ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

Regulations & Curriculum – 2019

HAND BOOK
2019

ANNAMALAI UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY
B.E. (Four Year) Degree Programme (FULL–TIME)
Choice Based Credit System (CBCS)
REGULATIONS 2019

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as courses of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamil Nadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma programme in Engineering of the State Board of Technical Education, Tamil Nadu (listed in Annexure-I) will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

2. Branches of Study in B.E.

BRANCH I	-	Chemical Engineering
BRANCH II	-	Civil Engineering
BRANCH III	-	Civil and Structural Engineering
BRANCH IV	-	Computer Science and Engineering
BRANCH V	-	Electrical and Electronics Engineering
BRANCH VI	-	Electronics and Communication Engineering
BRANCH VII	-	Electronics and Instrumentation Engineering
BRANCH VIII	-	Information Technology
BRANCH IX	-	Mechanical Engineering
BRANCH X	-	Mechanical Engineering (Manufacturing)
BRANCH XI	-	Computer Science and Engineering (Artificial Intelligence and Machine learning)
BRANCH XII	-	Computer Science and Engineering (Data Science)

3. Courses of Study and Scheme of Examinations

The courses of study with respective syllabi and the scheme of Examinations are given separately.

4. Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core,

Professional Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory and practical courses. The total credits for the entire degree Programme is 166 (124 for lateral entry students).

5. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed the prescribed examinations in all the four academic years. For the award of the degree, a student has to

5.1 Earn a minimum of 166 credits (124 for lateral entry students).

5.2 Serve in any one of the Co-curricular activities such as

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO) and
- Youth Red Cross (YRC)

for at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(or)

Enrol as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE, IEEE, SAE, ASHRAE, CSI and IWS

5.3 B.E (Honours) Degree

A student shall be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. Thus the total credits are 186. Out of 186 credits (144 credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure-II) in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses of SWAYAM portal also.

5.4 B.E Degree with Minor Engineering

A student shall be eligible to get Under Graduate degree with additional Minor Engineering, if he/she completes an additional 20 credits. Out of the 186 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure-II) in the Faculty of Engineering and Technology in sixth, seventh and eighth semesters . These additional 20 credits could be acquired through the MOOC courses offered in SWAYAM portal also.

6. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture/tutorial per week and half credit for one hour for laboratory or practical or drawing course per week.

7. Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than seven years from the time of admission.

8. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enrol for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 166 (124 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

8.1 Slow Learners

The **slow learners** may be allowed to withdraw certain courses with the approval by the Head of the Department and those courses may be completed by them in the fifth year of study and still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VII semester and take up those courses in the fifth year of study. However, courses withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

8.2 Advance Learners

The **advance learners** may be allowed to take up the open elective courses of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training/project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

9. Mandatory Internship (Industrial Training)

To promote industrial internship at the graduate level in technical institutes and also to enhance the employability skills of the students passing out from Technical Institutions, the internship for the students at different stages of the programme, is included in the curriculum. The student has to undergo the internship during the summer vacation, after the II semester / IV semester / VI semester of the programme as per the details outlined below. Further the student has to submit a report on completion of the internship during the subsequent Odd semester that is in the III / V / VII semesters respectively.

9.1 During the summer vacation, after the II Semester,

The student must get involved in any of the following **Inter/ Intra Institutional Activities** for **4 weeks** duration:

i. Training with higher Institutions; Soft skill training organized by Training and Placement Cell.
ii. Contribution at incubation/ innovation /entrepreneurship cell of the institute.
iii. Participation in conferences/ workshops/ competitions.
iv. Learning at Departmental Lab/ Institutional workshop.
v. Working for consultancy/ research project within the University.
vi. Participation in activities like IPR workshop / Leadership Talks/ Idea/ Design/ Innovation/ Technical Expos.

9.2 During the summer vacation, after the IV Semester and also after the VI Semester,

The student may choose any of the following **Internship / Innovation / Entrepreneurship** related activities for **4 weeks** duration:

i. Work on innovation or entrepreneurial activities resulting in start-up
ii. Undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/
iii. Medium enterprises Undergo internship with National Employment Enhancement Mission (NEEM) Facilitator.

10. Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his/her period of study in an industry and complete his/her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

11. Mandatory Induction program

A 3-week long induction program for the UG students entering the institution, right at the start is proposed. Normal classes start only after the induction program is over. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

Physical Activity
Creative Arts
Imparting Universal Human Values
Literary Activities
Conduct of crash courses on soft skills
Lectures by Eminent People
Visits to Local Area
Familiarization to Dept./Branch & Innovative practices

12.Electives

The elective courses fall under two basic categories: Professional Electives and Open Electives.

12.1 Professional Elective courses

The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned.

12.2 Open Elective courses

Apart from the various Professional elective courses, a student must study three open elective courses two of which offered by the Department concerned and the other open elective course offered by any other Department in the Faculty of Engineering & Technology during either sixth or seventh or eighth semester of study, with the approval of the Head of the Department and the Head of the Department offering the course.

12.3 MOOC (SWAYAM) Courses

Further, the student can be permitted to earn not more than 20 % of his total credits (that is 32 credits) by studying the Massive Open Online Courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent to the professional elective and/or open elective courses. Thus the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

12.4 Value added courses (Inter Faculty Electives)

Of the four open elective courses, a student must study one value added course that is offered by other Faculties in our University either in sixth or seventh semester of the B.E programme.

12.5 One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology.

12.5.1 Industry Expert

For one credit courses, a relevant potential topic may be selected by a committee consisting of the Head of the Department concerned and the Board of Studies member from the Department and a senior faculty member from the Department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two one credit courses (one each in VI and VII semesters). They shall be allowed to take one credit courses offered in other Departments with the permission of Head of the

Department offering the courses. A separate mark sheet shall be issued for one credit courses.

12.5.2 NSQF Courses

A student can be permitted to acquire additional credits not more than two by undergoing any two of the one credit courses conducted under the auspices of National Skills Qualification Framework (NSQF). NSQF is a nationally integrated education and competency based skill and quality assurance framework that will provide for multiple pathways, horizontal as well as vertical, including vocational education, vocational training, general education and technical education, thus linking one level of learning to another higher level. This will enable a student to acquire desired competency levels, transit to the job market and at an opportune time, return for acquiring additional skills to further upgrade their competencies.

13. Assessment

13.1 Theory Courses

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

13.2 Practical Courses

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

13.3 Project Work

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

13.4 Industrial Internship

After attending the internship during the summer vacation of even semester (II / IV / VI semester), the student has to present a report at the start of the subsequent odd semester (III / V / VII semester) to the committee which will assess and award marks out of 100. The committee is constituted with an

Internship Coordinator and a minimum of two members nominated by the Head of the Department for each class.

14. Substitute Assessment

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

15. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

16. Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator. The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All the Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.

For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from third to eighth semester will be as follows:

- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory/40 marks for seminar/ industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case of I & II Semester) for approval and transmission to the Controller of Examinations.

17. Attendance requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

18. Temporary break of study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

If a student wishes to apply for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the Department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of seven years.

19. Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' will appear in the mark sheet for such candidates.

20. Passing and declaration of examination results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of Examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course, is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA in the mark sheet must reappear for the examination of the courses except for Honours courses.

A student who obtains letter grade W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-valuation of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

21. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

21.1 Honours Degree

To obtain **Honours Degree** a student must earn a minimum of **186 credits** within four years (144 credits within three years for lateral entry students) from the time of

admission, pass all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 166 Credits within four years (124 credits within three years for lateral entry students) from the time of admission, by passing all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

21.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 166 credits within **five** years (124 credits within **four** years for lateral entry students) from the time of admission and obtain a CGPA of 6.75 or above for all the courses from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

21.4 Second Class

For Second Class, the student must earn a minimum of 166 credits within **seven** years (124 credits within **six** years for lateral entry students) from the time of admission.

21.5 B.E Degree with Minor Engineering

For Minor Engineering, the student must earn a minimum of 186 credits within four years (144 credits within three years for lateral entry students) from the time of admission, pass all the courses. The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class will be applicable for this also.

22. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates who are eligible to get the B.E. degree in First Class with Distinction will be ranked next after those with Honours on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The Candidates passing with First Class will be ranked next after those with distinction on the basis of CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

23. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the

new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

Annexure-I

Diploma Programmes Eligible for the B.E (Lateral Entry) Programmes offered in FEAT (from 2019 - 2020)

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
1.	**Chemical Engineering**	i. Petrochemical Engineering ii. Chemical Engineering iii. Environmental Engineering and Pollution Control iv. Leather Technology (Footwear) v. Leather Technology vi. Plastic Technology vii. Polymer Technology viii. Sugar Technology ix. Textile Technology x. Chemical Technology xi. Ceramic Technology xii. Petro Chemical Technology xiii. Pulp & Paper Technology xiv. Petroleum Engineering
2.	**Civil Engineering**	i. Civil Engineering ii. Civil Engineering (Architecture) iii. Environmental Engineering and Pollution Control (Full Time)
3.	**Civil and Structural Engineering.**	iv. Architectural Assistantship v. Civil Engineering (Rural Tech.) vi. Civil and Rural Engineering vii. Agricultural Engineering
4.	**Computer Science and Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
5.	**Electrical and Electronics Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
6.	**Electronics and Communication Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering ix. Electrical and Electronics Engineering x. Electronics and Instrumentation Engg
7.	**Electronics and Instrumentation Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
8.	**Information Technology**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
9.	**Mechanical Engineering**	i. Mechanical Engineering ii. Mechanical and Rural Engineering iii. Mechanical Design and Drafting iv. Production Engineering v. Production Technology vi. Automobile Engineering vii. Automobile Technology viii. Metallurgy ix. Mechatronics Engineering

10.	**Mechanical Engineering (Manufacturing Engineering)**	x. Machine Tool Maintenance and Repairs xi. Tool and Die making xii. Tool Engineering xiii. Tool Design xiv. Foundry Technology xv. Refrigeration and Air Conditioning xvi. Agricultural Engineering xvii. Agricultural Technology xviii. Marine Engineering xix. Mechanical Engineering(Production) xx. Mechanical Engineering(Tool &Die) xxi. Mechanical Engineering (Foundry) xxii. Mechanical Engineering(R & A.C.) xxiii. Electronics(Robotics) xxiv. Mining Engineering xxv. Agricultural Engineering and Farm Machinery xxvi. Equipment Technology
11	**Computer Science and Engineering (Artificial Intelligence and Machine learning)**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
12	**Computer Science and Engineering (Data Science)**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering

Annexure-II

S.No.	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
1.	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engg 4. Information Technology 5. Civil and Structural Engg 6. Electrical Engineering 7. Electronics and Communication Engg 8. Mechanical (Manufacturing) Engg 9. Computer Science and Engineering 10. Computer Science and Engineering. (Artificial Intelligence and Machine learning) 11.Computer Science and Engineering. (Data Science)
2.	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engg.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering. 5. Computer Science and Engineering. (Artificial Intelligence and Machine Learning) 6. Computer Science and Engineering (Data Science) 7. Mechanical (Manufacturing) Engg 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg
3.	Civil and Structural Engineering		
4.	Computer Science and Engineering	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering. (Artificial Intelligence and Machine learning) 5. Computer Science and Engineering. (Data science)	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
5.	Computer Science and Engineering (Artificial Intelligence and Machine learning)		
6.	Computer Science and Engineering (Data Science)		

<table>
<tr><td>7.</td><td>Electrical and Electronics Engineering</td><td rowspan="3">1. Electrical Engineering
2. Electronics and Instrumentation Engineering
3. Electronics and Communication Engineering</td><td rowspan="3">1. Civil Engineering
2. Civil and Structural Engg
3. Mechanical Engineering
4. Chemical Engineering
5. Mechanical (Manufacturing) Engg
6. Computer Science and Engineering
7. Computer Science and Engineering (Artificial Intelligence and Machine learning)
8. Computer Science and Engineering (Data Science)
9. Information Technology</td></tr>
<tr><td>8.</td><td>Electronics and Communication Engg.</td></tr>
<tr><td>9.</td><td>Electronics and Instrumentation Engg.</td></tr>
<tr><td>10.</td><td>Information Technology</td><td>1. Computer Science and Engg.
2. Information Technology
3. Electronics and Communication Engineering
4. Computer Science and Engineering. (Artificial Intelligence and Machine learning)
5. Computer Science and Engineering (Data Science)</td><td>1. Civil Engineering
2. Electronics and Instrumentation Engg
3. Electronics and Communication Engg
4. Mechanical Engineering
5. Mechanical (Manufacturing) Engg
6. Civil and Structural Engg
7. Electrical Engineering
8. Chemical Engineering</td></tr>
<tr><td>11.</td><td>Mechanical Engineering</td><td rowspan="2">1. Mechanical Engineering
2. Mechanical (Manufacturing) Engg.</td><td rowspan="2">1. Civil Engineering
2. Civil and Structural Engg
3. Electrical Engineering
4. Chemical Engineering
5. Computer Science and Engineering
6. Computer Science and Engineering (Artificial Intelligence and Machine learning)
7. Computer Science and Engineering (Data Science)
8. Electronics and Instrumentation Engg
9. Information Technology
10. Electronics and Communication Engg</td></tr>
<tr><td>12.</td><td>Mechanical (Manufacturing) Engg.</td></tr>
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ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE ANDENGINEERING

B.E. (Four Year) Degree Programme(FULL–TIME)

Choice Based Credit System (CBCS)

Computer Science and Engineering (Data Science)

CURRICULUM - 2019

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS101	**BS-I**	Physics	3	1	0	25	75	100	4
ETBS102	**BS-II**	Mathematics – I	3	1	0	25	75	100	4
ETES103	**ES-I**	Basic Electrical Engineering	3	1	0	25	75	100	4
ETBP104	**BSP-I**	Physics Laboratory	0	0	3	40	60	100	1.5
ETSP105	**ESP-I**	Electrical Engineering Laboratory	0	0	2	40	60	100	1
ETSP106	**ESP-II**	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
						Total Credits			**17.5**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS201	**HS-I**	English	2	0	0	25	75	100	2
ETBS202	**BS-III**	Chemistry	3	1	0	25	75	100	4
ETES203	**ES-II**	Programming for Problem Solving	3	0	0	25	75	100	3
ETBS204	**BS-IV**	Mathematics – II	3	1	0	25	75	100	4
ETHP205	**HSP-I**	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
ETBP206	**BSP-II**	Chemistry Laboratory	0	0	3	40	60	100	1.5
ETSP207	**ESP-III**	Computer Programming Lab	0	0	4	40	60	100	2
ETSP208	**ESP-IV**	Engineering Graphics and Drafting	1	0	4	40	60	100	3
						Total Credits			**20.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.									

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CURRICULUM – 2019

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
DSBS301	**BS-V**	Mathematical Foundations of Data Science	3	1	-	25	75	100	4
ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
DSES303	**ES-IV**	Digital Electronics	3	-	-	25	75	100	3
DSES304	**ES-V**	Computer Organization	2			25	75	100	2
DSPC305	**PC-I**	Object Oriented Programming	3	-	-	25	75	100	3
DSPC306	**PC-II**	Data Structures and Algorithms	3	1		25	75	100	4
DSSP307	**ESP-V**	Digital Electronics Lab	-	-	3	40	60	100	1.5
DSCP308	**PCP-I**	Object Oriented Programming Lab	-	-	3	40	60	100	1.5
DSCP309	**PCP-II**	Data Structures and Algorithms Lab	-	-	3	40	60	100	1.5
ETIT310	**IT-I**	Internship Inter/ Intra Institutional Activities*	***Four** weeks during the summer vacation at the end of **II Semester***				100	100	**4.0**
***For the **Lateral entry students** total credit for III Semester is **23.5** as they are exempted from internship during summer vacation of II semester.*						**Total Credits**			**27.5**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
DSBS401	**BS-VI**	Discrete Mathematics	3	-	-	25	75	100	3
DSES402	**ES -VI**	Software Engineering	2	-	-	25	75	100	2
DSPC403	**PC-III**	Database Technology	3	-	-	25	75	100	3
DSPC404	**PC-IV**	Operating Systems	3	-	-	25	75	100	3
DSPC405	**PC-V**	Data Science	3	-	-	25	75	100	3
DSPC406	**PC-VI**	Python Programming	3	-	-	25	75	100	3
DSCP407	**PCP-III**	Database Technology Lab	-	-	3	40	60	100	1.5
DSCP408	**PCP-IV**	Operating System Lab	-	-	3	40	60	100	1.5
DSCP409	**PCP-V**	Data Science Lab	-	-	3	40	60	100	1.5
						Total Credits			**21.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CURRICULUM – 2019

SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
DSPC501	**PC-VII**	Map Reduce Programming with Hadoop	3	-	-	25	75	100	3
DSPC502	**PC-VIII**	Data Visualisation	3	-	-	25	75	100	3
DSPC503	**PC-IX**	Machine Learning	3	-	-	25	75	100	3
DSPC504	**PC-X**	Computer Networks	3			25	75	100	3
DSPE505	**PE-I**	Professional Elective - I	3	-	-	25	75	100	3
DSPE506	**PE-II**	Professional Elective - II	3	-		25	75	100	3
DSCP507	**PCP-VI**	Map Reduce Programming with Hadoop Lab	-	-	3	40	60	100	1.5
DSCP508	**PCP-VII**	Data Visualisation Lab	-	-	3	40	60	100	1.5
DSCP509	**PCP-VIII**	Machine Learning Lab	-	-	3	40	60	100	1.5
ETIT510	**IT-II**	Industrial Training / Rural Internship/Innovation /Entrepreneurship	***Four*** *weeks during the summer vacation at the end of* ***IV Semester***				100	100	**4.0**
						Total Credits			**26.5**

SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
DSPC601	**PC-XI**	Data Analysis with R	3	-	-	25	75	100	3
DSPC602	**PC-XII**	Cloud Computing	3	-	-	25	75	100	3
DSPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
DSPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
DSPE605	**PE-V**	Professional Elective -V	3	-	-	25	75	100	3
YYOE606	**OE-I**	**Open Elective - I (Inter Department - FEAT)**	3	-	-	25	75	100	3
DSCP607	**PCP-IX**	Data Analysis with R Lab	-	-	3	40	60	100	1.5
DSCP608	**PCP-X**	Cloud computing Lab	-	-	3	40	60	100	1.5
						Total Credits			**21.0**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CURRICULUM – 2019

SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS701	**HS-II**	Ethics in Data Analytics	2	-	-	25	75	100	2
DSPC702	**PC-XIII**	Internet of Things(IoT)	3	-	-	25	75	100	3
DSPE703	**PE-VI**	Professional Elective - VI	3	-	-	25	75	100	3
DSPE704	**PE-VII**	Professional Elective - VII	3	-	-	25	75	100	3
YYOE705	**OE-II**	**Open Elective - II (Inter Department- Allied Branch)**	3	-	-	25	75	100	3
DSCP706	**PCP-XI**	Internet of Things(IoT) Lab	-	-	3	40	60	100	1.5
ETIT707	**IT-III**	Industrial Training / Rural Internship/Innovation /Entrepreneurship	***Four*** *weeks during the summer vacation at the end of* ***VI Semester***				100	100	**4.0**
						Total Credits			**19.5**

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
DSOE801	**OE-III**	**Open Elective – III (from the same Department)**	3	-	-	25	75	100	3
DSOE802	**OE-IV**	**Open Elective – IV (from the same Department)**	3	-	-	25	75	100	3
DSPV803	**PV-I**	Project Work and Viva-Voce	-	**PR** 10	**S** 2	40	60	100	**6**
						Total Credits			**12**

L	No. of Lecture Hours	**TR**	No. of Hours for Discussion on Industrial Training
T	No. of Tutorial Hours	**S**	No. of Seminar Hours on Industrial Training / Project
P	No. of Practical Hours	**PR**	No. of Hours for Discussion on Project work
CA	Continuous Assessment Marks	**FE**	Final Examination Marks
Credits	Credit points allotted to that course	**Total**	Total Marks

PE – PROFESSIONAL ELECTIVES

1. Distributed systems
2. Data Engineering
3. Scala Programming
4. NoSQL databases
5. Data Storage Technologies
6. Optimization Techniques
7. Extract Transform & Load (ETL) Tools
8. Business Intelligence
9. Programming with Spark
10. Data Security
11. Web Analytics
12. GPU Computing
13. Mining for Big Data
14. Predictive Analytics
15. Text Analytics
16. Social Media Analytics
17. Real Time Analytics
18. Applied Econometrics & Time Series Analysis
19. Recommender Systems
20. Health care Analytics
21. Business Analytics

OE- OPEN ELECTIVES

1. Soft Computing
2. Mobile Application Development
3. Cyber Security
4. Big Data for Bio Informatics
5. Deep Learning
6. Information Retrieval
7. Block Chain Technology
8. Digital Forensics

LIST OF HONORS ELECTIVE COURSES

S. No	Course Code	Course Name	Credits
1	DSHESCN	Big Data Testing Tools	4
2	DSHESCN	Big Data Analytics Tools	4
3	DSHESCN	Data Management	3
4	DSHESCN	Cognitive Computing	3
5	DSHESCN	High Performance Big Data Analytics	3
6	DSHESCN	Financial Analytics	3

LIST OF MINOR ENGINEERING ELECTIVE COURSES

S. No	Course Code	Course Name	Credits
1	DSMISCN	Data Structures and Algorithms	4
2	DSMISCN	Python Programming (or) Data Analysis with R	4
3	DSMISCN	Data Science	3
4	DSMISCN	Map Reduce Programming with Hadoop	3
5	DSMISCN	Machine Learning (or) Mining for Big Data	3
6	DSMISCN	NoSQL Databases	3

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.E. COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

(Students Admitted From the Academic Year 2019-2020)

VISION

To provide a congenial ambience for individuals to develop and blossom as academically superior, socially conscious and nationally responsible citizens.

