullysecure information within Cloud infrastructures.
3. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Course contents:

MODULE 1: INTRODUCTION TO CLOUD COMPUTING:

Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing.

MODULE 2: CLOUD COMPUTING ARCHITECTURE:

Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise .

MODULE 3: SECURITY ISSUES IN CLOUD COMPUTING

Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management.

MODULE 4: SECURITY MANAGEMENT IN THE CLOUD

Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations.

MODULE 5: AUDIT AND COMPLIANCE

Internal Policy Compliance, Governance, Risk and Compliance (GRC), Regulatory/External

Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud.

MODULE 6: DATA INTENSIVE COMPUTING

Map-Reduce Programming Characterizing Data-Intensive Computations, Technologies for DataIntensive Computing, Storage Systems, Programming Platforms, MapReduce Programming, MapReduce Programming Model, Example Application.

COURSE OUTCOMES:

a) Identify security aspects of each cloud model.
b) Develop a risk-management strategy for moving to the Cloud.
c) Implement a public cloud instance using a public cloud service provider.

TEXT/REFERENCES

1. "Cloud Computing Explained: Implementation Handbook for Enterprises", John Rhoton, Publication Date: November 2, 2009.
2. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)", Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009.

CODE: PEC-CS-D-701

SUBJECT NAME: SPEECH AND NATURAL LANGUAGE PROCESSING

CREDITS: 3

SESSIONAL:	**25**	**L**	**T**	**P**
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. To make the students familiar with difference levels/stages of natural language processing and to introduce concept of Formal languages and grammars: Chomsky hierarchy and problems associated (like Left-Associative grammars, ambiguous grammars) withthem.
2. To introduce the students with Morphology and Part of Speech Tagging by taking examples from Hindi, English.
3. To introduce the top down and the bottom up parsing approaches and their respective types of parsers.
4. To make the students familiar with grammar types like ATN & RTN.
5. To make thestudents familiarwith thebasic techniques of parsing like CKY, Earley&Tomita's algorithms and role Hidden Markov Model in NLP
6. To make the students familiar with Semantics-knowledge and itsutilization.

MODULE-1: AUTOMATIC SPEECH RECOGNITION

Introduction to Automatic Speech Recognition (ASR), Components in ASR, Challenges in ASR, Issues in ASR based Application development.

MODULE-2: COMPONENTS OF NATURAL LANGUAGE PROCESSING

Lexicography, syntax, semantics, pragmatics: word level representation of natural languages prosody& natural languages.

MODULE-3 FORMAL LANGUAGES AND GRAMMARS

Chomsky hierarchy, Left-Associative grammars, ambiguous grammars, resolution of ambiguities. Introduction of top down and bottom up parsers.

MODULE-4: COMPUTATION LINGUISTICS:

Morphology of natural languages like Hindi, English etc.,Part of Speech Tagging (POS), recognition and parsing of natural language structures: ATN & RTN, General techniques of parsing: CKY, Earley& Tomita's algorithms. Introduction to Hidden Markov Model (HMM)

MODULE-5: SEMANTICS-KNOWLEDGE REPRESENTATION

Semantic networks logic and inference pragmatics, graph models and optimization, Prolog for natural language semantic (e.g. DCG).

MODULE-6: APPLICATION OF NLP: INTELLIGENT WORK PROCESSORS

Machine translation, user interfaces, Man-Machine interfaces, natural language querying, tutoring and authoring systems, speech recognition, commercial use of NLP.

Course Outcomes:

1. Difference levels/stages of natural language processing and the concept of Formal languages and grammars: Chomsky hierarchy and problems associated (like Left Associative grammars, ambiguous grammars) withthem.
2. The top down and the bottom up parsing approaches and their respective types of parsers like

CKY, Earley& Tomita's.

3. The Hidden Markov Model and its application in NLP.
4. The student will be able to write small ATN & RTN grammars for simple English sentences.
5. The student will be able to do Morphology of words from natural languages like Hindi, English and Semantics-knowledge and its important to understand the documents.

References Books

1. "NaturalLanguageUnderstanding"James Allen,-1995 Benjamin/kummingsPub. Comp. Ltd
2. "Language as a cognitive process", Terry Winograd 1983, AW
3. "Natural Language processing in prolog", G. Gazder, 1989, Addison Wesley.
4. " Introductionof Formal LanguageTheory", Moll, Arbib&Kfoury, 1988, Springer Verlog.

CODE: PCC-DS-703
SUBJECT NAME: DEEP LEARNING AND IMAGE PROCESSING
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. To build an understanding of the fundamental concepts of Deep Learning
2. To familiarize students with the neural networks and CNN
3. To understand unsupervised Deep Learning
4. To introduce the new trends and dynamic systems in Deep Learning

Unit1: Introduction to Deep Learning, Bayesian Learning, Decision Surfaces

Unit2: Linear Classifiers, Linear Machines with Hinge Loss, Optimization Techniques, Gradient Descent, Batch Optimization

Unit 3: Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning

Unit 4: Deep Unsupervised Learning- Autoencoders (standard, denoising, contractive, etc etc), Variational Autoencoders, Adversarial Generative Networks, Maximum Entropy Distributions

Unit5: Convolutional Neural Networks - Invariance, stability, Variability models (deformation model, stochastic model), Scattering networks, Group Formalism

Unit 6: Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc.

Unit 7: Localization, regression, Embeddings (DrLim), inverse problems, Extensions to non-euclidean domains, Dynamical systems: RNNs.

Course Outcomes:

a. The students will be able to understand deep learning concepts.
b. The students will be able to understand Linear Classifiers, Linear Machines with Hinge Loss, Optimization Techniques, Gradient Descent, Batch Optimization
c. The students will be able to understand Neural Network, CNN, Unsupervised Learning with Deep Network
d. The students will be able to understand inverse problem and dynamic systems

CODE: PCC-DS-704
SUBJECT NAME: BUSINESS INTELLIGENCE AND PREDICTIVE ANALYSIS
CREDITS: 3

		L	T	P
SESSIONAL:	**25**			
THEORY EXAM:	**75**	**3**	**0**	**0**
TOTAL:	**100**			

Course Objectives:

1. Be exposed with the basic rudiments of business intelligence system
2. Understand the modeling aspects behind Business Intelligence
3. Understand of the business intelligence life cycle and the techniques used in it
4. Be exposed with different data analysis tools and techniques

Course Contents:

UNIT I : BUSINESS INTELLIGENCE

Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.

UNIT II: KNOWLEDGE DELIVERY

The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.