MISSION

- **M1**: Impart high quality computer knowledge to the students through a dynamic scholastic environment wherein they learn to develop technical, communication and leadership skills to bloom as a versatile professional.
- **M2**: Develop life-long learning ability that allows them to be adaptive and responsive to the changes in career, society, technology, and environment.
- **M3**: Build student community with high ethical standards to undertake innovative research and development in thrust areas of national and international needs.
- **M4**: Expose the students to the emerging technological advancements for meeting the demands of the industry.

B. E. COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO	PEO Statements
PEO1	To prepare graduates with potential to get employed in the right role and/or become entrepreneurs to contribute to the society.
PEO2	To provide the graduates with the requisite knowledge to pursue higher education and carry out research in the field of Computer Science and Engineering.
PEO3	To equip the graduates with the skills required to stay motivated and adapt to the dynamically changing world so as to remain successful in their career.
PEO4	To train the graduates to communicate effectively, work collaboratively and exhibit high levels of professionalism and ethical responsibility.

B.E.COMPUTER SCIENCE & ENGINEERING (DATA SCIENCE)
PROGRAMME OUTCOMES (PO)

After the successful completion of the B.E COMPUTER SCIENCE & ENGINEERING (DATA SCIENCE) degree program the students will be able to :

Sl. No.	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 lifelong learning in the broadest context of technological change.

B.E.COMPUTER SCIENCE & ENGINEERING (DATA SCIENCE) –

CONSISTENCY OF PEOS WITH MISSION OF THE DEPARTMENT

PEO Statements	Mission Statements			
	M1	M2	M3	M4
PEO1: To prepare the graduates with the potential to get employed in the right role and/or become entrepreneurs to contribute to the society.	2	3	2	3
PEO2: To provide the graduates with the requisite knowledge to pursue higher education and carry out research in the field of Computer Science.	2	2	3	2
PEO3: To equip the graduates with the skills required to stay motivated and adapt to the dynamically changing world so as to remain successful in their career.	2	3	2	3
PEO4: To train the graduates to communicate effectively, work collaboratively and exhibit high levels of professionalism and ethical responsibility.	3	3	2	3

3-Strong Correlation 2-Moderate Correlation 1-Weak Correlation

B.E.COMPUTER SCIENCE & ENGINEERING (DATA SCIENCE) –

MAPPING OF PEOs WITH POs

Mapping of PEOs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PEO1	3	2	3	2	3	1	1	1	2	2	1	2
PEO2	3	2	3	2	2	-	-	-	-	1	-	2
PEO3	2	2	2	1	3	1	1	1	2	2	-	3
PEO4	2	1	2	1	2	1	1	2	2	3	2	1

3-Strong Correlation 2-Moderate Correlation 1-Weak Correlation

DSBS301	MATHEMATICAL FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To study the characteristics of a population through a sample of population with variates.
- To understand probability theory for investigating the important features of the Random experiments.
- To explain certain probability distribution which is useful in constructing probabilistic models for observed phenomena.
- To describe the theory of sampling and the test of hypothesis.

UNIT – I Introduction to Statistics

Statistics: Classification-Graphical representation –Bar chart-Pie diagram-Frequency graph-Measures of central tendency: Mean – Median – Mode. Measures of Dispersion: Range – Quartile deviation – Mean deviation- Standard deviation.

UNIT – II Correlation and Regression

Correlation and Regression – Rank correlation- curve fitting: Method of least squares – Straight line – Parabola – Exponential curve.

UNIT – III Probability Theory

Probability Theory: Random Experiment – Axiomatic Definition of probability – Conditional probability – Independent Events – Theorem of total probability – Problems based on Baye's theorem.

UNIT – IV Probability distributions

Probability Distributions: Discrete distributions-Binomial and Poisson distribution. Continuous distributions: Uniform, Exponential and Normal distributions.

UNIT – V Test of Hypothesis

Test of Hypothesis: Critical region-level of significance-Confidence interval- Large sample: Test for single proportion and difference of proportions – Test for single mean and difference of means. Small sample test: t – test for single mean and difference of means, F-test for significance of variance – Chi square test for goodness of fit and independence of attributes.

TEXT BOOKS:

1. Veerarajan.T, "Probability, Statistics and Random Processes", Tata McGraw Hill Publishing Company Limited, New Delhi, 2014.
2. Kandasamy.P, ThilagavathyKandGunavathy.K, "Engineering Mathematics", Volume II, S. Chand & co Ltd, New Delhi, 2006.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons," 9th Edition, 2010.
2. N.P.Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publication, 2012.
3. Ramana .B.V, "Higher Engineering Mathematics", Tata McGraw Hill, 2016.

COURSE OUTCOMES:

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

1. Acquire the basic concepts about the characteristics of a population.
2. Understand the characteristics of the data associated with two variables.
3. Investigate the important features of the random experiments.
4. Identify and apply probability distributions in engineering and data analysis applications.
5. Explain the theory of sampling and measure the goodness of fit.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-		-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-
CO5	3	3	3		-	-	-	-	-	-	-	-

ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the types of resources such as forest, water, mineral, food, energy and land.
- To describe the structure and function of an ecosystem.
- To explain the value of biodiversity.
- To increase the types of pollution and increase awareness to protect the environment.

UNIT - I Introduction

Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness. Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest 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 using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. 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.

UNIT – II 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 - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT – III Bio Diversity

Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values

- Biodiversity at global, National and local 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: In-situ and Ex-situ conservation of biodiversity.

UNIT – IV Types of Pollution

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. 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.

UNIT – V Environment and Human Health

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.

TEXT BOOKS :

1. ErachBharucha, “Textbook of Environmental Studies”, University Press, 2005.
2. MP Poonia & SC Sharma, “Environmental Studies”, Khanna Publishing House, 2017.

REFERENCES:

1. Rajagopalan, “Environmental Studies”, Oxford University Press, 2005.
2. Brunner R.C., “Hazardous Waste Incineration”, McGraw Hill Inc., 1989.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., “Environmental Encyclopaedia”, Jaico Publ. House, Mumbai, 2001.
4. De A.K., “Environmental Chemistry”, Wiley Eastern Ltd. New Age International Limited, 3rd Edition, 2003.
5. Jadhav, H &Bhosale, V.M. “Environmental Protection and Laws”, Himalaya Pub. House, Delhi, 1995.
6. Wanger K.D., “Environmental Management”. W.B. Saunders Co. Philadelphia, USA, 1998.

COURSE OUTCOMES:

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

1. Understand renewable and non-renewable resources of our ecosystem.
2. Compare ecological system, causes and their relationship.
3. Explain political angers to the species of plants, animals and microorganisms in the environment and the threats to biodiversity
4. Analyse the causes and consequences of natural and man induced disasters (flood, earthquake, landslides, cyclones) and measure pollutions and minimize their effects.

5. Design modes with the help of information technology for eliminating or minimizing the problems of Environment and human health.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**

DSES303	**DIGITAL ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of semiconductor devices, transistors and amplifiers.
- To introduce the laws of Boolean algebra and solve problems in combinational logic.
- To illuminate the basic concepts of memory.
- To explain sequential logic and memory circuits and systems.

UNIT - I Digital Circuits- Introduction

Digital signals – digital circuits, AND, OR, NOT, NAND, NOR and Exclusive - OR operations – Boolean algebra – examples of IC gates – number systems - binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes-error detecting and correcting codes – characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT – II Standard Representation for Logic Function

K-map representation – Simplification of logic functions using K-map-minimization of logical functions, Don't care conditions - Multiplexer, De-Multiplexer/Decoders, Adders- Subtractors - BCD arithmetic- carry look ahead adder – serial adder- ALU- elementary ALU design – popular MSI chips – digital comparator – parity checker/generator-code converters- priority encoders – decoders / drivers for display devices-Q-M method of function realization.

UNIT – III Flip Flops and Counters

A1-bitmemory, the circuit properties of Bi stable latch, the clocked SR flip flop, J-K-T and D-type flip flops – applications of flip flops – shift registers-applications of shift registers-serial to parallel converter – parallel to serial converter – ring counter - sequence generator-ripple(Asynchronous)counters – synchronous counters – counters design using flip flops-special counter IC's- asynchronous sequential counters-applications of counters.

UNIT – IV ADC and DAC Converters

Digital to analog converters: weighted resistor/converter-R-2R Ladder D/A converter-specifications for D/A converters – examples of D/A converter ICs – sample and hold circuit – analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter – counting A/D converter – dual slope A/D converter -

A/D converter using voltage to frequency and voltage to time conversion- specifications of A/D converters – example of A/D converter ICs.

UNIT – V Memory Organization

Memory organization and operation – expanding memory size – classification and characteristics of memories – sequential memory-read only memory(ROM) – read and write memory(RAM)-content addressable memory(CAM)-charged e-coupled device memory (CCD)-commonly used memory chips-ROM as a PLD- Programmable logic array- Programmable array logic-complex Programmable logic devices (CPLDS)-Field Programmable Gate Array(FPGA).

TEXT BOOKS:

1. P. Jain, "Modern Digital Electronics", McGrawHillEducation,2009.
2. M.M.Mano, "Digital logic and Computer design",PearsonEducationIndia,2016.

REFERENCES:

1. Floyd,"ElectronDevices",PearsonAsia,5th Edition,2013.
2. Donald P Leach, Albert Paul Malvino, GoutanSaha, "Digital Principles and Applications", 7th Edition, 2010
3. V.K. Mehta, Rohit Mehta, "Principles of Electronics", S.Chand Publications, 2005.
4. Digital Electronics, Rishabh Anand, KhannaPublishingHouse,2nd edition,2014.
5. A.Kumar,"FundamentalsofDigitalCircuits",PrenticeHallIndia,2016.
6. Rashid,"Microelectroniccircuits",ThomsonPublications,2010.

COURSE OUTCOMES:

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

1. Acquire knowledge on Digital signals, Logic operations, Boolean algebra, number systems, codes and TTL / CMOS logic based digital lCs,
2. Apply the K-map & Q-M method to simplify logic and evaluate the design of logic circuits including Multiplexer, De-multiplexer/Decoders, Adders, Subtractor, digital comparator and parity checker/generator,
3. Demonstrate the operations of flip-flops including clocked SR, J-K, T and D-type, shift registers and Synchronous /Asynchronous counters.
4. Compare and contrast the design of weighted resistor & R-2R Ladder DAC and ADC such as successive approximation ADC, counting ADC and dual slope ADC.
5. Analyze the classification and characteristics of memories and to explain the design of PLD, CPLDS & FPGA.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

DSES304	COMPUTER ORGANIZATION	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To understand the basic structure of computers and control unit design.
- To study the hierarchical memory system including cache memories and virtual memory.
- To study the different ways of accessing I/O devices and standard I/O interfaces.
- To study the concept of pipelining and superscalar operation.

UNIT – I Basic Structure of Computers

Functional Units – Basic operational concepts – Bus structures – Performance and metrics – Numbers, Arithmetic Operations and Characters-Memory Locations and Addresses-Memory operations-Instructions and instruction sequencing – Instruction set architecture – Addressing modes – Basic Input/output operations-Stacks and queues -Subroutines- Additional instructions.

UNIT – II Basic Processing Unit

Fundamental concepts - Control of the Processor- Execution of a complete instruction – Multiple bus organization – Hardwired control – Micro programmed control –Micro programmed sequencing-Micro Programming Execution – TI8800- Nano programming.

UNIT – III Memory System

Basic concepts- Semiconductor RAM – ROM – Speed, Size and cost – Cache memory – Cache memory principle – Elements of cache design- Cache performance considerations– Virtual memory – Memory management requirements – Secondary storage devices.

UNIT – IV I/O Organization

Accessing I/O devices – Programmed I/O – Interrupts driven I/O – Direct memory access – Buses – Interface Circuits – Standard I/O interfaces: PCI, SCSI and USB– I/O Channels and processors.

UNIT - V Pipelining

Basic Concepts - Data hazards – Instruction hazards – Influence on instruction sets – Data path and control considerations – Superscalar Operation- Ultra SPARCII Example-Performance considerations.

TEXT BOOKS:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, “Computer Organization”, Tata McGraw-Hill Education Pvt. Ltd, 5th edition, 2011.
2. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Pearson Education Ltd.,10th Edition, 2016.

REFERENCES:

1. David A. Patterson and John L. Hennessy, “Computer Architecture – A Quantitative Approach”, Elsevier, a division of reed India Private Limited, 5th edition, 2012.
2. Hayes, J.P., “Computer Architecture and Organization”, Tata Mc-Graw Hill, 3rd Edition, 2012.
3. Ghosh T. K., “Computer Organization and Architecture”, Tata McGraw-Hill, 3rd edition, 2011.
4. BehroozParahami, “Computer Architecture”, Oxford University Press, 8th Impression, 2011.

COURSE OUTCOMES:

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

1. Understand the functional Units of a computer, bus organizations and addressing modes.
2. Compare and Contrast the Hardwired control and Micro programmed control.
3. Analyze RAM, ROM, Cache memory and virtual memory concepts.
4. Identify the various I/O interfaces that are communicated with computers.
5. Recognize the concept of parallel processing and Pipelining on Computers.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

DSPC305	**OBJECT ORIENTED PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To get a clear understanding of object-oriented concepts.
- To understand the basics of objects and classes, Inheritance, Polymorphism.
- To know the principles of packages and interfaces.
- To define exceptions and use thread to develop applications.

UNIT – I Introduction

Traditional Versus Object Orientation Approach – Benefits and applications of OOP– Characteristics of Object Oriented Programming Languages- C++ Programming Basics: Overview–C++ Data Types–Basics of object and class in C++ – Program structure– Member Functions and Member Variable – Techniques for Creating and Initializing Objects –Data Hiding – Namespace– Identifiers– Variables – Constants– Operators– Typecasting– Control structures– Loops and Decisions.

UNIT - II Member Functions and Overloading

Constructors and their types – Destructor – Access specifiers: Private Public and Protected members. C++ Functions: Simple functions- Arguments passed by value and by reference- Overloading of functions – Constructor Overloading-Inline functions - Passing and returning of objects- friend function - Friend Classes -Static Functions - Operator Overloading: Overloading Unary Operators- Overloading Binary Operators - Data Conversion: Conversions Between Objects and Basic Types -Conversions Between Objects of Different Classes.

UNIT - III Inheritance

Concept of Inheritance –Types of Inheritance: Single –Multiple – Multilevel – Hierarchical – Hybrid – Virtual Functions: Normal Member Functions Accessed with Pointers – Virtual Member

Functions Accessed with Pointers – Abstract Classes and Pure Virtual Functions – Virtual Destructors –Virtual Base Classes – THIS Pointer.

UNIT – IV OOP in Java

Characteristics of Java - The Java Environment -Java Source File -Structure –Compilation-Fundamental Programming Structures in Java -Defining classes in Java –constructors- method access specifiers - Packages - Interfaces -defining an Interface- implementing interface - differences between classes and interfaces and extending interfaces-packages.

UNIT - V Threads

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups.

TEXT BOOKS:

1. Robert Lafore, "Object -Oriented Programming in C++", Sams Publication, 4th edition, 2002.
2. Balaguruswamy. E, "Programming with Java", Tata McGraw-Hill Publication, 5th edition, 2014.

REFERENCES:

1. Balaguruswamy.E, "Object Oriented Programming with C++", Tata McGraw-Hill Publication, 6th edition, 2013.
2. R.S. Salaria, "Mastering Object-Oriented Programming with C++", Khanna Book Publishing, N.Delhi, 6th edition, 2016.
3. D.Samantha,"Object Oriented Programming in C++ and Java", PHI, 1st edition, 2004.
4. TanweerAlam, "Internet and Java Programming", Khanna Publishing House, 1st edition, 2012.

COURSE OUTCOMES:

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

1. Understand the basic concepts of Object oriented programming, data hiding, class and object concepts
2. Apply the concept of argument passing through function, operator overloading, function overloading, constructor and destructor function
3. Construct C++ program using inheritance concepts and virtual function
4. Develop Java applications using constructors, method access specifiers, Packages and Interfaces.
5. Build Java applications using multithreading and exception handling concepts.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-
CO5	2	2	3	3	-	-	-	-	-	-	-	-

DSPC306	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand various types of linear and non-linear data structures.
- To analyze algorithms for run time complexities and the space requirements.
- To understand algorithms that use data structures for operations such as storing, searching, hashing etc.
- To apply various data structures and algorithms to design, formulate and implement solution for any real time problem

UNIT - I Introduction to Data Structures

Data Types - Data Structures - Abstract Data Types (ADTs) - Goal of the Analysis of Algorithms Commonly Used Rates of Growth - Types of Analysis - Asymptotic Notation - Big-O Notation - Omega Notation - Theta Notation - Guidelines for Asymptotic Analysis - Simplifying properties of asymptotic notations - Commonly used Logarithms and Summations -Amortized Analysis- Linked Lists - Linked Lists ADT - Comparison of Linked Lists with Arrays & Dynamic Arrays - Singly Linked Lists - Doubly Linked Lists - Circular Linked Lists.

UNIT - II Stacks, Trees and Graphs

Stacks - Definition - How Stacks are used - Stack ADT - Applications - Implementation - Queues - Queue ADT - Applications – Implementation-Trees - Glossary - Binary Trees - Types and Properties of Binary Trees - Binary Tree Traversals - Generic Trees (N-ary Trees) - Expression Trees - Binary Search Trees (BSTs) – AVL(Adelson-Velskii and Landis) Trees - Priority Queues and Heaps - Priority Queue ADT - Priority Queue Applications - Priority Queue Implementations - Heaps - Binary Heaps - Graph - Glossary - Applications of Graphs - Graph Representation - Graph Traversals - Shortest Path Algorithms - Minimal Spanning Tree.