UNIT III: EFFICIENCY

Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis

UNIT IV: PREDICTIVE ANALYSIS BASICS

Data Exploration and Data Refinement: Data Summaries, Data Visualization, Treatment of Missing Observations, Detection of Outliers – the Box Plot, Correlation Analysis, Variable Importance and Dimension Reduction basics: Binning-Reducing the Number of Categories in Categorical Variables , Principal Component Analysis of Continuous Variables, Dimension Reduction using Best Subset Regression, Dimension Reduction using Bivariate Association Probabilities. Evaluation Methods for Prediction and Classification Problems: Prediction Measures- MAE, MSE, RMSE, MAPE, MSPE, and RMSPE, Application to Validation and Test Data Sets, Avoiding Overtraining.

Prediction methods: Linear regression, Logistic regression, K-NN, Neural Nets: architecture, input layer, hidden layer, output layer, back-propagation method, comparison of various methods. Confusion matrix

Course Outcomes:

1. Explain the fundamentals of business intelligence.
2. Link data mining with business intelligence.
3. Apply various modeling techniques.

4. Explain the data analysis and knowledge delivery stages.

Reference Books:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, “Decision Support and Business Intelligence Systems”, 9th Edition, Pearson 2013.
2. The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling, Ralph Kimball, Margy Ross

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: ComputerEngineering Specialization in Data Science

VALUE ADDED COURSES

CODE: HSMC (H-102)
SUBJECT NAME: UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY
NO OF CREDITS: 0

B.TECH 5th SEMESTER

L T P

2 1 0

The value-added courses is for UG/PG students. It may be taught through digital aided learning/class room teaching. Its duration is 35 hours. Minimum 75% attendance is compulsory for students and its evaluation will be done by concerned Dept. through Viva-Voce examination/internal examination.

Pre-requisites: None. Universal Human Values 1 (desirable)

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act

Human Values Course

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony" is designed which may be covered in their III or IV semester. During the Induction Program, students‟ world get and initial exposure to human values through Universal Human Values –I. This exposure is to be augmented by this compulsory full semester foundation course.

Universal Human Values 2: Understanding Harmony

MODULE-1: COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; „Natural Acceptance‟ and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include 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.

MODULE-2: UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

1. Understanding human being as a co-existence of the sentient „I‟ and the material „Body‟
2. Understanding the needs of Self („I‟) and „Body‟ - happiness and physical facility
3. Understanding the Body as an instrument of „I‟ (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of „I‟ and harmony in „I‟
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs,

meaning of Prosperity in detail

6. Programs to ensure Sanyam and Health.

7. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one‟s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE-3:UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN – HUMAN RELATIONSHIP

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students‟ lives.

MODULE-4:UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE – WHOLE EXISTENCE AS COEXISTENCE

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and selfregulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

MODULE-:5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Course Outcomes:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

ASSESSMENT

This is a compulsory non-credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.
Example:
Assessment by faculty mentor : 10 marks
Self –assessment : 10 marks
Assessment by peers : 10 marks
Socially relevant project/Group Activities/Assignments :20 marks
Semester End Examination : 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: ComputerEngineering Specialization in Data Science

AUDIT COURSES

CODE:AC02
SUBJECT NAME: MESSAGE OF BHAGWAT GITA
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
2 1 0	TOTAL : 100

Course Objectives:
To enable the students to create an awareness on Message of Bhagwat Gita to instill Moral, Social Values and to appreciate the Karma Yoga.

MODULE-1: Introduction: Relevance of Bhagavad Gita today- Background of Mahabharatha. Arjuna Vishada Yoda: Arjuna‟s Anguish and Confusion- Symbolism of Arjuna‟s Chariot. Sankhya Yoga: Imporance of Self-Knowledge- Deathlessness : Indestructibility of Consiousness- Being Established in Wisdom – Qualities of a Sthita-prajna.

MODULE-2: Karma Yoga: Yoga of Action – Living in the present- Dedicated Action without Anxiety over Results – Concept of Swadhrma, Dhyana Yoga: Tuning the Mind- Quantity, Quality and Direction of Thoughts- Reaching Inner Silence.

MODULE-3: Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine- Inner Qualities of a True Devotee, GanatrayaVibhaga Yoga: Dynamics of the Three Gunas: Tamas, Rajas, Sattva- Going Beyond the Three Gunas- Description of A Gunatheetha.

Course Outcomes:

Upon completion of the course, the student should be able to realize the Relevance of Bhagavad Gita today Yoga to devotion, realize the responsibilities and duty in the society.

REFERENCES

1. **Swami Chinmayananda, : The Holy Geeta”, Central Chinmaya Mission Trust 2002.**
2. **Swami Chinmayananda, “A Manual of Self Unfordment”, Central Chinmaya Mission Trust, 2001.**

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTERENGINEERING

WITH SPECIALIZATION IN DATA SCIENCE

OPEN ELECTIVE COURSES

CODE: OEC-CS-601(I)

SUBJECT NAME: SOFT SKILLS AND INTERPERSONAL COMMUNICATION

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Basic knowledge of reading and writing English.

Course Objectives:

The course aims at creating awareness among the stock holders of the corporate world in which the role of individuals as team players and also as responsible leaders materializes to a great extent. The course, with its interactive and need based modules, will address various challenges of communication as well as behavioral skills faced by individuals at workplace and organizations in bridging the gaps through effective skills of interviews, group discussions, meeting management, presentations and nuances of drafting various business documents for sustainability in today's global world.

MODULE-1: INTRODUCTION

Introduction to Soft Skills, Aspects of Soft Skills, Effective Communication Skills, Classification of Communication, Personality Development

Positive Thinking, Telephonic Communication Skills, Telephonic Communication Skills, Communicating Without Words, Paralanguage, Proxemics, Haptics: The Language of Touch, Meta-communication, Listening Skills, Types of Listening, Negotiation Skills , Culture as Communication, Communicating across Cultures , Organizational Communication.

MODULE-2: COMMUNICATION BREAKDOWN

Advanced Writing Skills, Principles of Business Writing, Types of Business Writing, Business Letters, Business Letters: Format and Style, Types of Business Letter.

MODULE-3: SKILL DEVELOPMENT

Writing Reports, Types of Report, Strategies for Report Writing, Strategies for Report Writing, Evaluation and Organization of Data,

Structure of Report, Report Style, Group Communication Skills, Leadership Skills, Group Discussion, Meeting Management, Adaptability & Work Ethics.
Advanced Speaking Skills, Oral Presentation, Speeches & Debates, Combating Nervousness, Patterns & Methods of Presentation, Oral Presentation: Planning & Preparation

MODULE-4: PRESENTATION AND INTERVIEWS

Making Effective Presentations, Speeches for Various Occasions, Interviews, Planning & Preparing, Effective Résumé, Drafting an Effective Résumé, Facing Job Interviews, Emotional Intelligence & Critical Thinking, Applied Grammar

Course Outcomes:

After completion of the course student will be able to :

1. Understand the concept of soft skills including communication skills, listening skills, positive thinking and also will be able to enhance own personality.

2. Able to write business letters.
3. Able to write reports.

4. Able to make effective resume and will also be able to present himself/herself in interview, speeches, presentations, talks etc.

REFERENCES:

1. Butterfield, Jeff. *Soft Skills for Everyone*. New Delhi: Cengage Learning. 2010.
2. Chauhan, G.S. and Sangeeta Sharma. *Soft Skills*. New Delhi: Wiley. 2016.
3. Goleman, Daniel. *Working with Emotional Intelligence*. London: Banton Books. 1998.
4. Hall, Calvin S. et al. *Theories of Personality*. New Delhi: Wiley. rpt. 2011.
5. Holtz, Shel. *Corporate Conversations*. New Delhi: PHI. 2007.
6. Kumar, Sanajy and Pushp Lata. *Communication Skills*. New Delhi: OUP. 2011.
7. Lucas, Stephen E. *The Art of Public Speaking*. McGraw-Hill Book Co. International Edition, 11th Ed. 2014.
8. Penrose, John M., et al. *Business Communication for Managers*. New Delhi: Thomson South Western. 2007.
9. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. New Delhi: TMH. 2016.
10. Sharma, Sangeeta and Binod Mishra. *Communication Skills for Engineers and Scientists*. New Delhi: PHI Learning. 2009, 6th Reprint 2015.
11. Thorpe, Edgar and Showick Thorpe. *Winning at Interviews*. Pearson Education. 2004.
12. Turk, Christopher. *Effective Speaking*. South Asia Division: Taylor & Francis. 1985.

CODE: OEC-CS-601(II)
SUBJECT NAME: CYBER LAW AND ETHICS
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:Basics of Data Structures and Mathematics

Course objectives:

MODULE- 1: INTRODUCTION

Computers and its Impact in Society, Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level

MODULE- 2: CYBER LAW- INTERNATIONAL PERSPECTIVES

UN & International Telecommunication Union (ITU) Initiatives Council of Europe - Budapest Convention on Cybercrime, Asia-Pacific Economic Cooperation (APEC), Organization for Economic Co-operation and Development (OECD), World Bank, Commonwealth of Nations

MODULE- 3: CONSTITUTIONAL & HUMAN RIGHTS ISSUES IN CYBERSPACE

Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace – Access to Internet, Right to Privacy, Right to Data Protection

MODULE- 4: CYBER CRIMES & LEGAL FRAMEWORK

Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft &Fraud, Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000

MODULE- 5: CYBER TORTS

Cyber Defamation, Different Types of Civil Wrongs under the IT Act, 2000

MODULE- 6: INTELLECTUAL PROPERTY ISSUES IN CYBER SPACE

Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues

MODULE- 7: E-COMMERCE CONCEPT

E-commerce-Salient Features, Online approaches like B2B, B2C & C2C Online contracts, Click Wrap Contracts, Applicability of Indian Contract Act, 1872

MODULE- 8: DISPUTE RESOLUTION IN CYBERSPACE

Concept of Jurisdiction, Indian Context of Jurisdiction and IT Act, 2000, International Law and Jurisdictional Issues in Cyberspace, Dispute Resolutions, Information warfare policy and ethical Issues.

References:

- **Chris Reed & John Angel, Computer Law, OUP, New York, (2007).**
- **Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012)**
- **Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)**
- **JonthanRosenoer, Cyber Law, Springer, New York, (1997).**
- **Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)**
- **S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).**
- **Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003).**

CODE: PCC-IT- 601
SUBJECT NAME: DATA ANALYSIS USING PYTHON
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:Basics of Data Structures and Mathematics

Course objectives: The student will learn how to apply

1. Fundamentals and Data structures of pythons programming language.
2. Object oriented concepts in python programming language.
3. Retrieving, processing, storing and visualization of data using python .

MODULE-1: INTRODUCTION TO PYTHON

Brief history of python, Data types - Built-in, Sequence, Sets, Strings, Literals, constants, keywords, variables, naming convention. Operators – Types, Precedence & Associativity, Input, Output, file handling, Control Statements.

MODULE-2: FUNCTIONS AND DATA STRUCTURES IN PYTHON

Functions – basics of functions, functions as objects, recursive functions, List –methods to process lists, Shallow & Deep copy, Nested lists, lists as matrices, lists as stacks, Queues, -Deques, Tuples - basic operations on tuples, nested tuples, Dictionaries – operations on dictionary, ordered dictionary, iteration on dictionary, conversion of lists & strings into dictionary, Sets & frozen sets, looping techniques on lists & dictionaries, Lamda, filter, reduce, map, list comprehension, iterators and generators.

MODULE-3: OBJECTS IN PYTHON

Class and instance attributes, inheritance, multiple inheritance, methos resolution order, magic methods and operator overloading, meta classes, abstract and inner classes, exception handling, modular programs and packeges.

MODULE-4: NUMERICAL ANALYSIS IN PYTHON

Introduction to NumPy, NumPy array object, Creating a multidimensional array, NumPy numerical types - Data type objects, Character codes, dtype constructors. dtype attributes. One-dimensional slicing and indexing. Manipulating array shapes -- Stacking arrays, Splitting NumPy arrays, NumPy array attributes, Converting arrays, Creating array views and copies. Indexing with a list of locations. Indexing NumPy arrays with Booleans. Broadcasting NumPy arrays.

MODULE-5: DATA MANIPULATION AND VISUALIZATION IN PYTHON

Data frames in panda, Creatingdataframes from .csv and excel files, Lists of tuples, Dataframes aggregation and concatenation, plotting data using matplotlib & panda

Course Outcomes:

After completion of course, students would be able to:

1. Write programs efficiently in python
2. Effectively use numerical analysis libraries of python
3. Carry out basic data science operations like retrieving, processing and visualizing using python.

REFERENCES:

1. **Wesley J Chun, Core Python Programming, Prentice Hall, Second Edition, 2006**
2. **Ivan Idris, Python Data Analysis, PacktPublishing,UK, 2014 (freely available online)**
3. **Wes McKinney, Python for Data Analysis, O'Reilly - 2013**

CODE: OEC-CS-601(IV)

SUBJECT NAME: ELECTRONIC DEVICES

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL: 100

Pre-requisites: Computer Organization & Architecture, Digital Electronics

Course objectives:

1. To give exposure to students about Semiconductor Physics.
2. To give the exposure about characteristics of Semiconductor devices
3. To introduce the working of difficult Semiconductor Electronic devices.
4. To introduce the concept of fabrication terminologies semiconductor electronic devices.