UNIT - III Sorting and Searching

Sorting - Classification of Sorting Algorithms - Bubble Sort - Selection Sort - Insertion Sort - Shell Sort - Merge Sort - Heap Sort - Quick Sort - Searching - Types of Searching - Unordered Linear Search - Sorted/Ordered Linear Search - Binary Search - Hashing - Hash Table ADT - Components of Hashing - Hash Table - Hash Function - Load Factor - Separate Chaining - Open Addressing - Hashing Complexity - Hashing Techniques.

UNIT - IV Greedy Method and Divide & Conquer Method

Algorithm Design Techniques - Greedy Algorithms - Greedy Strategy - Elements of Greedy Algorithms - Advantages and Disadvantages of Greedy Method - Greedy Applications – Topological Sort - Selection sort - Prim's and Kruskal's algorithms - Divide and Conquer Algorithms – General strategy - Divide and Conquer Visualization - Advantages and Disadvantages of Divide and Conquer - Divide and Conquer Applications – Quick sort and Binary Search.

UNIT - V Dynamic Programming and Backtracking Methods

Dynamic Programming – General Strategy - Properties of Dynamic Programming Strategy - Dynamic Programming Approaches - Examples of Dynamic Programming Algorithms- Shortest Path problem - Dijkstra's and Floyd's algorithms - Backtracking - 8 Queen's Problem - Knapsack Problem.

TEXT BOOKS:

1. NarasimhaKarumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", 5th Edition, CareerMonk Publications, 2017.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2002.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education,1983.
3. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
4. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
5. ReemaThareja, "Data Structures Using C", Second Edition, Oxford University Press, 2011.

COURSE OUTCOMES:

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

1. Understand the concepts of data structure, data type and algorithms and critically analyze the various algorithms for their time complexity.
2. Implement abstract data types for linear data structures such as lists stacks and queues.
3. Understand and apply various data structure such as trees and graphs to solve various real-time problems.
4. Implement and know where and when to apply standard algorithms for searching, sorting etc.
5. Effectively choose the data structure that efficiently models the information in a problem.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-

DSSP307	**DIGITAL ELECTRONICS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To study and experiment the characteristics of semiconductor diode and Zener diode.
- To do estimation of parameters of amplifiers, oscillators and multivibrators.
- To implement the concepts of Digital Logic design such as logic gates, flip flops, multiplexer and demultiplexer.
- To verify state table of flip-flops.

LIST OF EXERCISES

1. Characteristics of semiconductor diode.
2. Characteristics of Zener diode and Zener diode as a voltage regulator.

3. Estimation of ripple factor and efficiency in a full wave/Bridge rectifier with and without filter.
4. Characteristics of CE PNP and NPN transistor.
5. Frequency response of RC coupled amplifier.
6. Estimation of gain and efficiency in a class B power amplifier.
7. Measurement of frequency of the output voltage in a RC phase shift oscillator.
8. Estimation of the frequency of the output voltage of a Bi stable Multi vibrator.
9. Verification of Truth table of AND / OR / NOT / NAND/ NOR / XOR gates.
10. Reduction of variables using K-Map.
11. Study of multiplexer and Demultiplexer.
12. Verification of state table of RS / JK flip flop.

COURSE OUTCOMES:

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

1. Analyze the characteristics of diode, Rectifiers, transistors, Oscillators and Multivibrators.
2. Implement Digital logic circuits using logic gates, RS/JK Flip-flops, Multiplexer and De-multiplexer Understand the basic digital circuits and to verify their operation.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSCP308	**OBJECT ORIENTED PROGRAMMING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To learn object-oriented design principles and gain experience writing programs in C++ and Java.
- To develop applications using Object Oriented Programming Concepts.
- To implement features of Object Oriented programming to solve real world problems.
- To create packages, interfaces and threads in Java.

LIST OF EXERCISES

C++ Program

1. Write a C++ program to design a class having static function names showcount() which has the property of displaying the number of objects created of the class.
2. Write a C++ program to find maximum of two numbers using friend function.
3. Write a C++ program using copy constructor to copy data of an object to another object.
4. Write a C++ program to design a class representing complex numbers and having functionality of performing addition and multiplication of two complex numbers using operator overloading.
5. Write a C++ program to design a student class representing student roll no. and a teats class (derived class of student) representing the scores of the student in various subjects and

sports class representing the score in sports. The sport and test class should be inherited by the result class having the functionality to add the scores and display the final result for the student.

6. Write a C++ program to maintain the records of the person with details (Name and Age) and find the eldest among them. The program must use **this pointer** to return the result.
7. Write a C++ program to illustrate the use of virtual function in a class.
8. Write a C++ program showing data conversion between objects of different classes.

JAVA Program

9. Simple Java Applications
    a. Understanding References to an Instant of a Class
    b. Handling Strings

10. Simple Package Creation
    a. Creating User Defined Packages
    b. Creating User Defined Packages - Array of Objects
11. Interfaces
    a. Implementing User Defined Interfaces
    b. Implementing Pre Defined Exceptions
12. Threading
    a. Creation of Threading
    b. Multi-Threading
13. Exception Handling Mechanism in Java
    a. Implementing Predefined Exceptions
    b. Implementing User Defined Exceptions

COURSE OUTCOMES:

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

1. Design algorithms to implement data abstraction, encapsulation, data hiding, Inheritance, dynamic programming using C++.
2. Apply the concepts of interfaces, multithreads and exceptions to develop programs in Java SDK environment.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSCP309	DATA STRUCTURES AND ALGORITHMS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To understand and implement linear data structures such as linear list, stack and queue.
- To implement non-linear data structures such as linear trees and graphs.
- To understand algorithms that use data structures for operations such as sorting and searching.
- To study algorithm design methods such as the greedy method, divide and conquer, dynamic programming and backtracking.

LIST OF EXERCISES
(The Exercises are to be done in C++)

1. Write a program to create a Stack and perform insertion and deletion operations on it.
2. Write a program to create a List and perform operations such as insert, delete, update and reverse.
3. Write a program to create a Queue and perform operations such as insertion and deletion.
4. Using iteration and recursion concepts write programs for finding the element in the array using the Binary Search method.
5. Write a program and simulate various graph traversing techniques.
6. Write a program to Implement Binary Search Tree.
7. Write a program to simulate Bubble sort algorithm.
8. Write a program to implement separate chaining to handle collisions in hashing.
9. Write a program to Implement Heaps using Priority Queues.
10. Implement the Quick sort algorithm to illustrate Divide and Conquer method.
11. Using Dynamic programming method implement Dijkstra's shortest path Algorithm.
12. Write a program to simulate the n-Queens problem using backtracking approach.
13. Implement the Selection sort algorithm to illustrate Greedy Approach.

COURSE OUTCOMES:

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

1. Develop a C++ program to build the basic data structures like stack, queue and list.
2. Develop a C++ program for searching and sorting algorithms using iteration and recursion concept.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	3	2	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSBS401	DISCRETE MATHEMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the various finite structures of Mathematics which are essential to understand the various concepts of Computer Science.
- To learn the operations on sets and relations.
- To understand the representation methods and algorithms for graphs.
- To acquire the knowledge of Automata theory and formal languages for the purpose of developing compilers, programming languages and other natural language processing applications in Computer Science.

Unit – I Mathematical Logic

Mathematical Logic: Propositions – Connectives – Tautology and contradiction – Equivalence of prepositions – Tautological Implication – Normal Forms – Theory of Inference – Rules of Inference.

Unit – II Set Theory and Relations

Set Theory and Relations: Set operations – Ordered pairs and Cartesian product – Relations – Type of relations - Operations on relations – Properties of relations – Equivalence classes – Partition of set – Matrix and Graphical representation of relation.

Unit – III Graph Theory

Graph Theory: Graphs – Special simple graphs – Matrix representation of graphs – Path cycles and connectives – Eulerian and Hamiltonian graphs – Shortest path algorithms.

Unit – IV Finite Automata

Finite automata – Representation of a finite automaton – Language Accepted by a finite automaton – Non-deterministic finite automata – Acceptability of string by NFA – Equivalence of FA and NFA -∈ - NFA - Equivalence of ∈ - NFA and NFA.

Unit – V Grammar

Phase – Structure grammar – Derivation in a grammar G – Regular grammar – Context free grammar – Derivation trees of CFG – Normal forms of CFG.

TEXT BOOKS:

1. Veerarajan T, “Discrete Mathematics with Graph Theory and Combinatorics”, Tata McGraw Hill Publishing Company Ltd, 2014.
2. Venkataraman M. K, “Discrete Mathematics Structures”, the National Publishing Company, 2008.

REFERENCES:

1. Kolman Busby Ross, “Discrete Mathematical Structures”, Pearson Education Pvt. Ltd., 2000.
2. Trembley J P and Manohar R P, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw - Hill Publishing Company Ltd, 2005.

COURSE OUTCOMES:

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

1. Acquire the basic concepts in Mathematical Logic and theory of inferences.

2. Understand the concepts of Set theory, Relations and equivalence classes with matrix representation.
3. Implement Lattice theory and Boolean Algebra in circuit design.
4. Design coding and encoding group codes.
5. Understand the basic concepts of Graph theory, Eulerian and Hamiltonian graphs

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	2	-	-	-	2	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	2	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	1	-	-	-	-	-	2	-	-	-

DSES402	**SOFTWARE ENGINEERING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To understand the phases of development of a Software Project.
- To understand the major considerations for enterprise integration and deployment concepts of requirements engineering and Analysis Modeling.
- To learn various testing, maintenance measures and risk management methods.
- To learn the Software quality management and configuration management concepts.

UNIT- I Introduction to Software Process

The Software process- A Generic Process Model- Perspective Process Models-Specialized Process Models- The Unified Process-Personal and team process models-Agile Development-Extreme Programming (XP) - Requirements Engineering-Requirements Analysis-Establishing the Groundwork- Eliciting Requirements- Developing Use Cases- Negotiating Requirements-Validating Requirements-Requirements Analysis-Scenario-Based Modeling.

UNIT- II Design Concepts

The Design Process-Design Concepts-The Design Model- Architectural Design-Assessing Alternative Architectural Designs- Architectural Mapping Using Data Flow-Component-level design-Designing Class-Based Components-Conducting Component-Level Design-User Interface design-User Interface Analysis and Design- Interface Analysis-Pattern based Design- Web App design-Web App Design Quality-Web App Interface design.

UNIT- III Quality Management

Software Quality- The Software Quality Dilemma- Achieving Software Quality- Review techniques-Cost Impact of Software Defects-Defect Amplification and Removal-Review Metrics and Their Use-Informal Reviews-Formal Technical Reviews-Software Quality Assurance- Test Strategies for Conventional Software-Test Strategies for Object-Oriented Software-SQA Tasks, Goals, and Metrics-Statistical Software Quality Assurance-A Strategic Approach to Software Testing-System Testing-The Art of Debugging.

UNIT- IV Configuration Management

The SCM Repository-The SCM Process-Configuration Management for Web Apps-A Framework for Product Metrics-Metrics for the Requirements Model-Metrics for the Design Model- Project Management concepts- The management spectrum-People-The Product- The Process-Metrics in the Process and Project Domains.

UNIT- V Software Project Estimation

Decomposition Techniques-Empirical Estimation Models-The Make/Buy Decision-Project Scheduling-Defining a Task Set for the Software Project-Defining a Task Network-Reactive versus Proactive Risk Strategies-Risk Identification-Risk Projection-Risk Refinement-The RMMM Plan-Business Process Reengineering-Software Reengineering-Reverse Engineering-Restructuring-Forward Engineering-The SPI Process-The CMMI-The People CMM-SPI Return on Investment-SPI Trends.

TEXT BOOKS:

1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Mc Graw-Hill International Edition, Seventh Edition, 2010.
2. K.K. Aggarwal &Yogesh Singh, "Software Engineering", New Age International,2nd edition,2006.

REFERENCES:

1. Ian Sommerville, "Software Engineering", Pearson Education Asia,9th Edition, 2011.
2. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning Private Limited, Third Edition, 2009.
3. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
4. Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
5. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited, 2007.

COURSE OUTCOMES:

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

1. Comprehend the basic elements of Software Project Models.
2. Analyze the strategies in Software Designing.
3. Visualize the significance of the different kind of Software Testing methods.
4. Explore the various Management methods in Software Development Projects.
5. Acquire knowledge about Risk Management in Software Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	1	-	1	-
CO2	1	1	2	-	-	-	-	-	-	-	-	-
CO3	1	2	2	-	-	-	-	-	-	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	1	1	-	-	-	-	-	-

DSPC403	DATA BASE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of DBMS, E-R Diagrams, Relational model and SQL.
- To disseminate the knowledge on various Normal Forms.
- To inculcate the fundamentals of transaction management and Query processing.
- To give an introduction on current trends in data base technologies.

UNIT – I Introduction

File System vs. DBMS – Views of data – Data Models – Database Languages – Database Management System Services – Overall System Architecture – Data Dictionary – Entity – Relationship (E-R) – Enhanced Entity – Relationship Model.

UNIT – II Relational Approach

Relational Model – Relational Data Structure – Relational Data Integrity – Domain Constraints – Entity Integrity – Referential Integrity – Operational Constraints – Keys – Relational Algebra – Fundamental operations – Additional Operations –Relational Calculus - Tuple Relational Calculus – Domain Relational Calculus - SQL – Basic Structure – Set operations – Aggregate Functions – Null values – Nested Sub queries – Derived Relations – Views – Modification of the database – Joined Relations – Data Definition Language – Triggers.

UNIT – III Database Design

Functional Dependencies – Pitfalls in Relational Database Design – Decomposition – Normalization using Functional Dependencies – Normalization using Multi-valued Dependencies – Normalization using Join Dependencies – Domain - Key Normal form.

UNIT – IV Query Processing and Transaction Management

Query Processing Overview – Estimation of Query Processing Cost - Join strategies – Transaction Processing – Concepts and States – Implementation of Atomicity and Durability – Concurrent Executions – Serializability – Implementation of Isolation – Testing for Serializability – Concurrency control – Lock Based Protocols – Timestamp Based Protocols.

UNIT – V Trends in Data Base Technologies

Distributed Databases - Homogeneous and Heterogeneous Databases - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control in Distributed Databases - Availability - Distributed Query Processing - Heterogeneous Distributed Databases- Cloud-Based Databases - Directory Systems.

TEXT BOOKS :

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Tata McGraw Hill, Sixth Edition, 2010.
2. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Addision Wesley, Sixth Edition, 2010.

REFERENCES :

1. Raghu Ramakrishnan, Johannes Gehrke "Database Management Systems", McGraw Hill,Third Edition, 2002.
2. Peter Rob and Carlos Coronel, "Database Systems – Design, Implementation and Management", Thompson Learning, Course Technology, Seventh Edition, 2006.
3. C. J. Date, A.Kannan, S.Swamynathan , "An Introduction to Database Systems", Addison Wesley, 8th Edition, 2012.
4. Database Management Systems, R.P. Mahapatra&GovindVerma, Khanna Publishing House, 2013.

COURSE OUTCOMES:

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

1. Understand the fundamental concepts of Database Management Systems and Entity Relationship Model and develop ER Models.
2. Build SQL Queries to perform data creation and data manipulation operations on databases.
3. Understand the concepts of functional dependencies, normalization and apply such knowledge to the normalization of a database.
4. Identify the issues related to Query processing and Transaction management in database management systems.
5. Analyze the trends in data storage, query processing and concurrency control of modern database technologies.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	-	-	-
CO4	-	1	-	-	1	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-

DSPC404	**OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide an overview of operating systems, operating system structure and operations.
- To understand the concepts of process management.
- To impart knowledge on storage and I/O systems management.
- To learn the internal features of LINUX operating system and virtualization.

UNIT - I OPERATING SYSTEMS OVERVIEW

Computer System Overview - Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview - objectives and functions, Evolution of Operating System - Computer System Organization - Operating System Structure and Operations - System Calls, System Programs, OS Generation and System Boot.

UNIT- II PROCESS MANAGEMENT

Processes - Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads- Overview, Multicore Programming, Multithreading Models; Windows 7 - Process Synchronization - Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and Deadlocks.

UNIT- IIISTORAGE MANAGEMENT

Main Memory-Contiguous Memory Allocation, Segmentation, Paging, 32-bit and 64-bit architecture Examples; Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

UNIT- IV I/O SYSTEMS

Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage-File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- File System Structure, Directory Structure, Allocation Methods, Free Space Management; I/O Systems.

UNIT- V CASE STUDY

Linux System- Basic Concepts; System Administration-Requirements for Linux System Administrator, Setting up a LINUX Multifunction Server, Domain Name System, Setting Up Local Network Services; Virtualization- Basic Concepts, Setting Up Xen,VMware on Linux Host and Adding Guest OS.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts",John Wiley and Sons Inc., 9th Edition, 2012.
2. William Stallings, "Operating Systems – Internals and Design Principles", Prentice Hall,7th Edition, 2011.

REFERENCES:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Addison Wesley, Second Edition, 2001.
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education", 1996.
3. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Tata McGraw-Hill Education, Second Edition, 2007.
4. Robert Love, "Linux Kernel Development",Addison-Wesley, 3rd Edition, 2010.
5. http://nptel.ac.in/.

COURSE OUTCOMES:

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

1. Explain the types of operating systems, operating system services and to perform a case study on UNIX and WINDOWS operating system.
2. Explain the concepts of process state, Threads and compare the process scheduling algorithms.
3. Illustrate the concepts of Critical Section, semaphores, IPC and develop Bankers algorithm to detect deadlock.
4. Summarize page management techniques and select suitable page replacement algorithm.
5. Discuss the I/O hardware, I/O software, file and directories management and able to develop disk scheduling algorithms.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	1	-	-	-	-	-	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-

DSPC405	**DATA SCIENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the concepts of data science.
- To learn the mechanisms for data storage, wrangling, and aggregation.
- To understand high dimensional space and singular value decomposition.
- To acquire knowledge on algorithms for massive data problems and random graphs.

UNIT - I Introduction

Arrays and Vectorized Computation – Multidimensional Array object – Fast element-wise array functions – data processing using arrays - Data Structures – Series, Data Frame – Index Objects - Essential Functionality – Summarizing and Computing Descriptive Statistics – Handling Missing Data – Hierarchical Indexing.

UNIT –II Data Storage and Wrangling

Data Loading, Storage, File Formats: Reading Writing data in text format – binary data format – interacting with HTML and We API – Interacting with databases - Data Wrangling: Clean, Transform, Merge and Reshape - Combining and Merging Data sets – Reshaping and Pivoting – Data Transformation – String Manipulation.

UNIT - III Plotting and Data Aggregation

Plotting and visualization – figures and subplots – line plots, bar lots, histograms, density plots, scatter plots- Data Aggregation and Group Operations – Group by Mechanisms – Data Aggregation – Group-wise operations and transformations – Pivot Tables and Cross Tabulation.

UNIT –IV High Dimensional Space and Singular Value Decomposition

High Dimensional Space – Law of large numbers – Geometry of high dimensions – Properties of the Unit Ball – Gaussians in high dimension - Random projection – Separating Gaussians – Fitting a spherical Gaussian to data – Singular Value Decomposition (SVD) – Singular vectors – SVD – Best rank k-Approximations – Left Singular Vectors - Singular vectors and Eigenvectors – Applications of SVD.

UNIT – V Algorithms for Massive Data Problems and Random Graphs

Algorithms for Massive Data Problems – Frequency Moments of data streams – Matrix algorithms using Sampling. Random Graphs - The G(n,p) model – Phase transitions – Giant component – Cycles and Full Connectivity – Phase transitions for increasing properties – branching processes – Non-uniform models of Random Graphs – Growth Models.

TEXT BOOKS:

1. Wes McKinney, "Python for Data Analysis", O'Reilly, First Edition, 2012.
2. Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Press, 2018.