MODULE-1: INTRODUCTION TO SEMICONDUCTOR PHYSICS

Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon;

MODULE-2: CARRIER TRANSPORT

Diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

MODULE-3: BIPOLAR JUNCTION TRANSISTOR

I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

MODULE-4: INTEGRATED CIRCUIT FABRICATION PROCESS

Oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of Semiconductor junctions and 1. MOS transistors for circuits and systems.
3. Understand various Semiconductor, fabrication process.
4. Understand the design & characteristics of Semiconductor devices.

REFERENCES:

1. **G. Streetman, and S. K. Banerjee, "*Solid State Electronic Devices*," 7th edition, Pearson,2014.**
2. **D. Neamen , D. Biswas "*Semiconductor Physics and Devices*," McGraw-Hill Education**
3. **S. M. Sze and K. N. Kwok, "*Physics of Semiconductor Devices*," 3rd edition, John Wiley & Sons, 2006.**

4. **C.T. Sah, "*Fundamentals of Solid State Electronics*," World Scientific Publishing Co. Inc, 1991.**
5. **Y. Tsividis and M. Colin, "*Operation and Modeling of the MOS Transistor*," Oxford Univ.Press, 2011.**

CODE: OEC-CS-601(V)

SUBJECT NAME: DIGITAL SYSTEM DESIGN

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL: 100

Pre-requisites:

Course objectives:

1. To study the concept of combinational logic circuits
2. To make the student aware about modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. T o understand the synchronous sequential logic circuits
4. To study Logic families and semiconductor memories.
5. To study VLSI design flow.

MODULE-1: 1 LOGIC SIMPLIFICATION AND COMBINATIONAL LOGIC DESIGN

Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

MODULE-2: COMBINATIONAL CIRCUITS

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

MODULE-3: SEQUENTIAL LOGIC DESIGN

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

MODULE-4: LOGIC FAMILIES AND SEMICONDUCTOR MEMORIES

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

MODULE-5: VLSI DESIGN FLOW

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects,

Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design &analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design &analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

REFERENCES:

1. **R.P. Jain, "*Modern digital Electronics*", Tata McGraw Hill, 4th edition, 2009. Douglas Perry, "*VHDL*", Tata McGraw Hill, 4th edition, 2002.**
2. **W.H. Gothmann, "*Digital Electronics- An introduction to Theory and Practice*", PHI, 2nd edition ,2006.**
3. **D.V. Hall, "*Digital Circuits and Systems*", Tata McGraw Hill, 1989**
4. **Charles Roth, "*Digital System Design using VHDL*", Tata McGraw Hill 2nd edition 2012.**

CODE: OEC-CS-602(I)
SUBJECT NAME: HUMAN RESOURCE MANAGEMENT
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL: 100

Course objectives:

The primary concern of this course is to sensitize students to the various facts of managing people and to create an understanding of the various policies and practices of human resource management.

MODULE-1:

Human Resource Management: concept, evolution and scope; Strategic objectives of HR management; Roles, responsibilities and competencies of HR manager; Challenges to HR professionals; Human Resource Planning & Forecasting: significance and process; Human Resource Information System.

MODULE-2:

HR Sourcing and Recruitment; Selection: process, Placement; Induction and Socialization.

Job Analysis: job Description and job Specification; Job Design: approaches and methods; Job Evaluation-concept & methods; Performance Management System: appraisal and counselling.

MODULE-3:

Training: training process, training need analysis (TNA); training methods and techniques; Designing Training programs; Training evaluation; Career planning and Development; Potential Appraisal and Succession planning; Employee Compensation: basic concepts & determinants; New trends in compensation management.

MODULE-4:

Industrial Relations and Grievance Handling; Employee welfare; Dispute Resolution; International Human Resource Management; Contemporary Issues in HRM: knowledge Management, HR Audit &Accounting, HR in virtual organizations, ethics &corporate social responsibility.

Course Outcomes:

1. The course will help to understand the basics of HRM with roles and responsibilities of a HR manager.
2. This course enables the students to meet HR challenges in present scenario
3. It will facilitate them in employing, maintaining and promoting a motivated force in an organization.
4. Students will be aware about contemporary issues of human resource management.

RERERENCES:

1. **K. Aswathapa Human resource Management: Text and cases, 6th edition, Tata McGraw Hill, New Delhi.**
2. **Uday Kumar Haldar&JuthikaSarkarHuman resource Management New Delhi, Oxford University Press.**
3. **De Cenvo, Da & Robbins S.P. Fundamentals of Human Resource Management, 9th edition, New York, John Wiley & Sons.**

4. **Gary Dessler, Human Resource Management, 11th edition New Delhi: Pearson Prentice Hall.**
5. **TanujaAgarwala, Strategic Human resource Management, Oxford University Press**

CODE: OEC-CS-602(II)
SUBJECT NAME: ICT FOR DEVELOPMENT
NO. OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course objectives:

With rising use of Information and Communication technologies available, there is a high potential for these technologies to address sustainability issues. The students must be equipped with the knowledge about their applications in the development field so as to enable them to provide ICT solutions to the target communities. The students will gain knowledge and skills on how ICTs can be best used to overcome sustainability challenges. In order to succeed in the practice of sustainable development, professionals must be trained in a basic set of competencies that integrate cross-disciplinary knowledge for practical problem solving with the use of information and communication technologies.

MODULE-1: INTRODUCTION

Introduction to ICTs for sustainable Development Introduction to Information and Communication Technology (ICT); Role of ICTs in Sustainable Development; Current Status of ICTs in Sustainable Development- Global and India Scenario. Potential of ICTs in various fields, impact of information Technologies on GDP growth

MODULE-2: BUILDING KNOWLEDGE SOCIETIES

The concept of Knowledge Society; identifying stakeholders and target communities; Understanding information needs, Traditional vs. contemporary knowledge systems, information processing and retrieval; Understanding means of communication in different areas, developing an effective communication strategy Case: Warna Unwired

MODULE-3: INFORMATION AND COMMUNICATION TECHNOLOGIES

The hardware and software, the physical infrastructure, satellite, wireless solutions, telecommunication technologies, mobiles, fixed line, internet and world wide web, community radio, technology-user interface, design of relevant ICT products and services.

MODULE-4: ICT APPLICATIONS

Applications of ICT in education, Health (telehealth, telemedicine and health informatics), Gender Equality, Agriculture (e Governance, telecentres, Mobiles for development, climate change and disaster management, ICT Networks for water management (This module will be dealt with the help of country case studies in all the sectors and inputs from ICT4D practitioners Case Studies: eCME, Apollo Telemedicine Network Foundation, Bhoomi, eSewa, Gyandoot, eAgriculture. M-PESA, CYCLETEL)

MODULE-5: ICT FOR DEVELOPMENT IN INDIA

Policy and Institutional Framework in India, e governance, ICT Models in health, education, agriculture, finance, gender equality, Mobiles for Development Experience sharing by ICT for Development practitioners Case Studies: Reuters Market Light, IffcoKisaan Sanchar Ltd.

MODULE-6: ICT4D IMPLEMENTATION

Developing an ICT4D Project, Critical Success factors for technology diffusion and use, Constraints in adoption, The role of national policies, Institutional Policy framework, Multi-stakeholder partnerships, Role of Private Sector Case Studies: echaupal , Lifelines India.

Course Outcomes:

After completion of the course:

1. Students will be familiarized with main theories and conceptual frameworks in the field of ICT for development

2. Students will learn potential of both information and communication technologies in different areas such as health, education, agriculture, finance, gender equality and climate change.
3. Students will be able to understand the existing innovative business models and other applications in the above mentioned areas with reference to India and other developing countries
4. Students will be able to compare and contrast various business models (public, private sector, PPP, civil society) with respect to technology, infrastructure, capacity building, human resource etc.
5. Students will be able to learn how ICT models can be successfully implemented at the field and understand critical success factors and constraints in adoption.

CODE: OEC-CS-602(III)
SUBJECT NAME: INTELLECTUAL PROPERTY RIGHTS
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To make the student aware about Intellectual Property and why it is important
2. To study the concept of Patents, history of patent and its categorization.
3. To learn the procedure of obtaining Patents.
4. To make the student learn Assignment and Revocation of Patent
5. To study the concept of infringement and its defence.

MODULE-1: INTRODUCTION TO INTELLECTUAL PROPERTY

Concept of Intellectual Property, Kinds of Intellectual Property, Economic Importance of Intellectual Property, Indian Theory on Private Property: Constitutional Aspects of Property, Constitutional Protection of Property and Intellectual Property, Economic Development and Intellectual Property Rights Protection

MODULE-2: INTRODUCTION TO PATENTS

Overview, Historical Development, Concepts: Novelty, Utility, Patentable Subject-matter: Patent Act, 1970- Amendments of 1999, 2000, 2002 and 2005, Pharmaceutical Products and Process and Patent , Protection, Software Patents, Business Method, Protection of Plant Varieties and Farmers' Rights Act, 2001, Patenting of Micro-organism

MODULE-3: PROCEDURE OF OBTAINING OF PATENTS

Concepts of a Patent Application,, Specification: Provisional, Complete, Disclosure Aspects, Claims: Principal, Dependant, Omnibus, Examination of Application, Opposition of Application, Sealing of Patents

MODULE-4: WORKING OF PATENTS – COMPULSORY LICENSE

Commercialization of Inventions: License- Terms of License Agreement, Assignments of Patents, Revocation of Patents

MODULE-5: INFRINGEMENT

What is Infringement?, How is Infringement determined? Who is an Infringer?, Direct, Contributory and Induced, Defences of Infringement: Research Exemption, Invalidity, Misuse, Failure to mark, Laches and Estoppel and first sale doctrine

Course Outcomes:

After completion of the course student will be able to:

1. Understand the concept of Intellectual Property and its importance.
2. Understand Patents, categorization and procedure for obtaining patents.
3. Understand the commercialization of invention
4. Understand the concept of infringement and its defence.

REFERENCES:

1. **W.R. Cornish, Intellectual Property, Sweet & Maxwell, London (2000)**
2. **P. Narayana, Patent Law, Wadhwa Publication**
3. **Merges, Patent Law and Policy: Cases and Materials, 1996**
4. **Brian C. Reid, A Practical Guide to Patent Law, 2nd Edition, 1993**
5. **Brinkhof (Edited), Patent Cases, Wolters Kluwer.**
6. **Prof. Willem Hoyng& Frank Eijsvogels, Global Patent Litigation, Strategy and Practice, Wolters Kluwer.**
7. **Gregory Stobbs, Software Patents Worldwide, Wolters Kluwer.**
8. **Feroz Ali Khader, The Law of Patents- With a special focus on Pharmaceuticals in India, Lexis Nexis Butterworths Wadhwa, Nagpur.**
9. **Sookman, Computer Law, 1996**
10. **N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009). Eastern Book Company, Lucknow**

CODE: OEC-CS-602(IV)
SUBJECT NAME: INTERNATIONAL BUSINESS ENVIRONMENT
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:
To provide knowledge about International Business Environment. To provide the framework on basis of which business can be run smoothly.

MODULE-1:

International business environment; Concept of international business; domestic vs international business, stages of internationalization, tariff and non-tariff barriers,Risks involved in international business

MODULE-2:

Theories of international trade: Adam Smith, Ricardo and Ohlin & Heckler theory, Leontif paradox, PLC

MODULE-3:

International Monetary Systems: Historical background and structure. International Financial institutions; IMF, World Bank, Euro Currency.International financial markets and instruments.

MODULE-4:

Free trade zones.Bilateral and Multilateral Trade Laws – General Agreement on Trade and Tariffs, (GATT), World Trade Organization – IPR, TRIPS, TRIMS, GATS. Regional Economic Integrations: NAFTA, EU. Trade Blocks; ASEAN, SAAARC, BRICS

Course Outcomes:

1. The student will be aware of the international organizations in which India is a member or otherwise.
2. The students may take opportunity to take their business from domestic to international.
3. International organizations and their links to India will be understood by students in an easy manner.
4. The students will be aware business environment at international level

RERERENCES:

1. **Lasserre, Philippe Global Strategic Management, Palgrave MacMillan.**
2. **John D Daniels, Lee H Radebaugh Daniel P Sullivan ,Prashant Salwan. International Business Environments and Operations, Pearson Education**
3. **Tamer Cavusgil, Gary Knight International Business: Strategy, Management and the New Realities, 1st Edition, Pearson Education.**
4. **K Aswathappa, International Business, Tata Mcgraw Hill.**
5. **Richard Hodgetts, Fred Luthans, Jonathan Doh. International Management: Culture, Strategy And Behaviour, Pearson Education.**
6. **Deresky, International Management: Managing across borders and culture. Pearson Education.**
7. **Nandi : "International Business Environment" McGraw Hill Education.**

CODE: OEC-CS-602(V)
SUBJECT NAME: BASICS OF OPERATIONS RESEARCH
NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To introduce the student with Different types of OR Models and Linear Programming Model
2. To introduce the students about Dual Sensitive Method and Sensitive Analysis.
3. To introduce the concept of Assignment Problem.
4. To introduce the students with Network Model
5. To introduce the concept of Dynamic Programming and Queuing Model.