REFERENCES:

1. Jorl Gurus, "Data Science from Scratch", O'Reilly, First Edition, 2015.
2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, First Edition, 2016.
3. Samir Madhavan, "Mastering Python for Data Science", PACKT Publishing, 2015.
4. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials", PACKT Publishing, Third Edition, 2018.
5. Gopi Subramanian, "Python Data Science Cookbook", PACKT Publishing, 2015.

COURSE OUTCOMES:

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

1. Describe the data structures suitable for handling data.
2. Apply data cleaning and transformation techniques on datasets.
3. Create simple visualization plots of data.
4. Apply Singular Value Decomposition for data in high dimensional space.
5. Explain algorithms for massive data problems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	2	-	-	-	-	-	-	2
CO3	1	-	1	-	2	-	-	-	-	-	-	-
CO4	3	2	2	2	-	1	-	-	-	-	-	-
CO5	2	2	1	2	1	-	-	-	-	-	-	1

DSPC406	**PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the variables, conditionals, loops, recursion and function calls in Python.
- To use basic data structures such as List, Dictionary and be able to manipulate text files and images.
- To learn the object oriented concepts in Python.
- To acquire skills in database and GUI programming through Python.

UNIT - I Introduction

Elementary Programming, Selections and Loops: History of Python – Getting Started with Python – Programming Style – Writing a Simple Program – Reading Input from the Console – Identifiers – Variables, Assignment Statements, and Expressions – Simultaneous Assignments – Named Constants – Numeric Data Types and Operators – Type Conversions and Rounding–Introduction – Boolean Types, Values, and Expressions – if Statements – Two-Way if-else Statements – Nested

if and Multi-Way if-else Statements – Logical Operators – Conditional Expressions – Operator Precedence and Associativity – Detecting the Location of an Object Case Study: Computing Body Mass Index – The while Loop – The for Loop –Nested Loops – Keywords break and continue – Case Studies: Displaying Prime Numbers and Random Walk.

UNIT - II Python Function

Mathematical Functions, Strings and User Defined Functions: Simple and Mathematical Python Built–in Functions – Strings and Characters – Introduction to Objects and Methods – Formatting Numbers and Strings– Drawing Various Shapes – Drawing with Colors and Fonts – Defining a Function – Calling a Function –Functions with/without Return Values – Positional and Keyword Arguments –Passing Arguments by Reference Values –
Modularizing Code – The Scope of Variables – Default Arguments – Returning Multiple Values – Function Abstraction and Stepwise Refinement – Case Study: Generating Random ASCII Characters.

UNIT - III Class and Object

Introduction to Object – Oriented Programming – Basic principles of Object – Oriented Programming in Python – Class definition, Inheritance, Composition, Operator Overloading and Object creation – Python special Unit – Python Object System – Object representation, Attribute binding, Memory Management, and Special properties of classes including properties, Slots and Private attributes.

UNIT - IV Files and Exception Handling

Files, Exception Handling and Network Programming: Introduction –Text Input and Output – File Dialogs – –Exception Handling – Raising Exceptions – Processing Exceptions Using Exception Objects – Defining Custom Exception Classes – Binary IO Using Pickling – Case Studies: Counting Each Letter in a File and Retrieving Data from the Web–Client Server Architecture– sockets – Creating and executing TCP and UDP Client Server Unit – Twisted Framework – FTP – Usenets – Newsgroup – Emails – SMTP – POP3.

UNIT - V Database and GUI

Database and GUI Programming: DBM database – SQL database – GUI Programming using Tkinter: Introduction – Getting Started with Tkinter – Processing Events – The Widget Classes – Canvas – The Geometry Managers –Displaying Images – Menus – Popup Menus – Mouse, Key Events, and Bindings –List boxes – Animations – Scrollbars – Standard Dialog Boxes–Grids.

TEXT BOOKS:

1. Mark Lutz, “Learning Python, Powerful OOPs”, O’Reilly, 2011.
2. Guttag, John, “Introduction to Computation and Programming Using Python”, MIT Press, 2013.

REFERENCES:

1. Jennifer Campbell, Paul Gries, Jason montajo, Greg Wilson, “Practical Programming an Introduction to Computer Science Using Python” The Pragmatic Bookshelf, 2009.
2. Wesley J Chun “Core Python Applications Programming”, Prentice Hall, 2012.
3. Jeeva Jose, “Taming Python by Programming”, Khanna Publishing House, 1st edition, 2017.
4. J.Jose, “Introduction to Computing and Problem Solving with Python”, Khanna Publications, 1st edition, 2015.
5. ReemaThareja, “Python Programming”, Pearson, 1st edition, 2017.

COURSE OUTCOMES:

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

1. Understand basic concepts of Conditional and Looping Statements in python programming.
2. Solve large program in a easy way using Modules concepts.
3. Apply the concepts of Object Oriented programming including encapsulation, inheritance and polymorphism as used in Python.
4. Simulate the commonly used operations in file system and able to develop application program to communicate from one end system to another end.
5. Develop menu driven program using GUI interface and to gain knowledge about how to store and retrieve data.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	1	-	-	-	-	-	-	-
CO3	1	2	-	-	1	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	-	-	-	1	-	-	2

DSCP407	**DATABASE TECHNOLOGY LAB**	**L**	**T**	**P**	**C**
		3	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand basic database concepts, including the structure and operation of the relational data model.
- To construct simple and moderately advanced database queries using Structured Query Language (SQL).
- To understand and successfully apply logical database design principles, including E-R diagrams and database normalization.
- To design and implement a small database project.

LIST OF EXERCISES

1. Implementation of queries for student data base.
2. Data Definition Language – with constraint and without constraint.
3. Data Manipulation language – Insert, Delete, Update, Select and truncate.
4. Transaction Control Statement – Commit, Save point, Roll back.
5. Data Control Statement – Grant, Revoke.
6. Data Projection Statement – Multi column, alias name, arithmetic operations, Distinct records, concatenation, where clause.
7. Data Selection Statement – Between, and, not in, like, relational operators and logical operators.
8. Aggregate functions – count, maximum, minimum, sum, average, order by, group by, having.

9. Joint queries – inner join, outer join, self join, Cartesian join, or cross join.
10. Sub queries – in, not in, some, any, all, exist, not exist.
11. Set operations – union, union all, intersect, minus.
12. Database objects – synonym, sequences, views and index.
13. Cursor.
14. Functions and procedures.
15. Trigger.
16. Exceptions.
17. Packages.
18. Factorial of a number.
19. Checking whether a number is prime or not.
20. Fibonacci series.

COURSE OUTCOMES:

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

1. Create a sample database using Structed Query Language (SQL) DDL commands and develop simple and advanced SQL Queries to manipulate the database.
2. Develop PL/SQL Functions, Procedures, Packages to perform database specific operations on a database.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	3	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSCP408	**OPERATING SYSTEMS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand the basic concepts such as techniques, management of operating systems.
- To understand Operating System features and its difference from structured design.
- To use the UNIX as a modeling and communication utilities.
- To utilize the step of the process to produce better software.

LIST OF EXERCISES

1. Job scheduling techniques.
2. Disk scheduling techniques.
3. Memory allocation techniques.
4. Memory management techniques.
5. Page replacement techniques.
6. Producer consumer problem.
7. Bankers' algorithm.
8. Dining Philosophers problem.
9. Write a shell script to perform the file operations using UNIX commands.
10. Write a shell script to perform the operations of basic UNIX utilities.

11. Write a shell script for arrange 'n' numbers using 'awk'.
12. Write a shell script to perform ${}^{n}Cr$ calculation using recursion.
13. Write a shell script to sort numbers and alphabetic from a text file using single 'awk' command.
14. Write a Shell script to display all the files which are accessed in the last 10 days and to list all the files in a directory having size less than 3 blocks, greater than 3 blocks and equal to 3 blocks.
15. Write a Shell script to display the numbers between 1 and 9999 in words.
16. Write a Shell script for Palindrome Checking.

COURSE OUTCOMES:

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

1. Develop C programs for Job scheduling techniques, Disk scheduling techniques, Memory management techniques and for synchronization problems.
2. Develop Shell script to practice Unix commands and utilities.
3. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	3	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSCP409	**DATA SCIENCE LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To learn to implement the concepts of data science through Python programs.
- To load various kinds of data and display them in various formats for better understanding.
- To learn to collect, explore, clean, munge and manipulate data.
- To understand how statistics and probability is used in data science applications.

LIST OF EXERCISES
(The exercises are to be done in Python)

1. Study of Python Data Science Environment (NumPy, SciPy, matplotLib, Pandas, Scikit-learn).
2. Operations on Python Data Structures.
3. Reading data from various sources (Text files, CSV files, Excel files, HTML/XML files, JSON files).
4. Exploring data through simple visualization tools like charts and graphs using matplotlib.
5. Data cleansing operations for handling missing data.

6. Data Wrangling (Filtering, Pivoting dataset, Melting Shifted Datasets, Merging Melted data, Concatenating data, Exporting Data).
7. Data Aggregation (Grouping, Group wise operations and transformations).
8. Data Transformations (Rescaling and Dimensionality Reduction).
9. Measuring Central Tendency, Variability and Correlation.
10. Creating, Plotting and Understanding Probability Distributions.
11. Hypothesis Testing.
12. Creating and Displaying Geographic Maps.
13. Handling Graph Data.
14. Creating and Displaying Heat Maps.
15. Developing a simple spam filter application.

COURSE OUTCOMES:

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

1. Experiment the various data structures and libraries in Python for data science programming.
2. Conduct and present statistical measurements, hypothesis and tests on data.
3. Develop practical applications covering the concepts of Data Science.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	-	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSPC501	**MAP REDUCE PROGRAMMING WITH HADOOP**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**1.5**

COURSE OBJECTIVES:

- To acquire the basics of Hadoopv2 configuration and administration.
- To understand concepts of MapReduce design patterns namely summarization, filtering, data organization, join, output and Meta patterns.
- To develop MapReduce applications.
- To solve real-time problems such as simple analytics, classifications, finding relationships, online marketing recommendations, massive text data processing and searching using MapReduce.

UNIT - I Hadoop v2 Configuration and Administration

Hadoop v2 : Introduction - Setting up Hadoop v2 in local machine - Writing a Word Count Map Reduce application, bundling it, and running it using the Hadoop local mode - Adding a combiner step to the Word Count Map Reduce program - Setting up HDFS - Setting up Hadoop YARN in a distributed cluster environment using Hadoop v2 - Setting up Hadoop ecosystem in a distributed cluster environment using a Hadoop distribution - HDFS command-line file operations - Running the Word Count program in a distributed cluster environment - Using Hadoop YARN on Cloud Environments - Hadoop Configurations, Unit Tests, and Other APIs.

UNIT- II Map Reduce Design Patterns I

Summarization Patterns: Numerical Summarizations - Inverted Index Summarizations - Counting with Counters - Filtering Patterns: Filtering - Bloom Filtering - Top Ten Examples - Data Organization Patterns: Structured to Hierarchical - Partitioning - Binning - Total Order Sorting – Shuffling.

UNIT -III Map Reduce Design Patterns II

Join Patterns : A Refresher on Joins - Reduce Side Join - Replicated Join - Composite Join - Cartesian Product - Metapatterns : Job Chaining - Chain Folding - Job Merging - Input and Output Patterns : Customizing Input and Output in Hadoop - Generating Data - External Source Output - External Source Input - Partition Pruning.

UNIT -IV Developing Complex Map Reduce Applications

Introduction - Hadoop data types - Custom Hadoop Writable data type - Hadoop key type - Emitting data from a Mapper - Hadoop Input Format- Adding support for new input data formats - Formatting the results of Map Reduce computations – Hadoop Output Formats - Writing multiple outputs - Intermediate data partitioning - Secondary sorting – sorting Reduce input values - Using Hadoop with legacy applications – Hadoop streaming - Adding dependencies between Map Reduce jobs - Hadoop counters to report custom metrics.

UNIT -V Analytics and Applications Using Map Reduce

Analytics : Introduction - Simple analytics using Map Reduce - Performing GROUP BY - Calculating frequency distributions and sorting - Plotting the results using gnuplot - Calculating histograms - Calculating Scatter plots - Parsing a complex dataset with Hadoop - Joining two datasets Applications : Content-based recommendations - Classification using the naïve Bayes - Assigning advertisements to keywords - Data preprocessing and De-duplicating data using Hadoop streaming and Python.

TEXT BOOKS:

1. Thilina Gunarathne, “Hadoop Map Reducev2 Cookbook”, Second Edition, Packt Publishing Ltd., 2015.
2. Donald Miner and Adam Shook, “Map Reduce Design Pattern”, O’Reilly Media Inc.,First Edition, 2012.

REFERENCES:

1. Garry Turkington, “Hadoop Beginner's Guide”, Packt Publishing Ltd.,First Edition, 2013.
2. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Media Inc.,Fourth Edition,2015.
3. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop® Solutions”, Wrox, First Edition,2013.
4. SrinathPerera, “Instant Map Reduce Patterns – Hadoop Essentials How-to”, Packt Publishing Ltd., First Edition,2013.
5. Kevin Schmidt and Christopher Phillips, “Programming Elastic Map Reduce”, O’Reilly Media Inc., First Edition, 2013.
6. https://data-flair.training/blogs/hadoop-mapreduce-tutorial/ - “Hadoop Map Reduce Tutorial, A Complete Guide to Map reduce”, Data flair Team · Published on November 23, 2016 · Updated on November 14, 2018.

COURSE OUTCOMES:

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

1. Configure and administer Hadoop v2, Hadoop YARN, and HDFS clusters and deploy clusters to cloud environments.
2. Design Map Reduce patterns such as summarization patterns, filtering patterns, and data organization patterns.
3. Develop Map Reduce patterns such as join patterns, meta patterns, output Patterns.
4. Solve large-scale analytics problems using Map Reduce-based applications.
5. Tackle complex problems such as classifications, finding relationships, online marketing recommendations, massive text data processing and searching using Hadoop Map Reduce.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	1	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	1	-	-	-	-	-	-	-
CO3	1	2	-	-	1	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	-	-	-	1	-	-	2

DSPC502	**DATA VISUALISATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the concepts and significance of data visualization.
- To learn the visualization idioms and map data attributes to graphical attributes.
- To evaluate the effectiveness of visualization designs.
- To comprehend the considerations in information dashboard design.

UNIT - I Introduction

Visualization Definition and Need – Data Abstraction – Data Semantics and Types - Data Types – Dataset Types (DL) – Attribute Types – Semantics – Task Abstraction – Analyze tasks abstractly – Actions– Targets – Analyzing and Deriving.

UNIT - II Analysis

Four levels for Validation – Reasons to Validate – Four levels of Design – Angles of Attack – Threats to Validity – Validation Approaches – Validation Examples – Marks and Channels – Defining Marks and Channels – Using Marks and Channels – Channel Effectiveness – Relative versus Absolute Judgements – Rules of Thumb to be followed – No unjustified 3D - No unjustified 2D – Eyes beat memory – Resolution over Immersion – Overview, Zoom, Filter, Details on demand – Responsiveness is required – Get it Right in Black and White.

UNIT - III Tables and Spatial Data

Arrange by Keys and Values – Express: Quantitative Values – Separate, Order, and Align: Categorical Regions – Matrix Alignment: Two Keys – Volumetric Grid: Three Keys – Recursive Subdivision: Multiple Keys – Spatial Axis Orientation – Spatial Layout Density – Arrange Spatial

data – Geometry – Scalar Fields: One Value – Vector Fields: Multiple Values – Tensor Fields: Many Values.

UNIT - IV Networks, Trees, Map Color

Connection: Link Marks – Matrix Views - Connection versus Matrix – Containment: Hierarchy Marks – Map Color and Other Channels – Color Theory – Color maps – Other Channels – Reduce items and attributes – Reasons to Reduce - Filter – Aggregate – Manipulate View – Reasons for Change - Change View over Time – Select Elements – Navigate: Changing Viewpoint, Reducing Attributes.

UNIT – V Information Dashboard Design

Dashboards – Purpose – Importance – Reasons for Failure – Common Mistakes in Dashboard Design – Assessing what is needed from dashboards – Fundamental considerations in dashboard design – Visual perception and cognition to design dash board – An ideal library of graphs useful on dashboards.

TEXT BOOKS:

1. Tamara Munzner, "Visualization Analysis and Design", CRC Press, 2014.
2. Stephen Few, "Information Dashboard Design: Displaying Data for At-a-glance Monitoring", Analytics Press, Second Edition,2013.

REFERENCES:

1. Ben Fry, "Visualizing Data", O'Reilly, 2008.
2. Andy Kirk, "Data Visualization: A Successful Design Process", PACKT Publishing, 2012.
3. Alexander Telea, "Data Visualization Principles and Practice", CRC Press, Second Edition, 2014.
4. Julia Steele, Noah Ilinsky, "Beautiful Visualization: Looking at Data through the Eyes of Experts", O'Reilly, 2010.
5. Karl Pover, "Leaning Qlik View Data Visualization", PACKT, 2013.
6. Stephen Few, "Show Me the Numbers: Designing Tables and Graphs to Enlighten", Analytics Press, Second Edition, June 2012.

COURSE OUTCOMES:

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

1. Design and create data visualizations.
2. Apply data transformations such as aggregation and filtering for visualization.
3. Evaluate choice of colour and visual encoding suitable for visualization.
4. Build visual presentations of wide variety of data for effective communication.
5. Use knowledge of perception and cognition to design information dashboards.

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	1	-	-	-	-	-	-	-
CO3	2	2	-	-	1	-	-	-	-	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-
CO5	1	2	3	1	-	-	-	-	-	-	-	-

DSPC503	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of machine learning and its applications
- To learn the classification, clustering and regression based machine learning algorithms
- To understand the deep learning architectures
- To understand the methods of solving real life problems using the machine learning techniques

UNIT – I Bayesian Decision Theory and Normal Distribution

Machine perception - feature extraction - classification, clustering, linear and logistic regression. Types of learning. Bayesian decision theory - classifiers, discriminant functions, and decision surfaces - univariate and multivariate normal densities - Bayesian belief networks.

UNIT – II Classification Algorithms

Perceptron and back propagation neural network - k-nearest-neighbor rule. Support vector machine: multi category generalizations - Regression. Decision trees: classification and regression tree - random forest.

UNIT – III Component analysis and Clustering Algorithms

Principal component analysis - Linear discriminant analysis - Independent component analysis. K-means clustering - fuzzy k-means clustering - Expectation-maximization algorithm-Gaussian mixture models – auto associative neural network.

UNIT – IV Deep Learning Architectures and Applications

Convolution neural network (CNN) - Layers in CNN - CNN architectures. Recurrent Neural Network. Applications: Speech-to-text conversion-image classification-time series prediction.

UNIT -V Combining Multiple Learners

Generating diverse learners - model combination schemes - voting - error-correcting output codes - bagging - boosting - mixture of experts revisited - stacked generalization - fine-tuning an ensemble – cascading.

TEXT BOOKS:

1. Francois Chollet, “Deep Learning with Python”, Manning Publications, Shelter Island, New York, 2018.
2. R. O. Duda, E. Hart, and D.G. Stork, “Pattern classification”, John Wiley & Sons,Second edition, Singapore, 2012.

REFERENCES:

1. EthemAlpaydin, “Introduction to Machine Learning”,, Third Edition, MIT Press, 2014.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. Navin Kumar Manaswi, “Deep Learning with Applications using Python”, Apress, New York, 2018.

COURSE OUTCOMES:

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

1. Understand the basic concepts of Bayesian theory and normal densities.
2. Implement different classification algorithms used in machine learning.
3. Implement clustering and component analysis techniques.
4. Design and implement deep learning architectures for solving real life problems.
5. Combine the evidence from two or more models/methods for designing a system.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	2	3	3	2	1	-	-	-	-	-	-	-
CO5	2	3	3	2	1	-	-	-	-	-	-	-

DSPC504	**COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

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

UNIT-I 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.

UNIT-II 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.