MODULE-1:

The origin of OR, Phases of an O.R. study, Impact of OR, Formulation of Linear-programming model, Graphical solution. Converting the linear programming problem to standard form, Simplex method.

MODULE-2:

Big-M method, Two-phase method, Degeneracy, Alternate optima, unbounded and infeasible solution.

MODULE-3:

Definition of the dual problem, prima-dual relationship, Dual Simplex method, Post optimal and sensitivity analysis.

MODULE-4:

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem.

MODULE-5:

Network models, Minimal spanning tree algorithm, Shortest-route problem (Floyd's Algorithm and Dijkstras algorithm), Maximal flow problem, Introduction to CPM & PERT.

MODULE-6:

Introduction to Dynamic Programming, General inventory Model, Static Economic Order Quantity (EOQ) Models.

MODULE-7:

Elements of a Queuing model, Pure Birth & Death model, Generalized Poisson Queuing, Specialized Poisson Queues.

Course Outcomes:

After completion of the course student will be able to:

1. Understand different types of OR Model and solve Linear programming problems.
2. Understand dual simplex problem and sensitive analysis.
3. Solve Assignment problem.
4. Understand Dynamic Programming and Queuing Model.

REFERENCES:

1. **Operations Research by Hamdy A Taha**
2. **Introduction to Operations Research by Hiller and Dieherman, TMH**
3. **Optimization Theory and Application: SS Rao, John Wiley.**

CODE: OEC-CS-701(I)
SUBJECT NAME: FINANCIAL MANAGEMENT
NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:
To develop understanding among the students regarding nature of finance and its interaction with other Management functions and the objectives of Financial Management.

MODULE-1:
Financial management-scope finance functions and its organisation, objectives of financial management; time value of money; sources of long term finance.

MODULE-2:
Investment decisions importance, difficulties, determining cash flows, methods of capital budgeting with excel; risk analysis (risk adjusted discount rate method and certainty equivalent method); cost of different sources of raising capital; weighted average cost of capital.

MODULE-3:
Capital structure decisions-financial and operating leverage; EBIT/EPS Analysis, capital structure theories- NI, NOI, traditional and M-M theories; determinants of dividend policy and dividend models - Walter, Gordon & M.M. models.

MODULE-4:
Working Capital- meaning, need, determinants; estimation of working capital need; management of cash, inventory and receivables.

Course Outcomes:

1. It creates understanding among the students regarding the key decisions like Investment, Financing and dividend Decisions of financial Management.
2. They are able to understand the usage and applications of leverages in financial decisions.
3. The students are able to use their best knowledge in finance towards the value creation for the organization.
4. The students will be made aware of working capital management concept.

RERERENCES:

1. **Pandey, I.M., "*Financial Management*", Vikas Publishing House, New Delhi**
2. **Khan M.Y, and Jain P.K., "*Financial Management*", Tata McGraw Hill, New Delhi**
3. **Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, "*Financial Management*", Pearson Education**
4. **Chandra, Prasanna, "*Financial Management*", TMH, New Delhi**
5. **Van Horne, James C., "*Financial Management and Policy*", Prentice Hall of India**
6. **Brigham & Houston, "*Fundamentals of Financial Management*", Thomson Learning, Bombay.**
7. **Kishore, R., "*Financial Management*", Taxman's Publishing House, New Delhi**

CODE: OEC-CS-701(II)

SUBJECT NAME: E-COMMERCE AND ENTREPRENEURSHIP

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To understand the basic concept of electronic transactions, types of business models and about customer relationship management.
2. To study about various legal and ethical issues related to electronic transactions and also understating the concepts of IPR.
3. To understand the skills of Entrepreneurship, to identify the projects and the analysis and report making.

MODULE-1: INTRODUCTION TO E-COMMERCE

Need, importance, Business models, revenue models and business processes, economic forces & e-commerce, identifying e-commerce opportunities, international nature of e-commerce, technology infrastructure-internet & WWW; Business strategies for ecommerce: Revenue models in transaction, revenue strategic issues, customer behavior and relationship intensity, advertising on the web, e-mail marketing, technology enabled CRM

MODULE-2: BUSINESS TO BUSINESS STRATEGIES

(Overview strategic methods for Developing E-Commerce) Purchasing, logistics and supply activities, electronic data interchange (EDI), electronic data interchange on the internet, supply chain management using internet technologies, electronic market place & portals (Home shopping, E-marketing, Tele marketing), auctions, online auctions, virtual communicative & web portals; legal, and ethical issues in e-commerce — use and protection of intellectual property in online business, online crime, terrorism & warfare, ethical issues.

MODULE-3: ENTREPRENEURSHIP

Definition, Concept, Growth and role. The Entrepreneur: types, Characteristics, theories of Entrepreneurial class, Urges and importance of Entrepreneurship Stimulants; Seed-Beds of Entrepreneurship, Influencing Factors; Problems (Operational and Non-Operational) and Obstacles. Entrepreneurial Management. Role of socio-economic environment

MODULE-4:

Skills for a New Class of Entrepreneurs, The Ideal Entrepreneurs, The Entrepreneurship Audit, Identification of opportunities by an Entrepreneur, The steps to identify the project /ventures, Process of

converting business opportunities into reality. Feasibility Report and analysis, Process of setting up a small scale industry / unit

MODULE-5:

Promotion of a venture, External Environment Analysis: Economic, Social, Technological and competition, Legal Framework for establishing and fund raising Venture Capital: Sources and Documents required.

Course Outcomes:

After completion of course, students would be able to:

1. The students will be able to understand the basic concepts of electronic transactions.
2. Study of various types of business models and customer relationship management.
3. Students will be able to understand about various business strategies and marketing strategies.
4. Study of various legal and ethical issues related to electronic transactions.
5. Study of intellectual property rights and its importance.
6. Study of Entrepreneurship management
7. Study of analyzing the external environment, the competition and designing the framework for establishing a venture capital.
8. Study of business intelligence and knowledge management tools.

REFERENCES:

1. **Gary P. Schneider, "Electronic Commerce", Seventh Edition, CENGAGE Learning India Pvt. Ltd., New Delhi.**
2. **K.K.Bajaj, D. Nag "E-Commerce", 2nd Edition, McGraw Hill Education, New Delhi**
3. **P.T. Joseph, "E-Commerce An Indian Perspective", PHI Publication, NewDelhi.**
4. **Bhaskar Bharat, "Electronic Commerce-Technology and Application", McGraw Hill Education, New Delhi**
5. **Mary Sumner, "Enterprise Resource Planning", 2005, PHI Learning India Pvt. Ltd. / Pearson Education, Inc. New Delhi. 6. Chan, " E-Commerce fundamentals and Applications", Wiley India, New Delhi**

CODE: OEC-CS-701(III)
SUBJECT NAME: R PROGRAMMING
NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Basic Programming
Course Objectives:

1. Understand what R is and what it can be used for
2. Why would you choose R over another tool
3. Troubleshoot software installs (keep your fingers crossed)
4. Gain familiarity with using R from within the RStudio IDE
5. Get to know the basic syntax of R functions
6. Be able to install and load a package into your R library

MODULE-1: INTRODUCTION

Getting **R,** R Version, 32-bit versus 64-bit, The **R** Environment, Command Line Interface, RStudio, Revolution Analytics RPE
R Packages: Installing Packages, Loading Packages, Building a Package
R Basics: Basic Math, Variables, Data Types, Vectors, Calling Functions, Function Documentation, Missing Data
Advanced Data Structures: data frames, Lists, Matrices, Arrays

MODULE-2: R DATA

Reading Data into **R:** Reading CSVs, Excel Data, Reading from Databases, Data from Other Statistical Tools, R Binary Files, Data Included with R, Extract Data from Web Sites
Statistical Graphics: Base Graphics, ggplot2

MODULE-3: R FUNCTIONS & STATEMENTS

Writing **R** Functions: Hello, World!, Function Arguments, Return Values, do.call
Control Statements: if and else, switch, ifelse, Compound Tests
Loops: for Loops, while Loops, Controlling Loops

MODULE-4: DATA MANIPULATION

Group Manipulation: Apply Family, aggregate, plyr, data.table
Data Reshaping: cbind and rbind, Joins, reshape2
Manipulating Strings: paste, sprint, Extracting Text, Regular

MODULE-5: R STATISTICS & LINEAR MODELING

Probability Distributions: Normal Distribution, Binomial Distribution, Poisson
Basic Statistics: Summary Statistics, Correlation and Covariance, T-Tests 200, ANOVA
Linear Models: Simple Linear Regression, Multiple Regression
Generalized Linear Models: Logistic Regression, Poisson
Model Diagnostics: Residuals, Comparing Models, Cross-Validation, Bootstrap, Stepwise Variable

Selection

MODULE-6: NON-LINEAR MODELING

Nonlinear Models: Nonlinear Least Squares, Splines, Generalized Additive Models, Decision Trees, Random Forests
Clustering: K-means, PAM, Hierarchical Clustering

Course Outcomes:

After completion of the course, students will be able to:

1. Familiarize themselves with R and the RStudio IDE
2. Understand and use R functions
3. Install and load a package into your R library
4. Get insight into the capabilities of the language as a productivity tool for data manipulation and statistical analyses.

REFERENCES:

1. **Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Pearson Edu. Inc.**
2. **Christian Heumann, Michael Schomaker and Shalabh, Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R , Springer, 2016**
3. **Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, The R Software-Fundamentals of Programming and Statistical Analysis, Springer 2013**
4. **By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, A Beginner's Guide to R (Use R) Springer 2009**

CODE: OEC-CS-701(IV)
SUBJECT NAME: NON-CONVENTIONAL ENERGY SOURCES
NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources
3. To understand Power Electronics Interface with the Grid

MODULE-1:

Introduction, Distributed vs Central Station Generation
Sources of Energy such as Micro-turbines
Internal Combustion Engines.

MODULE-2:

Introduction to Solar Energy, Wind Energy, Combined Heat and Power
Hydro Energy, Tidal Energy, Wave Energy
Geothermal Energy, Biomass and Fuel Cells.

MODULE-3:

Power Electronic Interface with the Grid

MODULE-4:

Impact of Distributed Generation on the Power System
Power Quality Disturbances

MODULE-5:

Transmission System Operation
Protection of Distributed Generators
Economics of Distributed Generation

Course Outcomes:

After completion of the course,Students will be able to:

1. Gain knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid connected modes
3. Know the Impact of Distributed Generation on Power System

REDERENCES:

1. **Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011**
2. **Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011,Wiley –IEEE Press**
3. **Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.**
4. **Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010**

5. **James F. Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010**

CODE: OEC-CS-702(I)
SUBJECT NAME: ECONOMIC POLICIES IN INDIA
NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:
The candidates at the post-graduate level are expected to analyze various issues pertaining to India's economic development. The performance of the economy is to be assessed on the backdrop of various Five Year Plans implemented in the economy. Wherever possible, critical appraisal is expected by taking cognizance of the contemporary developments in the economy.

MODULE-1: FRAMEWORK OF INDIAN ECONOMY

- National Income: Trends and Structure of National Income
- Demographic Features and Indicators of Economic Growth and Development Rural-Urban Migration and issues related to Urbanization
- Poverty debate and Inequality, Nature, Policy and Implications
- Unemployment-Nature, Central and State Government's policies, policy implications, Employment trends in Organized and Unorganized Sector

MODULE-2: DEVELOPMENT STRATEGIES IN INDIA

- Agricultural- Pricing, Marketing and Financing of Primary Sector
- Economic Reforms- Rationale of Economic Reforms, Liberalization, Privatization and Globalization of the Economy,
- Changing structure of India's Foreign Trade
- Role of Public Sector- Redefining the role of Public Sector, Government Policy towards Public Sector, problems associated with Privatization, issues regarding Deregulation-Disinvestment and future of Economic Reforms

MODULE-3: THE ECONOMIC POLICY AND INFRASTRUCTURE DEVELOPMENT

- Energy and Transport
- Social Infrastructure- Education, Health and Gender related issues, Social Inclusion
- Issues and policies in Financing Infrastructure Development
- Indian Financial System- issues of Financial Inclusion, Financial Sector Reforms-review of Monetary Policy of R.B.I. Capital Market in India.