UNIT-III Network Layer

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

UNIT-IV Transport Layer and Application 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.
Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

UNIT-V Services Mechanism
Attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).Finite Fields And Number Theory: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

TEXT BOOKS:

1. William Stallings, "Data and Computer Communication", Pearson Prentice HallIndia,10th Edition, 2013.
2. William Stallings, "Cryptography and Network Security", Principles and Practice,5th Edition, PHI, 2006.

REFERENCES:

1. Behrouz A. Forouzan , "Data Communication and Networking", McGraw- Hill,4th Edition.
2. Andrew S. Tanenbaum, "Computer Networks", Pearson New International Edition, 8th Edition.
3. M. Dave, "Computer Networks", Cengage Learning India, 1st edition, 2012.
4. Keshav, "An Engineering Approach to Computer Networking", Pearson,1stedition,2014.
5. Keshav, "An Integrated Approach to Computer Networks", Khanna Publications,1st edition,2015.
6. Viswanathan, "Telecommunication Switching System and Networks", PHI, 2ndedition.

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

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 components available in the market.
4. For a given problem related to TCP/IP protocol develop 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.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	1	3	2	-	-	-	-	-	-	-	-
CO4	3	1	3	2	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-

DSCP507	MAP REDUCE PROGRAMMING WITH HADOOP LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To learn how to setup standalone Hadoopv2 on a local machine, Hadoop YARN and Hadoop ecosystem in a distributed cluster environment and HDFS.
- To gather knowledge to executeHadoopMapReducev2 computations on standalone Hadoopv2 on a local machine and distributed cluster environment.
- To understand how to runHadoopMapReducev2 computations using Amazon Elastic Map Reduce cloud environment.
- To perform simple analytics, accomplish mass text data processing and develop applications such as classifications, recommendations and finding relationships.

LIST OF EXERCISES

1. Study on setting up standalone Hadoopv2 on a local machine and Hadoop YARN in a distributed cluster environment.
2. Write a Map Reduce application to count the number of occurrences of words in a dataset and run it using the Hadoop local mode.
3. Write a Map Reduce application to count the number of occurrences of words in a dataset and run it in the Hadoop distributed cluster environment.
4. Execute Word Count Map Reduce application (count the number of occurrences of words in a dataset) on Amazon Elastic Map Reduce (EMR).
5. Write a Map Reduce application to calculate simple aggregate metrics about the weblog dataset.
6. Write a Map Reduce application to group web server log data and calculate histogram and other analytics.
7. Write a Map Reduce application to calculate frequency distributions; the number of hits received by each URL.
8. Write a Map Reduce application to calculate the correlation between two datasets using scatter plots.
9. Write a Map Reduce application to parse the Tomcat e-mail list dataset that has complex data format using Hadoop by writing an input formatter.
10. Write a Map Reduce application to join two MBOX-formatted e-mail datasets.
11. Write a Map Reduce application to perform content-based recommendations for the Amazon product co-purchasing network metadata dataset.
12. Write a Map Reduce application to assign advertisements to keywords using the AdWords balance algorithm for the Amazon product co-purchasing network metadata dataset.
13. Write a Map Reduce application to clean and extract data from the 20news dataset and store the data as a tab-separated file and remove duplicate mail records using Python.

COURSE OUTCOMES:

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

1. Install standalone Hadoop v2 on a local machine and Hadoop YARN in a distributed cluster environment.
2. Execute Map Reduce applications on Amazon Elastic Map Reduce.
3. Formulate new solutions for programming problems or improve existing code using learned Map Reduce techniques.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	-	-	-	-	-	-	-	-	-
CO2	1	2	2	2	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSCP508	**DATA VISUALISATION LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To learn the interface in Tableau / MS-Excel for creating visualisations.
- To understand the methods for drawing charts and graphs.
- To learn the use of maps and tables in creating visualisation.
- To prepare dashboard design for data analytics applications.

LIST OF EXERCISES
(The exercises are to be done in Tableau / MS-Excel)

1. Study of interface, screen and visual cues in Tableau / MS-Excel
2. Connecting with various data sources
3. Working with measures and dimensions
4. Working with Colours
5. Working with Expressions, Functions, Date, Time
6. Drawing Charts and Graphs
7. Creating Maps
8. Working with Table Calculations
9. Sorting Data
10. Applying Filters
11. Dashboard design

COURSE OUTCOMES:

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

1. Discover the various elements in the interface to load and analyze data.
2. Design filters for data visualization.
3. Develop dashboard design for typical data analytics applications.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	-	-	-	-	-	-	-	-	-
CO2	1	2	2	2	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	2	-	2

DSCP509	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To understand the Gaussian densities and its implementation using Python
- To implement classification, clustering and regression algorithms in Python.
- To implement the convolution neural network architecture using Python
- To solve the challenging research problems in the area of Speech and Image processing

LIST OF EXERCISES

1. Linear and logistic regression with error estimation
2. Implementation of univariate and multivariate Gaussian densities
3. Dimensionality reduction using principal component analysis (PCA)
4. Clustering using
   a) k-means
   b) Gaussian mixture modeling (GMM)
5. Classification using
   a) Back propagation neural network (BPNN)
   b) Support vector machine (SVM)
6. Construction of decision tree and random forest
7. Implementation of convolution neural network (CNN)
8. Sequence prediction using recurrent neural network (RNN)
9. Isolated-word speech recognition
10. Face detection and tracking
11. Object recognition

COURSE OUTCOMES:

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

1. Understand the basic concepts of machine learning.
2. Design and implement the classification, clustering and regression algorithms using Python.
3. Design and implement methods for solving real life problems using a suitable machine learning technique.

Mapping of Course Outcomes with Programme Outcomes												
	PO 1	**P O2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**
CO1	2	2	3	2	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	2	-	1	-	-	-	-	-	2	-	2

DSPC601	DATA ANALYSIS WITH R	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Gain a thorough understanding of statistical reasoning and sampling theory and Employ hypothesis testing to draw inferences from your data.
- Learn Bayesian methods for estimating parameters and Train regression, classification, and time series models.
- Handle missing data gracefully using multiple imputation; Identify and manage problematic data points.
- Learn how to scale your analyses to larger data with Rcpp, data. table, dplyr, and parallelization.

UNIT – I Introduction to Data and its Relationship

Basics: Navigating the basics - Getting help in R – Vectors – Functions – Matrices - Loading data into R - Working with packages. The Shape of Data: Univariate data - Frequency distributions - Central tendency – Spread. - Populations, samples, and estimation - Probability distributions - Visualization methods. Describing Relationships: Multivariate data - Relationships between a categorical and continuous variable - Relationships between two categorical variables - The relationship between two continuous variables - Visualization methods.

UNIT - II Probability and Hypothesis Testing

Basic probability – Sampling from distributions – The normal distribution. Using Data to Reason: Estimating means - The sampling distribution - Interval estimation - Smaller samples. Testing Hypotheses: The null hypothesis significance testing framework - Testing the mean of one sample - Testing two means - Testing more than two means - Testing independence of proportions.

UNIT – III Bayesian Methods and Bootstrap:

Bayesian Methods: The big idea behind Bayesian analysis - Choosing a prior - Who cares about coin flips - Enter MCMC – stage left - Using JAGS and run jags - Fitting distributions the Bayesian way - The Bayesian independent samples t-test. The Bootstrap: Performing the bootstrap in R - Confidence intervals - A one-sample test of means - Bootstrapping statistics other than the mean - Busting bootstrap myths.

UNIT - IV Predictive Analysis

Predicting Continuous Variables: Linear models - Simple linear regression - Simple linear regression with a binary predictor - Multiple regression - Regression with a non-binary predictor - Kitchen sink regression - The bias-variance trade-off - Linear regression diagnostics. Predicting Changes with Time: Creating and plotting time series – Components of time series – Time series decomposition – White noise – Autocorrelation - Smoothing – ETS and the state space model – Interventions for improvement. Predicting Categorical Variables: k-Nearest neighbors - Logistic regression - Decision trees - Random forests - Choosing a classifier.

UNIT - V Implementation of Data Analysis

Sources of Data: Relational databases – Using JSON – XML – Other data formats – Online repositories. Dealing with Missing Data: Analysis with missing data – Visualizing missing data – Types of missing data – Unsophisticated methods for dealing with missing data. Dealing with Messy Data: Checking unsanitized data - Regular expressions - Other tools for messy data. Dealing with Large Data: Wait to optimize - Using a bigger and faster machine - Be smart about

the code - Using optimized packages - Using another R implementation - Using parallelization - Using Rcpp. Working with Popular R Packages: The data. Table package - Using dplyr and tidyr to manipulate data - Functional programming as a main tidy verse principle - Reshaping data with tidyr. Reproducibility and Best Practices: R scripting - R projects - Version control - Communicating results.

TEXT BOOKS:

1. Tony Fischetti, "Data Analysis with R", O'Reilly Packt Publisher, Second Edition, 2018.

REFERENCES:

1. Richard Cotton, "Learning R: A Step-by-Step Function Guide to Data Analysis", O'Reilly Media, First Edition, 2013.
2. Dr. Bharti Motwani, "Data Analytics with R", Willey, First Edition, 2019.
3. Joseph Schmuller, "Statistical Analysis with R for Dummies", Dummies First Edition, 2017.
4. Hadley Wickham, "R for Data Science", O'Reilly, First Edition, 2016.

COURSE OUTCOMES:

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

1. Get the knowledge about the data and its relationship by applying various statistical methods.
2. Acquire the knowledge on probability and different testing hypothesis testing methods.
3. Analyze different Bayesian methods to test the sample taken independently.
4. Apply the predictive analysis by various regression statistical methods.
5. Apply various statistical methods for analysis of the real world data using R language.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	2	-	-	-	-	-	-	2
CO3	1	-	1	-	2	-	-	-	-	-	-	-
CO4	3	2	2	2	-	1	-	-	-	-	-	-
CO5	2	2	1	2	1	-	-	-	-	-	-	1

DSPC602	**CLOUD COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To know the fundamentals of cloud computing.
- To acquire the knowledge of cloud computing technologies and architecture.
- To be familiar with cloud services and applications of cloud computing.
- To understand the role of Networks in Cloud Computing

UNIT - I Introduction

Layers of Cloud Computing - Types - Cloud Computing Versus Cloud services - Cloud

Computing Features - Platforms - Challenges - Cloud Computing Security - Model Application Methodology - Cloud-Based High Performance Computing Clusters - Virtual Private Clouds - Data Centers - Applications.

UNIT - II The Role of Networks in Cloud Computing

Cloud Deployment Models and Network - Network Architectures for Clouds - Requirements and Architecture for Hybrid Cloud Networking - Data-Intensive Technologies for Cloud Computing - Characteristics of Data-Intensive Computing Systems - Data-Intensive System Architecture - Distributed Agent Based Scheduling Platform Inside Clouds -Basics of Grid and Cloud Computing - Layered Models and Usage patterns in Grid and Cloud.

UNIT - III Enterprise Architecture

Enterprise Knowledge Management - Enterprise Knowledge Architecture - Enterprise Computing Clouds - Enterprise Knowledge Clouds - Enterprise Knowledge Cloud Technologies - The VCL Cloud Architecture - Integrating High-Performance Computing into the VCL Cloud Architecture - Overview of SwinDeW-G Environment - SwinDeW-C System Architecture - Architecture of SwinDeW-C Peers.

UNIT - IV Cloud Services and Cloud Roles

Infrastructure as a Service - Platform as a Service - Software as a Service - Grids and Clouds - Application Scalability - Automating Scalability - General Cloud Architectures for Scaling - Delivering Scientific Computing services in the Cloud - A Dynamic Collaborative Cloud Services Platform.

UNIT - V Amazon Web Services

Google App Engine - Microsoft Azure - Scientific Applications - Business and Consumer Applications - Case Study: Cloud as Infrastructure for an Internet Data Center - Cloud Computing for Software Parks - Cloud Computing Supporting SaaS.

TEXT BOOKS:

1. L BorkoFurht and Armando J. Escalante, “Handbook of Cloud Computing”, Springer, 2010.
2. Dr. RajkumarBuyya, Dr. Christian Vecchiola and Dr. S ThamaraiSelvi, “Mastering Cloud Computing”, Tata McGraw Hill, 1st Edition, 2013.

REFERENCES:

1. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate”, Que Publishing, 1st Edition, 2008.
2. D Anthony T Velte, Toby J Velte and Robert Elsenpeter, “Cloud Computing : A Practical Approach”, Tata McGraw-Hill, 1st Edition, 2010.
3. John Rittinghouse& James Ransome, “Cloud Computing, Implementation, Management and Strategy”, CRC Press, 1st Edition, 2010.

COURSE OUTCOMES:

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

1. Explain the fundamentals and technologies of cloud computing.
2. Describe the role of networks in cloud computing.
3. Address different cloud architectures and cloud services.
4. Explore various applications by integrating the cloud services.
5. Fundamentals of Web services.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	-	-	-	-	-	-		-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	1	-	-	-	-	-	-	-

DSCP607	**DATA ANALYSIS WITH R LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- Gain a thorough understanding of statistical reasoning and sampling theory and Employ hypothesis testing to draw inferences from your data.
- Learn Bayesian methods for estimating parameters, and Train regression, classification, and time series models.
- Handle missing data gracefully using multiple imputation; Identify and manage problematic data points.
- Learn how to scale your analyses to larger data with Rcpp, data.table, dplyr, and parallelization

LIST OF EXERCISES

1. Write a function that takes two matrices as arguments and returns a logical value representing whether the matrices can be matrix multiplied.
2. Find a free dataset on the web, download it, and load it into R. Explore the structure of the dataset.
3. Write an R function to compute the inter quartile range.
4. For each species of iris, find the correlation coefficient between the sepal length and width. Are there any differences? How did we just combine two different types of the broad categories of bivariate analyses to perform a complex multivariate analysis?
5. Download a dataset from the web, or find another built-into-R dataset that suits your fancy (using library (help = "datasets")). Explore relationships between the variables.
6. Write a function that takes a vector and returns the 95 percent confidence interval for that vector. You can return the interval as a vector of length two: the lower bound and the upper bound. Then, parameterize the confidence coefficient by letting the user of your function choose their own confidence level, but keep 95 percent as the default. Hint:the first line will look like this: conf.int <- function(data.vector, conf.coeff=.95) {.
7. Read about data-dredging and p-hacking and formulate a hypothesis, set an alpha level, and set a sample size before collecting data and analyzing results?
8. Use the library(help="datasets") command to find a list of datasets that R has already inbuilt. Pick a few interesting ones and form a hypothesis about each one. Rigorously define your null and alternative hypotheses before you start. Test those hypotheses even if it means learning about other statistical tests.

9. Write a function that will take a vector holding MCMC samples for a parameter and plot a density curve depicting the posterior distribution and the 95% credible interval. Be careful of different scales on the y-axis.
10. Examine the various distributions on chosen data sets.
11. Examine and plot the pressure dataset, which describes the relationship between the vapour pressure of mercury and temperature. What assumption of linear regression does?
12. Write a function called dt_table similar to the table function in base R. The arguments will be a data.table, and a string specifying a column name. Do the same thing for tibbles and call it dp_table.

COURSE OUTCOMES:

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

1. The power and domain-specificity of R allows the user to express complex analytics easily, quickly, and succinctly.
2. Solve the difficulties relating to performing data analysis in practice and find solutions to working with messy data, large data, communicating results, and facilitating reproducibility.
3. Starting with the basics of R and statistical reasoning, into an advanced predictive analytics.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	2	-	2

DSCP608	**CLOUD COMPUTING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To learn how to create a warehouse application in cloud environment.
- To learn Apex Programming language for creating cloud applications.
- To study and implement SOAP web services and para - virtualization.
- To create, install, configure and manage Hadoop services.

LIST OF EXERCISES

1. Introduction to cloud computing.
2. Creating a Warehouse Application in SalesForce.com.
3. Creating an Application in SalesForce.com using Apex programming Language.
4. Implementation of SOAP Web services in C#/JAVA Applications.
5. Implementation of Para-Virtualization using VM Ware‘s Workstation/ Oracle‘s Virtual Box and Guest O.S.
6. Installation and Configuration of Hadoop.
7. Create an application (Ex: Word Count) using Hadoop Map/Reduce.
8. Case Study: PAAS(Facebook, Google App Engine)
9. Case Study: Amazon Web Services.

COURSE OUTCOMES:

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

1. Design and create warehouse application.
2. Have practical knowledge on SOAP and para virtualisation.
3. Use Paas services Facebook, Google App Engine and AWS.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	1	1	3	1	-	-	-	-	-	-	-	-
CO3	2	2	-	1	-	-	-	-	-	2	-	2

ETHS701	**ETHICS IN DATA ANALYTICS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To understand engineering ethics, moral and legal issues.
- To use data science to reduce risk for peace and prosperity.
- To understand the moral and ethical dimensions in data analysis.
- To discuss how data is appropriately used and how to address misuse.

UNIT – I Introduction

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT – II Ethics Experiments & Examples

Engineers as responsible – Experimenters – Research Ethics – Codes of Ethics – Industrial Standards. A well Balanced Outlook on Law – The Challenger Case Study. Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

UNIT – III Loyalty and Intellectual Property

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination. Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

UNIT – IV Good Data Science

Ethics and Data Science – Doing Good data Science - Five Cs – Consent, Clarity, Consistency and trust, Control and transparency, Consequences – Implementing Five C's.

UNIT – V Future with Data Science Ethics

Ethics and Security Training - Developing Guiding Principles - Building Ethics into a Data-Driven Culture - Regulation - Building Our Future - Case studies.

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.
2. DJ Patil, Hilary Mason, Mike Loukides, "Ethics and Data Science", O'Reilly Media, Inc., July 2018. ISBN: 9781492043898

REFERENCES:

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
2. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.
6. Viktor Mayer-Schönberger, Kenneth Cukier, "Big Data: A Revolution That Will Transform How We Live, Work, and Think", Houghton Mifflin Harcourt, 2013
7. Bruce Schneier, "Data and Goliath: The Hidden Battles to Collect Your Data and Control Your World", W.W. Norton, Feb-2016.
8. Marc Goodman, "Future Crimes: Everything Is Connected, Everyone Is Vulnerable and What We Can Do About It", Penguin Random House, 2016

COURSE OUTCOMES:

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

1. Understand data, legal and ethical and technological aspects
2. Understand the Risk analysis in Ethics.
3. Understand the relationship between the data and fair practices.
4. Learn the importance of decisions for public good.
5. Achieve data driven culture.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	2	-	-	-	-	-	-	2
CO3	1	-	1	-	2	-	-	-	-	-	-	-
CO4	3	2	2	2	-	1	-	-	-	-	-	-
CO5	2	2	1	2	1	-	-	-	-	-	-	1

DSPC702	INTERNET OF THINGS	L	T	P	C
		3	0	3	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of Internet of Things.
- To introduce network and communication protocols of IoT.
- To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To apply the concept of Internet of Things in the real world scenario

UNIT –I Introduction to IoT

Defining IoT –Characteristics of IoT- Physical design of IoT-Logical design of IoT-Functional blocks of IoT- Communication models & APIs, Machine to Machine-Difference between IoT and M2M-SoftwaredefinedNetwork (SDN).

UNIT – II Network, Challenges and applications of IoT

Network and communication aspects: Wireless medium access issues-MAC protocol survey, Survey routing protocols-Sensor deployment & Node discovery-Data aggregation& dissemination-Design challenges- Development challenges-Security challenges- Other challenges- Applications of IoT- Home automation, Industry applications, Surveillance applications- Other IoT applications

UNIT –III Microcontrollers

Architecture of 8031/ 8051- Introduction to 16 bit Microcontroller- Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation.

UNIT – IV Raspberry PI with Python and Arduino

Introduction to Python-Building IoT with RASPERRY Pi- IoT Systems-IoT Physical Devices & Endpoints-IoT Device – Building blocks-Raspberry Pi-Board-Linuxon RaspberryPi-RaspberryPiInterfaces-ProgrammingRaspberryPiwithPython-Other IoT Platforms– Arduino.

UNIT –V Development of IoTs

Developingsensorbasedapplicationthroughembeddedsystemplatform,-Industrialautomation,smartgrid,Commercialbuildingautomation,Smartcities-participatorysensing-DataAnalyticsforIoT

TEXTBOOKS:

1. Vijay Madisetti, ArshdeepBahga,"InternetofThings:A Hands-On Approach", Orient Blackswan Pvt., Ltd., NewDelhi,2015.
2. WaltenegusDargie,ChristianPoellabauer,"FundamentalsofWirelessSensorNetworks:Theorya ndPractice",AJohnWileyandSons,Ltd.,Publication,2010.

REFERENCES:

1. JeevaJose, "InternetofThings",(ISBN:978-93-86173-591) KBPHouse, 1st edition, 2018.
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017.
3. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media, 2011.

COURSE OUTCOMES:

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

1. Understand the concepts of Internet of Things.
2. Analyze basic protocols in wireless sensor network.
3. Design IoT applications in different domain and be able to analyze their performance.
4. Implement basic IoT applications on embedded platform.
5. Explore IoT using Rasperry Pi and Arduino.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	-	3	2	3	-	-	-	-	-	-	1
CO4	1	-	3	1	3	-	-	-	-	-	-	-
CO5	1	-	3	1	3	-	-	-	-	-	-	-

DSCP706	**INTERNET OF THINGS (IoT) LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand the working principle of Embedded System.
- To make use of various sensors in IoT.
- To know how to use various tools in IoT for designing applications.
- To develop simple IoT applications

LIST OF EXERCISES

1. Alphanumeric LCD interface using 8051.
2. Study of ARM evaluation system.
3. Flashing of LEDs using ARM (LPC2148).
4. Interfacing keyboard and LCD using ARM (LPC2148).
5. Temperature sensor interface using ARM (LPC2148).
6. Identifying Moisture content in Agricultural Land.
7. Fire Alarm Indicator.
8. Basic Home Automation.
9. How to Control PWM Signals.
10. Designing a Calculator using NumPi.
11. Designing Game using PyGame.
12. Designing frontend GUI using TKinter.
13. Identification of Earthquake.
14. Implementation of sorting mechanism.
15. Accessing GPIO using Google Assistance.
16. Uploading data to cloud and monitoring in cloud.

17. Connecting social media (twitter).

COURSE OUTCOMES:

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

1. Comprehend the basic elements of Microcontroller Programming.
2. Use Raspberry Pi3 in Peripheral and in Trouble shooting.
3. Evaluate networking technologies for application within IoT.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	2	-	2	-	-	-	-	-	-	-
CO2	-	3	3	1	3	1	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	-	2	-	2

ETIT707	**SEMINAR/INDUSTRIAL TRAINING**	**L**	**TR**	**S**	**C**
		0	1	2	4

Note: * - Four weeks during the summer vacation at the end of sixth semester

COURSE OBJECTIVES:

- To work/train on a technical topic/field work related to Data Science to acquire the ability of written/oral presentation and to have a practical knowledge in carrying out the Data Science related problems.
- To acquire the ability of writing technical papers for Conferences.
- To train and develop skills in solving problems during execution of the problems related to Data Science.
- To make the students to get hands on working experience in reputed concerns.

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than 15 minutes and not more than 30 minutes on any technical topic of student's choice related to Data Science and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation also should be submitted. Evaluation will be done by the student counsellor based on the technical presentation, the report and also on the interaction shown during the seminar.

The students will individually undertake a training program in reputed concerns in the field of Data Science during summer vacation (at the end of sixth semester) for a minimum stipulated period of four weeks. At the end of training the student has to submit the detailed report on the training undertaken within ten days from the commencement of the seventh semester. The student will be evaluated by a team of staff members nominated by the Head of the Department through a viva-voce examination.

COURSE OUTCOMES:

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

1. Face the audience and to interact during group discussion in the corporate interviews confidently.
2. Acquire the ability to work in the actual environment and to use the technical resources.

3. Apply prior acquired knowledge in problem solving and to demonstrate the use, interpretation and application of an appropriate international Data Science standard in a specific situation.
4. Analyze a given Data Science problem and to identify and implement appropriate problem solving methodology to propose a meaningful solution.
5. Present the solution acquired in the form of written and oral presentation.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	1	2	2	-	-	-	-	-	-	-	-	3
CO3	1	-	2	1	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	2	-	2	1
CO5	1	-	-	-	2	-	-	-	-	3	-	-

DSPV803	**PROJECT WORK AND VIVA VOCE**	**L**	**PR**	**S**	**C**
		0	**10**	**2**	**6**

COURSE OBJECTIVES :

- To develop the ability to identify a problem.
- To perform a literature review.
- To implement the problem and to analyze the results.
- To train the students in preparing project reports and to face reviews and viva voce examination.

Course outcomes:

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

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Carry out any experiment based on Computer software and Hardware available.
3. Present the conclusions with understandability using appropriate tables and graph in the form of report.
4. Analyze any short coming while implementing a technical problem and to handle the same.
5. Implement any research problem in current thrust area using the gained practice knowledge.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	3	-	-	-	-	-	-	3	-	3	-
CO2	1	2	-	-	-	-	-	-	3	-	3	3
CO3	1	-	2	-	-	-	-	-	3	-	3	-
CO4	1	-	2	2	2	-	-	-	3	-	3	-
CO5	1	-	-	-	-	-	-	-	3	3	3	3

PE – PROFESSIONAL ELECTIVES

DSPESCN	DISTRIBUTED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Distributed System.
- To introduce the concepts of peer to peer systems and distributed system models.
- To understand the components and support required for distributed system.
- To understand the process management and resource management in distributed systems.

UNIT - I Introduction

Examples of Distributed System – Trends in Distributed System – Focus on resource sharing – Challenges – Case study: World Wide Web – System Model – Physical models – Architectural models – Fundamental models.

UNIT - II System Model

Inter process Communication – the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction – Request – reply protocols - Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish – subscribe systems – Message queues – Shared memory approaches – Distributed objects – Case study: Enterprise Java Beans – from objects to components.

UNIT - III Peer to peer Systems

Introduction – Napster and its legacy – Peer to peer – Middleware –Routing overlays. Overlay case studies: Pastry, Tapestry – Distributed File Systems – Introduction – File service architecture – Andrew File system. File System: Features - File model – File accessing models – File sharing semantics naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

UNIT - IV Clocks, events and process states

Synchronizing physical clocks – Logical time and logical clocks – Global states – Coordination and Agreement – Introduction – Distributed mutual exclusion – Elections Transactions and Concurrency Control – Transactions – Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit protocols - Distributed deadlocks – Replication – Case study – Coda.

UNIT – V Process Management

Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction – Features of Scheduling Algorithms – Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

TEXT BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Pearson Education, 5th Edition, 2012.
2. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.

REFERENCES:

1. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
2. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
3. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

COURSE OUTCOMES:

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

1. Acquire knowledge on foundations of Distributed System.
2. Familiarize the idea of peer to peer services and file system.
3. Familiarize the components and support required for distributed system.
4. Acquire Knowledge on remote method invocation and objects.
5. Gain experienced skills on design process and resource management systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	2	-	-	1	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-

DSPESCN	DATA ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The objective of this course is to introduce data engineering and role of data engineers.
- Familiarize students with the basic and advanced techniques of data engineering, data modeling and data acquisition.
- To learn key techniques of the data modeling framework and Big data tools.
- To learn categories of API and data science projects using API.

UNIT - I Introduction

Data Scientist vs Data Engineer vs Data Analyst – Definition of Data Engineering? – Explaining the Data Pipeline, Data Warehouse and Data Engineer Role – Explaining Data Engineering and Data Warehouse- Building Data Warehouse: Understanding the Data Pipeline – Beyond Data Warehousing: Big Data Engineering – The Role of Data Engineer –The Hierarchy of Analytics – Building Data Foundations & Warehouses – ETL: Extract, Transform, and Load – Choosing ETL Frameworks – Two Paradigms: SQL vs. JVM – Centric ETL.

UNIT - II Data Acquisition and Data Modelling

Data Acquisition – Data Gathering and Preparation – Data Cleaning – Storage – Data Modeling, Normalization and Star Schema – Data Partitioning by Datestamp– Backfilling Historical Data – Defining the Directed Acyclic Graph (DAG) – Operators: Sensors, Operators and Transfers – ETL Best Practices to follow.

UNIT - III Data Engineering Frameworks and Big Data Tools

A Common Scenario – From Pipelines To Frameworks – Design Patterns For Data Engineering Frameworks – Incremental Computation Framework – Backfill Framework – Global Metrics Framework – Experimentation Reporting Framework – Data Warehousing / Big Data Tools – Hadoop and MapReduce– Hive and PIG– Apache Spark

UNIT - IV Categories of API

Overview – Categories of API – Difference between an API and a Library – Walk through an example – 5 APIs – Facebook API – Google Map API – Twitter API – IBM Watson API – Quandl API

UNIT - V Data science projects using API

Data science projects using API – Social Media Sentiment Analysis – Introduction to Sentiment Analysis – Sentiment Analysis Use Cases – Sentiment Classification – Challenges of Sentiment Analysis– Opinion Mining – Applications – Challenges – Stock Prediction

TEXT BOOK:

1. Laura La Bella, "Becoming a Data Engineer"The Rosen Publishing Group, Inc, 2017.
2. Brian Shive, "Data Engineering: A Novel Approach to Data Design", Technics Publications, October 2013, ISBN: 9781935504603

REFERENCES:

1. Robert Chang, "A Beginner's Guide to Data engineering — Part I, Data Engineering: The Close Cousin of Data Science".
2. Robert Chang, "A Beginner's Guide to Data Engineering — Part II,Data Modeling, Data Partitioning, Airflow, and ETL Best Practices".
3. "A Beginner's Guide to Data Engineering — The Series Finale, From ETL Pipelines to Data Engineering Frameworks".
4. https://www.altexsoft.com/blog/datascience/what-is-data-engineering-explaining-data-pipeline-data-warehouse-and-data-engineer-role/
5. https://www.analyticsvidhya.com/blog/2016/11/an-introduction-to-apis-application-programming-interfaces-5-apis-a-data-scientist-must-know/
6. https://data-flair.training/blogs/data-scientist-vs-data-engineer-vs-data-analyst/
7. https://blog.algorithmia.com/introduction-sentiment-analysis

COURSE OUTCOMES:

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

1. Acquire Knowledge on principles of data engineering
2. Study the data engineering design process to acquire data and develop data modeling methods for their evaluation
3. Explain data engineering frameworks and Big data tools
4. Understand the Categories of API
5. Learn and Understand data science projects using API

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	2	-	1	-	-	-	-	-	-	-	-
CO5	1	2	1	-	-	-	1	-	-	1	-	2

DSPESCN	**SCALA PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To get a solid understanding of the fundamentals of the language, the tooling, and the development process
- To understand the principles of functional programming
- To write purely functional programs using recursion, pattern matching, and higher-order functions
- To Combine functional programming with objects and classes

UNIT - I Basics of Scala

Introduction to Scala - Evolution of Scala - Features - The Scala Interpreter - Keywords, Identifiers, Comments, Data types, Variables, Constants, Control Statements, Decision making and Looping Statements - Working with Arrays, Functions - Normal and Higher Order functions, Currying - Procedures, Lazy values, Exceptions, Maps and Tuples.

UNIT – II OOP concepts

Classes - Simple classes and Parameterless Methods, Properties with Getters and Setters, Properties with only Getters, Object - Private Fields, Bean properties, Auxiliary Constructors, The Primary Constructor, Nested Classes. Objects - Singletons, Companion objects, Objects extending a class or Trait, The apply method, Application objects, Enumerations.

UNIT – III Packages and Imports

Packages - Scope Rules, Chained Package Clauses, Top-of-file Notation, Package objects, Visibility. Imports – Implicit Imports, Renaming and Hiding members.

Inheritance - Extending a class, Overriding methods, Type checks and casts, protected fields and methods, super class construction, overriding fields, Anonymous subclasses, abstract classes and fields, Construction order, inheritance hierarchy, object equality, Value classes.

UNIT – IV: Files and Input - Output

Reading characters lines, tokens and numbers - Reading binary and text files - Traits and Type Conversions - Using Collections, Working with Lists-Pattern matching.

UNIT – V: Using Scala

Extractors – Annotations – Concurrent programming – Combining Scala and Java – GUI programming.

TEXT BOOKS:

1. Martin Odersky, "Lex Spoon and Bill Venners, Programming in Scala", Artima Press, Third Edition, 2016.
2. Cay S. Horstmann, "Scala for the Impatient", Addison Wesley, Second Edition, 2017.

REFERENCES:

1. VenkatSubramaniam, "Programming Scala", The Pragmatic Bookshelf, First Edition, 2009.
2. Dean Wampler and Alex Payne,"Programming Scala", O'Reilly, First Edition, 2009.
3. Alvin Alexander, Learning Functional Programming in Scala, O'Reilly, First Edition, 2017.
4. Alvin Alexander ,"Scala Cookbook", O'Reilly,First Edition, 2013.
5. Bhim P Upadhyaya, "Programming with Scala, Language Exploration", Springer, First Edition, 2017.

COURSE OUTCOMES:

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

1. Master the basics of programming language Scala.
2. Understand the OOP concepts of Scala.
3. Obtain knowledge on Packages imported in Scala.
4. Study operations in files.
5. Perform Concurrent and GUI programming with Scala.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	-	-	-	-	-	-	-	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	1	1	-	-	-	1	-	-	1	-	2

DSPESCN	**NoSQL DATABASES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn various NoSQL systems and their features.
- To compare NoSQL databases with each other in relational systems.
- To understand the impact of the cluster on database design.
- To know how to define objects, load data, query data and performance tune Graph NoSQL databases.

UNIT - I Introduction to NoSQL

Overview and History of NoSQL Databases - Definition of the Four Types of NoSQL Database - The Value of Relational Databases - Getting at Persistent Data – Concurrency – Integration - Impedance Mismatch - Application and Integration Databases - Attack of the Clusters - The

Emergence of NoSQL - Comparison of relational databases to new NoSQL stores – MongoDB – Cassandra – HBASE - Neo4j.

UNIT – II Data Models

RDBMS approach - Challenges NoSQL approach - Key-Value and Document Data Models– Column Family Stores - Aggregate-Oriented Databases -Replication and sharding -MapReduce on databases - Distribution Models - Single Server –Sharding - Master-Slave Replication - Peer-to-Peer Replication - Combining Sharding and Replication.

UNIT - III Document Database

NoSQL Document databases using MongoDB -Introduction to Document Databases - Features Consistency - Transactions, Availability - Query Features – Scaling - Document Databases Terminology - Event Logging - Content Management Systems - Blogging Platforms - Web Analytics or Real-Time Analytics - E-Commerce Applications - Designing for Document Databases - Complex Transactions Spanning Different Operations - Queries against Varying Aggregate Structure.

UNIT - IV Key Value Database

NoSQL Key/Value databases using Riak -Introduction to Key-Value Databases -Key-Value Store Features Key value Databases Terminology -Storing Session Information - User Profiles – Preferences - Shopping Cart Data -Relationships among Data -Multioperation Transactions - Query by Data - Operations by Sets -Designing Key value Databases.

UNIT - V Column and Graph Database

Introduction to Column Family Database - Features Column Family Database Terminology - Event Logging - Content Management Systems - Blogging Platforms – Counters - Expiring Usage - Designing for Column Family Databases - Introduction to Graph Databases - Features Consistency – Transactions – Availability - Query Features – Scaling -Graph Database Terminology -Designing for Graph Databases -Connected Data – Routing – Dispatch - Location-Based Services.

TEXT BOOKS:

1. Dan Sullivan, “NoSQL for Mere Mortals”, Addison – Wesley, Pearson Education, 2015.
2. Pramod J. Sadalageand Martin Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence “, Addison - Wesley, 2012.

REFERENCES:

1. Luc Perkins,Eric Redmond and Jim R. Wilson, “Seven Database in Seven Weeks : A Guide to Modern Databases and the NoSQL Movement”, The Pragmatic Bookshelf, 2nd Edition,2012.
2. Aaron Ploetz,DevramKandhare,SudarshanKadambiandXun (Brian) Wu “Seven NoSQL Databases in a Week: Get up and running with the fundamentals and functionalities of seven of the most popular NoSQL databases”,packt Publishing, 2018.
3. Gaurav Vaish, “Getting Started with NoSql”,Packt Publishing, 2013.
4. Adam Flower,”NoSQL for Dummies”, John Wiley & Sons Inc, 2015.

COURSE OUTCOMES:

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

1. Compare and Contrast NoSQL databases with each other and Relational Database Systems.

2. Knowledge of Replication, distribution, sharding, and resilience in a NoSQL database.
3. Demonstrate the knowledge of Document Databases.
4. Knowledge of Key-Value databases in NoSQL database.
5. Demonstrate the knowledge of Column Databases and Graph Database.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	2

DSPESCN	**DATA STORAGE TECHNOLOGIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide learners with a basic understanding of Information Storage and Management Technologies.
- To understand the basics of various intelligent storage systems and network attached Storage.
- To analyze various backup and replication techniques of data storage.
- To Analyze the Performance, Reliability, Scalability and Security issues related to Data Storage.

UNIT - I. Introduction to Information Storage

Information Storage, Evolution of Storage Architecture, Data center Infrastructure, Virtualization and cloud computing. Data Center Environment: Application, Database Management System(DBMS), Host(compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based On Application, Disk Native Command Queuing, Introduction to Flash Drives, Data Protection: RAID: RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison.

UNIT – II Intelligent Storage Systems

Components of an Intelligent Storage System, Storage Provisioning, Types of intelligent Storage Systems, Fiber Channel Storage Area Networks: Fiber Channel: Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fiber Channel Architecture, fabric Services, Switched fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN.

UNIT – III Network-Attached Storage

General-purpose Servers versus NAS Devices, benefits of NAS, File Systems and network File Sharing. Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, factors Affecting NAS Performance, File-Level Virtualization, Object-Based and unified Storage: Object-Based Storage Devices, Content-Addressed Storage, CAS use Cases, unified Storage.

UNIT – IV. Backup and Archive

Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operation, Backup Topologies, Backup in NAS Environments, Backup Targets, Data duplication for Backup, Backup in Virtualized Environments, Data Archive ,Archiving Solution Architecture, Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas, Local Replication in Virtualized Environment, Remote Replication: Modes of Remote Replication, Remote Replication Technologies, Three-Site Replication, Data Migration Solutions, Remote Replication and Migration in a Virtualized Environment

UNIT – V Securing the Storage Infrastructure

Information Security Framework, Risk Triad, Storage Security Domains, Security implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments, Managing the Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, and Storage Infrastructure Management Challenges, Developing an Ideal Solution, Information Lifecycle Management and Storage Tiering.

TEXT BOOKS:

1. "EMC2 : Information Storage and Management", EMC Education Services, Willey India, 2nd Edition, ISBN-13: 978-1118094839, 2013
2. Robert Spalding ,"Storage Networks: The Complete Reference", Tata McGraw Hill India, 1st Edition, ISBN: 9780070532922, 2017.

REFERENCES:

1. Marc Farley, "Storage Networking Fundamentals – An Introduction to Storage Devices Subsystems Applications Management and File Systems", Cisco Press, 2005.
2. Ulf Troppens, Rainer Erkens, Wolfgang Muller-Friedt, Rainer Wolafka, Nils Haustein "Storage Networks Explained", Wiley India, 2nd Edition, 2009.
3. Nigel Poulton,"Data Storage Networking: Real World Skills for the CompTIA Storage" 2015.
4. Fei Hu, "Big Data: Storage, Sharing", Auerbach Publications, 1st Edition, 2016.