MODULE-4: THE ECONOMIC POLICY AND INDUSTRIAL SECTOR

- Industrial Sector in Pre-reforms period, Growth and Pattern of Industrialization
- Industrial Sector in Post-reform period- growth and pattern of Micro, Small, Medium Enterprises s, problems of India's Industrial Exports
- Labour Market- issues in Labour Market Reforms and approaches to Employment Generation Basic

REFERENCES

1. **Brahmananda, P.R. and V.A. Panchmukhi.[2001], Ed. 'Development Experience in Indian Economy, Inter-state Perspective,' Bookwell, New Delhi.**
2. **Gupta,S.P.[1989],'Planning and Development in India: A Critique,' Allied Publishers Private Limited, New Delhi.**

3. **Bhagwati, Jagdish.[2004],'In Defense of Globalization,' Oxford University**
4. **Dhingra, Ishwar //C.[2006],'Indian Economy,' Sultan Chand and Sons, New Delhi.**
5. **Datt, Ruddar and Sundaram, K.P.M.[Latest edition] ,'Indian Economy,' S. Chand and Co, New Delhi.**

CODE: PEC-IT-I-703

SUBJECT NAME: BASICS OF CLOUD COMPUTING

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course objectives: The student will learn how to apply

1. Trust-based security model to real-world security problems.
2. An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
3. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

MODULE-1: INTRODUCTION TO CLOUD COMPUTING

Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing .

MODULE-2: CLOUD COMPUTING ARCHITECTURE

Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise .

MODULE-3: SECURITY ISSUES IN CLOUD COMPUTING

Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

MODULE-4: SECURITY MANAGEMENT IN THE CLOUD

Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

MODULE-5: AUDIT AND COMPLIANCE

Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud.

MODULE-6: DATA INTENSIVE COMPUTING

Map-Reduce Programming Characterizing Data-Intensive Computations, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, MapReduce Programming, MapReduce Programming Model, Example Application

Course Outcomes:

After completion of course, students would be able to:

1. Identify security aspects of each cloud model
2. Develop a risk-management strategy for moving to the Cloud
3. Implement a public cloud instance using a public cloud service provider

REFERENCES:

1. Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, “Distributed and Cloud Computing: From parallel processing to IOT” Morgan Kaufmann Publishers; 1 edition [ISBN: 978-0-12-385880], 2012.

3.

CODE: OEC-CS-702 (III)
SUBJECT NAME: OPTICAL NETWORK DESIGN
NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To make students familiar with SONET and SDH Architecture and add Drop Multiplexer.
2. To make students aware of wavelength division multiplexing techniques.
3. To introduce T-Carrier multiplexed hierarchy.
4. To introduce features of SONET and SDH.
4. To study about LDP protocol in detail

MODULE-1: INTRODUCTION TO OPTICAL NETWORKING

Introduction SONET/SDH and dense wavelength-division multiplexing (DWDM) , Add/drop multiplexers (ADMs), DWDM, CWDM, Time-Division Multiplexing, Synchronous TDMs, Statistical TDMs, Circuit Switched Networks, T-Carrier multiplexed Hierarchy, DS framing, DS multiframing formats, D4 Superframe, D5 extended superframe, E-Carrier multiplexed Hierarchy, TDM network elements, and Ethernet switching.

MODULE-2:SONET ARCHITECTURES

SONET integration of TDM signals, SONET electrical and optical signals, SONET Layers, SONET framing, SONET transport overhead, SONET alarms, multiplexing, virtual tributaries, SONET network elements, SONET topologies, SONET protection mechanisms, APS, two-fiber UPSR, DRI, and two-fiber and four-fiber BLSR rings. SPR,RPR

MODULE-3:SDH ARCHITECTURES

SDH integration of TDM signals, SDH electrical and optical signals, SDH Layers, SDH framing, SDH higher layer graming, SDH transport overhead, SDH alarms, multiplexing, virtual containers, SDH network elements, SDH topologies, SDH protection mechanisms, APS, 1+1 protection, 1:1protection, 1:N protection, Unidirection v/s bidirectionsl rings, Path and multiplex section switching, Subetwork Connection protection rings, DRI, and two-fiber and four-fiber Multiplex section-shared protection rings,

MODULE-4:WAVELENGTH-DIVISION MULTIPLEXING

Wavelength-division multiplexing principles, coarse wavelength-division multiplexing, dense wavelength-division multiplexing, WDM systems, WDM characteristics, impairments to transmission, and dispersion and compensation in WDM systems. Optical link design, factors affecting system design, point-to-point link based on Q-factor and OSNR, OSNR calculations for fiber amplifiers.

MODULE-5:LABEL DISTRIBUTION PROTOCOLS

The Label Distribution Protocol (LDP), Label Spaces, LDP Sessions, and Hello Adjacencies , The LDP PDU Format, The LDP Message Format, The LDP Messages, The Multi-Protocol Label Switching (MPLS) Architecture, Label Allocation Schemes, The Next Hop Label Forwarding Entry (NHLFE), Explicit Routing, An Example of the Use of the Label Stack, Schemes for Setting up an LSP

Course Outcomes:

Upon successful completion of the course, the student will be able to understand

1. SONET and SDH Architecture.
2. wavelength and time division multiplexing techniques.
3. SONET and SDH frames and their architectures
4. LDP protocol in detail.

REFERENCES

1. **"Optical Network Design and Implementation (Networking Technology)", by Vivek Alwayn, Cisco press**
2. **"Handbook of Fiber Optic Data Communication", Third Edition: A Practical Guide to Optical Networking by Casimer De Cusatis**

CODE: OEC-CS-702(IV)

SUBJECT NAME: HIGH SPEED NETWORK

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To make the students familiar with High Speed Network technologies.
2. To make students aware of advantages and disadvantages of high speed technologies.
3. Study of techniques available for congestion control traffic management.
4. How to make congestion control in TCP and ATM.
5. To study integrated and differentiated services architecture.
6. Protocols for high speed communication

MODULE-1: HIGH SPEED NETWORKS

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL.High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

MODULE-2:CONGESTION AND TRAFFIC MANAGEMENT

Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

MODULE-3:TCP AND ATM CONGESTION CONTROL

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management.

MODULE-4:INTEGRATED AND DIFFERENTIATED SERVICES

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services

MODULE-5: PROTOCOLS FOR QOS SUPPORT

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

Course outcomes:

1. Students will be able to understand basic high speed networks like Frame relay and ATM.
2. Students will be familiar with advantages and disadvantages of high speed network.
3. Students will be aware of congestion control traffic management techniques.
4. Students will be aware of TCP and ATM congestion control techniques.
5. To learn the functionality of integrated and differentiated services architecture.
6. Familiarity with various high speed protocols currently available.

REFERENCES

1. **William Stallings, "HIGH SPEED NETWORKS AND INTERNET", Pearson Educatin, Second Edition, 2002.**

2. **Warland& Pravin Varaiya, "HIGH PERFORMANCE COMMUNICATION NETWORKS", Jean Harcourt Asia Pvt. Ltd., II Edition, 2001.**
3. **IrvanPepelnjk, Jim Guichard and Jeff Apcar, "MLS and VPN architecture", Cisco Press, Volume1 and 2, 2003.**