COURSE OUTCOMES:

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

1. Illustrate the basic concepts of Information storage management and RAID levels.
2. Classify various intelligent storage systems and infer the concepts related to fiber channel storage area network.
3. Identify the issues related to Network attached storage implementation and object based storage devices.
4. Analyze various techniques related to backup, data deduplication and replication.
5. Examine the security framework in storage networking, storage infrastructure management and information life cycle management.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	2	1	-	1	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	1

DSPESCN	**OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide the Knowledge of Optimization techniques and approaches.
- To apply mathematical and computational needed for the practical utility of optimization techniques.
- To learn the various Genetic Algorithms.
- To teach about decision and replacement models.

UNIT - I Linear Programming Problem

Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Penalty methods: M-method, Two Phase method – Duality.

UNIT - II Transportation Problem

Introduction-Formulation-Solution of the transportation problem(Min and Max): Northwest Corner rule, row minima method, column minima method, least cost method, Vogel's approximation method –Optimality test : MODI method.

UNIT - III Assignment and Sequencing Models

Assignment problems–Applications-Minimization and Maximization : Sequencing–Problem with N jobs and 2 machines – n jobs and 3 machines problem–n jobs and m machines problem.

UNIT - IV Genetic algorithms

Basic concepts – working principle – encoding – different methods – fitness function – reproduction different methods. Genetic modeling – inheritance – Crossover mutation – convergence of genetic algorithm – Ant Colony Optimization algorithm – Particle Swarm Optimization.

UNIT - V Game theory and Replacement models

Game theory: Competitive games– Useful terminology– Rules for game theory–Two person zero sum game – Property of dominance – Graphic solution – Algebraic method. Replacement models: Replacement of items that deteriorate with time: No changes in the value of money, changes in the value of money–Items that fail completely : Individual replacement and group replacement policies.

TEXT BOOKS:

1. Hamdy A Taha, "Operations Research: An Introduction", Pearson Education, Inc., 9th edition 2014.
2. KantiSwarup, Gupta P.K., and Man Mohan, "Operations Research", S.Chand& Sons, 18th edition, 2015.

REFERENCES:

1. Hira D S and Gupta P K, "Operations Research, Revised edition", S.Chand& Sons, 2014.
2. Manohar Mahajan, "Operations Research", Dhanpat Rai & Co., 2013.
3. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Network, Fuzzy Logic and Genetic Algorithms", Synthesis and Applications, PHI, 2003.
4. SingiresuS.Rao, "Engineering Optimization: Theory and Practice", John Wiley and Sons, 2009.

COURSE OUTCOMES:

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

1. Illustrate the use of operations research models in Linear Programming problems.
2. Solve transportation and assignment problem for a wide range of applications.
3. Solve assignment and sequencing problems.
4. Analyze genetic algorithms and apply them for optimization.
5. Explain the concepts of game theory and replacement models

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

DSPESCN	EXTRACT TRANSFORM & LOAD (ETL) TOOLS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the Requirements and Architecture of ETL tools
- To analyze ETL basics, best practices and standards
- To acquaint the concepts in ETL data validation
- To learn about ETL scheduling

UNIT - I Requirements, Realities, and Architecture

Requirements - Business Needs - Compliance Requirements - Data Profiling - Security Requirements. Architecture- ETL Tool versus Hand Coding - The Back Room - Preparing the Data - The Front Room – Data Access - The Mission of the Data Warehouse - The Mission of the ETL Team.

UNIT – II ETL Data Structures

Data Structures in the ETL System - Flat Files - XML Data Sets - Relational Tables - Independent DBMS Working Tables - Third Normal Form - Entity/Relation Models - Non relational Data Sources-Dimensional Data Models - Fact Tables - Dimension Tables - Atomic and Aggregate Fact Tables-Surrogate Key Mapping Tables.

UNIT - III Data Flow

The Logical Data Map - Components of the Logical Data Map - Using Tools for the Logical Data Map - Collecting Business Rules in the ETL Process - Integrating Heterogeneous Data Sources - Transferring Data between Platforms - Handling Mainframe Data - Flat Files - XML Sources - Web Log Sources - W3C Common and Extended Formats - Name Value Pairs in Web Logs - ERP System Sources.

UNIT – IV Dimension Tables and Fact Tables

The Basic Structure of a Dimension - Dimensions - Date and Time Dimensions - Big Dimensions - Small Dimensions - One Dimension or Two - Dimensional Roles - Delivering Fact Tables - The Basic Structure of a Fact Table - Preparing for Loading Fact Tables - Loading the Data - Inserting Facts - Updating and Correcting Facts - Negating Facts - Updating Facts - Deleting Facts - Fact less Fact Tables - Multiple Units of Measure in a Fact Table - Late Arriving Facts

UNIT - V Scheduling and Support

ETL Scheduling - Scheduling Tools – Monitoring the ETL System - Measuring ETL Specific Performance – ETL System Security. Metadata - Defining Metadata - Types of Metadata - ETL Generated Metadata. Popular ETL tools: Features of Improvado - Skyvia - HEVO - Informatica - Power Center - IBM - Infosphere Information Server - Oracle Data Integrator.

TEXT BOOK:

1. Kimball R, Caserta J. “The data warehouse ETL toolkit: practical techniques for extracting, cleaning, conforming, and delivering data”, John Wiley & Sons, 1st Edition, 2011 Apr 27.

REFERENCES:

1. Coté, Christian, Michelle KamratGutzait, and Giuseppe Ciaburro, “Hands-on data warehousing with Azure Data Factory: ETL techniques to load and transform data from various sources, both on-premises and on cloud”, Packt Publishing Ltd, 2018.
2. Casters, Matt, Roland Bouman, and Jos Van Dongen, “Pentaho Kettle solutions: building open source ETL solutions with Pentaho Data Integration”, John Wiley & Sons, 2010.
3. https://www.softwaretestinghelp.com/best-etl-tools/

COURSE OUTCOMES:

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

1. Understand the requirements and architecture of ETL tools.
2. Understand the ETL data structures.
3. Learn how to handle main frame data.
4. Understand about dimensions and fact tables.
5. Understand the features of recent ETL tools.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	1	1	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	1	1	-	-	-	-	-	-	-	-
CO5	-	1	-	-	-	-	-	-	-	-	-	-

DSPESCN	**BUSINESS INTELLIGENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the types of Business Intelligence and business intelligence life cycle.
- To familiarize business intelligence environment and models
- Provide the context that influences performance metrics.
- Focus on business Data Design
- An exceptional BI system provides the foundation for better decision making

Unit - I Introduction

History and Evolution - Business Intelligence (BI) Segments - Difference between Information and Intelligence - Defining Business Intelligence Value Chain - Factors of Business Intelligence System - Real time Business Intelligence -Business Intelligence Applications - Business Intelligence Types: Types of Business Intelligence Tools - Modern Business Intelligence - The Enterprise Business Intelligence - Information Workers.

Unit - II Business Intelligence Life Cycle

Enterprise Performance Life Cycle (EPLC) - Framework Elements - Life Cycle Phases - Human Factors in BI Implementation - BI Strategy - Objectives and Deliverables - Transformation Roadmap - Building a transformation roadmap - BI Development Stages and Steps - Parallel Development Tracks - BI Framework

Unit - III Business Intelligence Essentials

Creating Business Intelligence Environment - Business Intelligence Landscape - Business Intelligence Platform-Dynamic roles in Business Intelligence - Roles of Business Intelligence in Modern Business - Challenges of BI - Business Intelligence User Model: Introduction - Business Intelligence Opportunity Analysis Overview - Content Management System - End User Segmentation-Basic Reporting and Querying - Online Analytical Processing - OLAP Techniques.

UNIT - IV Business and Technical Needs

The Business Demand for Data, Information and Analytics - Business and Technical Needs - Justifying BI: Business and Technical Needs - Defining Requirements-Business, Data and Quality - Data Design: Foundational Data Modelling - Dimensional Modelling.

UNIT - V Data Design

Business Intelligence Dimensional Modelling - Business Intelligence Design – Business Intelligence Applications - BI Design and Development - Organization People, Process and Politics – Project Management.

TEXT BOOKS:

1. Efraim Turban, Ramesh Sharda, DursunDelen, "Decision Support Cambridge and Business Intelligence Systems", 9 th Edition, Pearson 2013.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/Elsevier Publishers, 2013.

REFERENCES:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003.
4. David Loshin Morgan Kaufmann, "Business Intelligence: The Savvy Manager"sGuide",Second Edition,2012.

COURSE OUTCOMES:

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

1. Link Big Data with Business Intelligence.
2. Provides practical guidelines for building successful BI solutions.
3. Describes best practices and pragmatic approaches for BI.
4. Communicate effectively in a variety of modes and contexts.
5. Build and enhance Business Intelligence capabilities by adapting the Appropriate Technology.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	-	1	1	1	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-

DSPESCN	**PROGRAMMING WITH SPARK**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To familiarize the students with the basic concepts and various level of analysis involved in spark and their related technologies.
- To understand the basics of Resilient Distributed Datasets programming.
- To gain knowledge on spark components.
- To acquire basic understanding on how a Machine Learning pipeline works on spark programming.

UNIT - I Introduction to Data Analysis with Spark

Spark's Python and Scala shells - Core Spark concepts - Standalone applications - Programming with Resilient Distributed Datasets: RDD Basics - Creating RDDs - RDD operations - Passing Functions to Spark - Transformations and Actions -Working with Key-Value Pairs: Creating Pair RDDs- Transformations on Pair RDDs: Aggregations - Grouping data- Joins- Sorting Data- Actions available on Pair RDDs.

UNIT – II Data Partitioning

Determining an RDD's Partitioner- Operations that benefit from Partitioning- Operations that affect Partitioning- Custom Partitioners - Loading and Saving Data: File formats- File systems - Structured data with Spark SQL: Apache Hive, JSON -Databases: Java Database Connectivity, HBase, Elasticsearch.

UNIT - III Advanced Spark Programming

Accumulators- Custom Accumulators-Broadcast variables - Running on a Cluster: Spark Runtime Architecture- Packaging your Code and Dependencies - Cluster Managers - Tuning and Debugging Spark: Finding Information - Key Performance Considerations - Spark SQL: Using Spark SQL in Applications - Loading and saving data - JDBC/ODBC Server - User defined Functions -Spark SQL Performance.

UNIT - IV Spark Streaming

Architecture and Abstraction– Transformations: Stateless Transformations - Stateful Transformations - Output Operations - Input Sources - 24/7 Operation- Performance considerations- Batch and Window Sizes - Level of Parallelism - Garbage collection and Memory usage.

UNIT – V Machine Learning with Spark

MLlib – ML - Graph processing - GraphX- Graph Frames - Graph algorithms -. Spark Optimizations: Cluster-level optimizations – Memory - Disk - CPU cores- Project Tungsten - Application optimizations - Language choice - Structured versus unstructured APIs - File format choice - RDD optimizations - Data Frame and dataset optimizations.

TEXT BOOK:

1. Holden Karau, Andy Konwinsk, Patrick Wendell, and MateiZaharia, "Learning Spark: Lightning Fast Big Data Analytics", Oreilly publishing Ltd., First Edition, 2015.

REFERENCES:

1. ShreyMehrotra, and Akash Grade, "Apache Spark Quick Start Guide", packt publishing Ltd.,First Edition, U.K, 2019.
2. **J**illurQuddus, "Machine Learning with Apache Spark Quick Start",packt publishing Ltd., First Edition, U.K, 2018.
3. Bill Chambers, MateiZaharia, "Spark: The Definitive Guide: Big Data Processing Made Simple", Oreilly publishing Ltd., First Edition, 2018.
4. Holden Karau , Rachel Warren, "High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark",Oreilly publishing Ltd., First Edition, U.S.A., 2017.

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COURSE OUTCOMES:

At the end of this course the students able to

1. Understand various level of Data analysis and RDD programming with Spark.

2. Discuss the data portioning and their supportive file formats.
3. Know the spark SQL and advanced level of spark programming.
4. Analyses the output operations and spark streaming.
5. Work on GraphX processing and MLlib.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSPESCN	**DATA SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the significance of privacy, ethics and security in Big Data environment.
- To get knowledge about the pragmatic steps to secure data and classifying data.
- To know the Hadoop ecosystem components and understand the limitation of Hadoop.
- To learn about the concept of Hadoop with enterprise security systems and audit logging in Hadoop cluster.

UNIT - I Data Security for Big Data

Introduction – History of Big Data – Definition of Big Data – Big Data trends – Big Data privacy – Reidentification of anonymous people – Big Data privacy – Ethics –ownership – Ethical guidelines – Big Data security – Organizational security.

UNIT – II Security, Compliance, Auditing and Protection

Pragmatic steps to securing Big Data – Classifying Data – Protecting Big Data analytics – Big Data and compliance– Intellectual property challenge – Evolution of Big Data.

UNIT – III Hadoop Security Design

Introduction – Definition of Hadoop – Hadoop components- Kerberos – Hadoop default security model without Kerberos – Hadoop Kerberos security implementation – Configuring Hadoop with Kerberos authentication.

UNIT – IV Hadoop Ecosystem Security

Configuring Kerberos for Hadoop ecosystem components – Securing Hive – Securing Hive using sentry – Securing Hbase– Securing Hcatalog– Securing Pig, Securing Sqoop– Securing Oozie– Securing Flume – Securing Hadoop sink – Securing Mahout –Securing ZooKeeper – Best practices for securing the Hadoop ecosystem components –Hadoop limitations.

UNIT – V Data Security & Event Logging

Integrating Hadoop with enterprise security systems – Secure sensitive data in Hadoop – Security event and audit logging in Hadoop–SIEM system – setting up audit logging in a secured Hadoop cluster – Configuring Hadoop audit logs.

TEXT BOOKS:

1. Mark Van Rijmenam, "Think Bigger: Developing a successful Big Data strategy for your Business", Amazon, First Edition, 2014.
2. Sudeesh Narayanan, "Securing Hadoop", Packet Publishing, 2013.

REFERENCES:

1. FrankOhihorst John Wiley & Sons "Big Data Analytics: Turning Big Data into Big Money", John Wiley & Sons, 2013.
2. Vijaya Lakshmi M and RadhaShankaramani, "Big Data Analytics", Kindle Edition, 2016.
3. Ben Spivey, Joey Echeverria, "Hadoop Security Protecting Your Big Data Problem", O'Reilly Media, 2015.
4. SherifSakr, "Large Scale and Big Data Processing and Management", CRC Press,2014.

COURSE OUTCOMES

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

1. Describe in data security for big data.
2. Acquire knowledge and understanding security, auditing and protection.
3. Explain the Hadoop security model.
4. Analyze the various Hadoop ecosystem components in a security perspective.
5. Correlate in Data Security and Event Logging.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	1	-	-	-	-	-	-	-
CO3	2	2	-	2	-	-	-	-	-	-	-	-
CO4	-	1	-	-	1	-	-	-	-	-	-	-
CO5	-	1	2	2	-	-	-	-	-	-	-	-

DSPESCN	**WEB ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the growing connectivity and complexity in the world ranging from small groups to World Wide Web.
- To gain a practical understanding of common monitoring or analysis tasks and techniques used in web analytics
- To evaluate different types of software tools, techniques, and reports that are relevant to web analytics

- To make informed decisions on how to analyze and interpret web channel data and understand the difficulties and issues involved

UNIT - I Introduction

Web Analytics 2.0: State of the Analytics Union - State of the Industry - Web Analytics 2.0. Click stream analysis : Eight Critical Web Metrics - Bounce Rate - Exit Rate - Conversion Rate – Engagement - Web Metrics Demystified - Strategically-aligned Tactics. Practical solution : Web Analytics Primer - Web Analytics Report - Foundational Analytical Strategies - Everyday Click stream Analyses - Perspectives on Key Web Analytics Challenges.

UNIT - II Measuring success and leveraging qualitative data

Measuring success: Five examples of actionable outcome - conversion rates - macro and micro conversions - Quantifying Economic Value - measuring success for a non-ecommerce website - Measuring B2B Websites. Leveraging qualitative data: lab usability - usability alternative – surveys - web enabled emerging user research options. Testing and experimentation: A Primer on Testing Options: A/B and MVT, Actionable Testing Ideas, Controlled Experiments, Creating and Nurturing a Testing Culture.

UNIT - III Information retrieval

Search engines: Search challenge – History of search engines – Architecture and components – Crawling – Indexing. Link analysis: Web graph – link-based ranking - page rank - hypertext induced topic search – Link-based analysis. Recommendation and diversification for the web: Pruning information – Recommendation systems - Result diversification. Advertising in search.

UNIT - IV Competitive Intelligence analysis and emerging analytics

Competitive Intelligence analysis: CI data sources, types and secrets - website traffic analysis - search and keyword analysis - segmentation analysis. Emerging analytics: measuring the new social web - Analysing offline customer experiences - Analysing mobile customer experiences - measuring the success of blogs - quantifying the impact of twitter - Analyzing Performance of Videos.

UNIT - V Google Analytics

Google Analytics contribution - Creating implementation plan - Working of Google analytics: Data collection and processing – Reports – Tracking code. Tracking visitor clicks, Outbound links, Non html files - Google analytics accounts and profiles: Google analytics accounts -Creating a Google Analytics Account - Profiles.

TEXTBOOKS:

1. AvinashKaushik, “Web Analytics 2.0: The Art of Online Accountability”, John Wiley & Sons, 2009.
2. Stefano Ceri, Alessandro Bozzon, Marco Brambilla, Emanuele Della Valle, PieroFraternali, Silvia Quarteroni, ”Web Information retrieval”, Springer,2013.

REFERENCES:

1. Justin Cutroni, “Google Analytics”, O’Reilly, 2010.
2. Hansen, Derek, Ben Sheiderman, Marc Smith ,”Analyzing Social Media Networks with NodeXL: Insights from a Connected World”, Morgan Kaufmann, 2011.
3. Wasserman. S, Faust. K, “Social network analysis: Methods and applications”, New York: Cambridge University Press,1994.

4. Monge. P. R, Contractor. N. S, "Theories of communication networks", New York: Oxford University Press,2003.

COURSE OUTCOMES

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

1. Recognize the role of web analytics within the digital marketing landscape.
2. Measure the success rate and testing options.
3. Use the search engines for retrieving the information.
4. Understand the intelligence analysis and emerging analytics.
5. Analyze Google analytics contribution and study the working of Google analytics, accounts and profiles.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	-	-	2	1	1	-	-	-	-	-	-	-
CO3	2	2	-	2	-	-	-	-	-	-	-	-
CO4	-	1	-	-	1	-	-	-	-	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-

DSPESCN	**GPU COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

The students should be made to

- Learn the architecture of Graphics Processing Units (GPUs).
- Use GPUs for traditional purposes like graphics & visualization and for general purpose computations.
- Implement some problems like prefix sum, matrix-vector multiplication etc., using CUDA C.
- Carry out parallel programming using computing paradigms such as CUDA C, OpenCL and OpenACC.

UNIT - I Introduction

Heterogeneous Parallel Computing - Architecture of a Modern GPU – Parallelism - Parallel Programming Languages and Models – History : Evolution of Graphics Pipelines, GPGPU- GPU Computing - Future Trends – Overview of Parallel Programming Platforms : Compute Unified Device Architecture(CUDA) C – OpenCL – OpenACC – CUDA Fortran – C++ AMP - CUDA Python - MPI.

UNIT- II CUDA C and Memories

CUDA C : Data Parallelism - CUDA Program Structure - Vector Addition Kernel - Device Global Memory and Data Transfer - Kernel Functions and Threading - Data-Parallel Execution Model : CUDA Thread Organization - Mapping Threads to Multidimensional Data – Matrix-Matrix Multiplication - Synchronization and Transparent Scalability - Assigning Resources to Blocks,

Querying Device Properties - Thread Scheduling and Latency Tolerance - CUDA Memories : Importance - CUDA Device Memory Types - Strategy for Reducing Global Memory Traffic – Tiled Multiplication – Limiting Factor.

UNIT- III Performance Considerations and Convolution

Performance Considerations : Warps and Thread Execution - Global Memory Bandwidth - Dynamic Partitioning of Execution Resources - Instruction Mix and Thread Granularity, Floating-Point Considerations – Convolution : 1D Parallel Convolution-A Basic Algorithm, Constant Memory and Caching - Tiled 1D Convolution with Halo Elements - A Simpler Tiled 1D Convolution—General Caching.

UNIT- IV Prefix Sum and Matrix-Vector Multiplication

Prefix Sum : A Simple Parallel Scan - Work Efficiency Considerations - A Work-Efficient Parallel Scan - Parallel Scan for Arbitrary-Length Inputs – Sparse Matrix-Vector Multiplication : Parallel SPMV using CSR – Padding and Transposition- Using Hybrid to Control Padding – Sorting and Partitioning for Regularization - Case Study : Advanced MRI Reconstruction, Molecular Visualization and Analysis.

UNIT- V Parallel Programming

Parallel Programming and Computational Thinking : Goals – Problem Decomposition – Algorithm Selection – Computational Thinking - Introduction to OpenCL : Data Parallelism Model - Device Architecture - Kernel Functions - Device Management and Kernel Launch - Electrostatic Potential Map in OpenCL - Parallel Programming with OpenACC : OpenACC versus CUDA C - Execution Model - Memory Model - Basic OpenACC Programs.

TEXT BOOK:

1. David B. Kirk and Wen-mei W. Hwu, “Programming Massively Parallel Processors - A Hands-on Approach”, Elsevier, Second Edition, 2013.

REFERENCES:

1. Jason Sanders and Edward Kandrot,”CUDA by Example - An Introduction to General Purpose GPU Programming”, Addison-Wesley, First Edition, 2010.
2. Shane Cook, “CUDA Programming - A Developer’s Guide to Parallel Computing with GPUs”, Elsevier Inc., First Edition, 2013.
3. John Cheng, Max Grossman and TyMcKercher, ”Professional CUDA C Programming”, John Wiley & Sons, First Edition,2014.
4. Nicholas Tilt,”The CUDA Handbook: A Comprehensive Guide to GPU Programming”, Addison-Wesley Professional, First Edition, 2013.

COURSE OUTCOMES:

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

1. Learn GPU architecture, GPU computing and parallel programming platforms such as CUDA C, OpenCL, Open ACC, CUDA Fortran, CUDA Python etc.
2. Understand CUDA C program structure and CUDA memories.
3. Study CUDA performance considerations and concept of convolution.
4. Device and debug parallel programs on GPUs using CUDA C.
5. Implement basic programs using OpenCL and OpenACC.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	-	-	-	-	-	-		-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	1	-	-	-	-	-	-	-

DSPESCN	**MINING FOR BIG DATA**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the concepts of big data, components of Hadoop ecosystem, and features of Hive and Pig
- To acquire the fundamentals of data mining and its applications in document mining
- To gain knowledge on mining data streams and link analysis
- To explain the algorithms for handling frequent item sets and social network graphs

UNIT – I Big Data and Hadoop Ecosystem

Big Data - Definition- Evolution-Storing the data- Elements of Big Data Analytics- Use of big data in various sectors- Technologies for handling big data - Distributed and Parallel computing for Big data- Hadoop - Cloud computing and Big data-In-memory computing for Big Data- Hadoop Ecosystem- Hadoop distributed File System- MapReduce- Hadoop YARN-HBase- Combining HBase and HDFS-Hive-Pig and Pig Latin- Sqoop- Zookeeper-Flume- Oozie.

UNIT – II Hive and Pig

Exploring Hive- Hive Services- Data Types- Built-in functions- Hive DDL- Data manipulation in Hive- Data Retrieval Queries- Using JOINS in Hive- Analyzing Data with Pig- Running Pig- Introduction to Pig Latin- Pig operators-Debugging in Pig-Functions in Pig- Error Handling in Pig.

UNIT – III Data Mining

Data Mining- Definitions- Statistical limits on Data Mining- Finding Similar Items-Applications of Near-Neighbor Search- Shingling of Documents- Similarity- Preserving Summaries of Sets- Locality-Sensitive Hashing (LSH) for Documents- Distance Measures- Theory of locality-Sensitive Functions- Applications of LSH- Methods for high degrees of Similarity.

UNIT - IV Mining Data Streams and Link Analysis

Mining Data Streams- Stream Data Model- Sampling data in a stream- Filtering Streams- Counting Distinct elements in a stream- Estimating moments- Counting ones in a window- Decaying Windows- Link Analysis- Page Rank- Efficient Computation of Page Rank- Topic- Sensitive Page Rank- Link Spam.

UNIT - V Frequent Item sets and Mining Social Network Graphs

Frequent Item sets- Market-Basket Model- Market-Baskets and the A-Priori Algorithm- Handling larger datasets in main memory- Limited-Pass Algorithm- Counting frequent items in a stream-

Mining Social Network Graphs- Social Networks as graphs- Clustering of Social Network graphs- Direct Discovery of Communities- Partitioning of Graphs- Finding overlapping Communities- Simrank.

TEXT BOOKS:

1. DT Editorial Services, "Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Wiley, 2016.
2. Jure Leskovec, AnandRajaraman, Jeffrey D. Ullaman, "Mining of Massive Datasets", Cambridge University Press, Second Edition, 2014.

REFERENCES:

1. David Loshin, "Big data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann, 2013.
2. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley and SAS Businesss Series, 2012.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilley, Third Edition, 2012.
4. E.Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
6. Alan Gates, "Programming Pig", O'Reilley, 2011.

COURSE OUTCOMES:

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

1. Enumerate the elements of big data and describe the components of Hadoop ecosystem
2. Prepare queries using Hive and construct programs in Pig to analyze data
3. Identify and compare the distance and similarity measures suitable for data mining
4. Analyze data streams and links in the context of data mining
5. Examine algorithms for market basket analysis and social network graph mining

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	1	2	1	1	-	-	-	-	-	-	-
CO4	2	-	2	-	2	-	-	-	-	-	-	-
CO5	3	-	-	-	2	-	-	-	-	-	-	-

DSPESCN	**PREDICTIVE ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the art and science of predictive analytics to define clear actions that result in improved decisions and business results.
- To learn methods for regression and classification.

- To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
- To also learn how to combine two or more models to improve prediction.

UNIT - I Introduction to Predictive Analytics

Analytics- Definition and Need- Introduction to Tools and Environment-Application of Modeling in Business Databases -Types of data and variables- Data Modeling Techniques- Missing imputations -Need for Business Modeling-Regression –Concepts-Blue property-assumptions-Least Square Estimation,-Variable Rationalization and Model Building.

UNIT - II Linear Methods for Regression and Classification

Overview of Supervised Learning: Linear regression models and Least Squares-Multiple regression- Multiple Outputs-Subset Selection -Ridge Regression-Lasso Regression-Linear Discriminant Analysis -Logistic regression -Perceptron Learning algorithm.

UNIT - III Model Assessment and Selection

Bias,Variance,and model complexity: Bias-variance trade off- Optimism of the training error rate-Estimate of in-sample Prediction Error-Effective number of Parameters-Bayesian approach and BIC-Cross- validation-Boot Strap methods-Conditional or Expected Test error.

UNIT - IV Additive Models, Trees and Boosting

Generalized additive model: Regression and Classification Trees- Decision trees-Neural Networks-Fitting Neural Networks- Back Propagation- Issues in training NN - Bayesian Networks-Association Rules-Random Forests and Analysis-Boosting Methods-Exponential loss and AdaBoost-Numerical Optimization via Gradient Boosting

UNIT – V Model Evaluation and Deployment

Introduction- Model Validation- Rule Induction Using CHAID- Automating Models for Categorical and Continuous targets- Comparing and Combining Models- Evaluation Charts for Model Comparison,-Meta Level Modeling- Deploying Model- Assessing Model Performance-Updating a Model.

TEXT BOOKS:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning-Data Mining, Inference,and Prediction”,Springer Verlag, Second Edition, 2009.
2. Ralph Winters ,"Practical Predictive Analytics”,Packt Publishing,2017.

REFERENCES:

1. Gareth James’ Daniela Witten Trevor Hastie Robert Tibshirani,”An Introduction to Statistical Learning with Applications in R”,7 th edition, 2017.
2. E.Alpaydin,” Introduction to Machine Learning”, Prentice Hall Of India,2010
3. Nathan Yau, “Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics”, Wiley, 2011.
4. “Predictive & Advanced Analytics”,IBM ICE Publication, https://www.ibm.com/in-en/analytics/predictive-analytics
5. https://practicalanalytics.co/predictive-analytics-101/

COURSE OUTCOMES:

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

1. Understand the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.
2. Understand various predictive modelling techniques.
3. Compare the underlying predictive modelling techniques.
4. Select appropriate predictive modelling approaches to identify cases to progress with.
5. Apply predictive modelling approaches using a suitable package

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSPESCN	**TEXT ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students conversant with basic principles of text processing
- To classify text and extract features
- To develop expertise in analyzing text similarity and document clustering
- To perform semantic and sentiment analysis

UNIT- I Processing Text

Overview of Text Analytics - Sources of Text - Text Tokenization - Issues in Tokenization - Words and their Categories - Text Normalization: Cleaning Text - Removing Special Characters - Expanding Contractions - Case Conversions - Removing Stopwords - Correcting Words - Stemming - Lemmatization - Understanding Text Syntax and Structure - Tools for text processing.

UNIT- II Text Classification

Text Classification - Automated Text Classification - Text Classification Blueprint - Text Normalization - Feature Extraction: Bag of Words Model, TF-IDF Model, Word Vectorization Model - Classification Algorithms: Naive Bayes, Support Vector Machines - Evaluating Classification Models - Building a Multi-Class Classification System - Applications and Uses.

UNIT- III Text Summarization and Information Extraction

Text Normalization - Feature Extraction - Feature Matrix - Singular Value Decomposition - Key phrase Extraction: Collocations, Weighted Tag-Based Phrase Extraction - Topic Modeling: Latent Semantic Indexing, Latent Dirichlet Allocation, Non-Negative Matrix Factorization - Automated Document Summarization: Latent Semantic Analysis - TextRank - Summarizing a Product Description.

UNIT- IV Text Similarity and Clustering

Information Retrieval - Feature Engineering - Similarity Measures - Unsupervised Machine Learning Algorithms - Text Similarity - Analyzing Term Similarity: Hamming Distance, Manhattan Distance, Euclidean Distance, Levenshtein Edit Distance, Cosine Distance - Analyzing Document Similarity - Clustering foundations - Document Clustering: K-means Clustering, Affinity Propagation, and Ward's Agglomerative Hierarchical Clustering - Flat Clustering.

UNIT- V Semantic and Sentiment Analysis

Semantic Analysis - Exploring WordNet: Understanding Synsets, Analyzing Lexical Semantic Relations - Word Sense Disambiguation - Named Entity Recognition - Analyzing Semantic Representations: Propositional Logic, First Order Logic - Sentiment Analysis: Setting Up Dependencies, Supervised Machine Learning Technique, Unsupervised Lexicon-based Technique, Comparing Model Performances.

TEXT BOOKS:

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your data", Apress, 2016.
2. Grant S. Ingersoll, Thomas S. Morton , Drew Farris, Taming Text: "How to Find, Organize, and Manipulate It", Manning, 1st Edition, 2013.

REFERENCES:

1. Christopher D. Manning, PrabhakarRaghavan and HinrichSchutze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. Steven Bird , Ewan Klein , Edward Loper ," Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit", O'Reilly, 1st Edition, 2009.
3. Julia Silge and David Robinson, "Text Mining with R: A Tidy Approach", O'Reilly, 2017.
4. Benjamin Bengfort, Rebecca Bilbro, Tony Ojeda, "Applied Text Analysis with Python: Enabling Language-Aware Data Products with Machine Learning", O'Reilly, 2018.

COURSE OUTCOMES:

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

1. Normalize text for processing.
2. Build text classification systems.
3. Extract information from the text.
4. Analyze text similarity and perform document clustering.
5. Carry out semantic and sentiment analysis.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	1	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSPESCN	SOCIAL MEDIA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain an understanding of social media analytics concepts, techniques, and tools.
- To understand how social media data is obtained, analyzed and visualized.
- To prepare social media analytics reports to inform executives/senior managers thereby impacting social media policy.
- To understand how managers can make better strategic decision based on social media analytics.

UNIT - I Introduction

Social Media Analytics Overview - grading and attendance policies - Business Social Media Analytics: Definition, Benefits, and Challenges. Foundations of Media Analytics. The Case for Measurement- Goal Setting, Goal Alignment, and Objectives

UNIT – II Social Media Text Analytics

Introduction - Netlytic Text Analytics - Sentiment Analysis Collecting social media data using APIs, collecting tweets by hash tags, user, or keyword - Social Media Network Analytics - Collecting social media data through web scrawling, collecting web contents.

UNIT – III User Generated Content and Social Listening

Big Data analytics and sentiment analysis - Social Media ROI & SWOT Analysis - Text Mining of User-Generated Content (UGC). Social Media Marketing and Analytics. Trends in social and digital marketing Paid/Earned/Owned media and Inbound/Outbound.

UNIT – IV Web Analytics

Introduction- Google analytics- Google Analytics Accounts – How to set up Google Analytics Account?- Customer Relationship Management (CRM) analytics, Analysis vs intuition, the "Digital" Marketing Mix, Web Metrics with Google Analytics, web Analytics report.

Unit – V Mobile Analytics and Social Communities

Mobile path to purchase - mobile couponing, mobile showrooming and location based advertising - Mobile advertising - cross - device synergies- mobile commerce, and mobile apps. Social communities and Facebook Analytics.

TEXT BOOKS:

1. Matthew A. Russell, “Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More”, O’ Reilly Publication. Elseiver Inc., Second Edition, 2014.

REFERENCES:

1. Avinash Kaushik, “Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity” (Author) Publisher: Sybex; Wiley Publishing, Inc, First edition, 2009.
2. Jennifer Golbeck, “Analyzing the Social Web”, Publisher: Morgan Kaufmann, First Edition, 2013.
3. Marshall Sponder, “Social Media Analaytics: Effective Tools for Building, Interpreting and using Metrics”, McGraw-Hill Education, First edition, 2013.
4. Krish Krishnan Shawn Rogers, “Social Data Analytics”, Morgan Kaufmann, Elseiver Inc., 2014.

COURSE OUTCOMES:

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

1. To understand with basic principles of social media analytics
2. To know about the social media data and analysis
3. To identify and learn the different types of web analytics.
4. To acquire knowledge about the mobile analytics and communities.
5. To understand the principles and practices of social media and web media.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	1	1	-	-	-	-	-	-	-	-
CO4	1	-	-	-	2	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

DSPESCN	**REAL TIME ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the concepts of real time analytics and ingredients of real time applications.
- To explore the concepts of Data processing with Storm.
- To learn real time operating system concepts, the associated issues and techniques.
- To understand design and synchronization problems in Real Time System.

UNIT - I Introduction

Real time analytics: the myth and the reality - Near real time solution an architecture that works - Lambda architecture analytics possibilities - IoT thoughts and possibilities – Edge analytics - Cloud considerations for NRT and IoT – The NRT system and its building blocks – NRT high level system view – NRT technology view.

UNIT - II Streaming Data

Understanding Data Streams – Setting up infrastructure for Data ingestion - Streaming analytics architecture; Designing Real Time streaming architectures – Service configuration and coordination – Data flow management in streaming analysis – Processing streaming data – storing streaming data.

UNIT –III STORM

Overview of STORM – architecture and its components – Setting up and configuring STORM – Setting up Apache STORM - Storm in clustered mode – STORM high Availability and Failover - Integrating STORM with RabbitMQ – Building high availability of components - STORM management and maintenance – Advanced concepts in STORM.

UNIT - IV Real Time Systems

Concepts and Misconceptions - Multidisciplinary Design Challenges - Birth and Evolution of Real Time Systems – Basic Processor Architecture – Memory Technologies – Architecture Advancements - Peripheral Interfacing - Distributed Real-Time Architectures.

UNIT - V Real-Time Operating Systems

From Pseudo kernels to Operating Systems - Theoretical Foundations of Scheduling - System Services for Application Programs - Memory Management Issues - Selecting Real Time Operating Systems - Performance Analysis Techniques**;** Real-Time Performance Analysis - Applications of Queuing Theory- Input/Output Performance- Analysis of Memory Requirements.

TEXT BOOKS:

1. Saurabh Gupta,ShilpiSaxena, "Practical Real Time Data Processing and Analytics", Packt Publishing Ltd.2nd edition, 2017.
2. ShilpiSaxena, "Real – Time Analytics with Storm and Cassandra", Packt Publishing Ltd., 2nd edition, 2015.

REFERENCES:

1. Sumit Gupta, ShilpiSaxena, "Real – Time Big Data Analytics", Packt Publishing Ltd, 1st edition, 2016.
2. Byron Ellis, "Real – Time Analytics, Techniques to Analyze and Visualize Streaming Data", John Willey & Sons, Inc., 1st edition, 2014.
3. Philip A. Laplante and Seppo J. Ovaska, "Real – Time Systems Design and analysis: Tool for the Practitioner", IV edition IEEE papers, 2013.
4. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, and Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc.,2nd edition, 2013.

COURSE OUTCOMES:

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

1. To leverage the insights from Real – Time analytics.
2. Perform analytics on real-time streaming data.
3. Understand Storm architecture for real time processing
4. Acquire knowledge about real time systems.
5. Analyze performance and memory requirement for real time systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	2	2	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	1	-	-	1	2	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

DSPESCN	APPLIED ECONOMETRICS & TIME SERIES ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students learn to use econometric methods for modeling and predicting economic time series.
- To impart knowledge on the concepts of theory and methods of time series analysis.
- To know how to use time series analysis in examining financial processes and understand the methods, ideas, results and conclusions that can be met in the majority of books and articles on economics and finance.
- To know the differences between cross-sections and time series, and those specific economic problems, which occur while working with data of these types.

UNIT - I Difference Equations

Introduction - Time-Series Models - Difference Equations and Their Solutions - Solution by Iteration - An Alternative Solution Methodology - The Cobweb Model - Solving Homogeneous Difference Equations - Particular Solutions for Deterministic Processes -The Method of Undetermined Coefficients - Lag Operators.

UNIT – II Stationary Time-Series Models

Stochastic Difference Equation Models - ARMA Models - Stationarity - Stationarity Restrictions for an ARMA (p, q) Model - The Autocorrelation Function - The Partial Autocorrelation Function - Sample Autocorrelations of Stationary Series - Box–Jenkins Model Selection - Properties of Forecasts - A Model of the Interest Rate Spread - Seasonality - Parameter Instability and Structural Change - Combining Forecasts.

UNIT – III Modeling Volatility

Economic Time Series: The Stylized Facts - ARCH and GARCH Processes - ARCH and GARCH Estimates of Inflation - Three Examples of GARCH Models - A GARCH Model of Risk - The ARCH-M Model - Additional Properties of GARCH Processes - Maximum Likelihood Estimation of GARCH Models - Other Models of Conditional Variance - Estimating the NYSE U.S. 100 Index - Multivariate GARCH - Volatility Impulse Responses.

UNIT – IV Models with Trend

Deterministic and Stochastic Trends - Removing the Trend - Unit Roots and Regression Residuals - The Monte Carlo Method - Dickey–Fuller Tests - Examples of the Dickey–Fuller Test - Extensions of the Dickey–Fuller Test - Structural Change - Power and the Deterministic Regressors - Tests with More Power - Panel Unit Root Tests - Trends and Univariate Decompositions.

UNIT – V Multiequation Time-Series Models

Intervention Analysis - Autoregressive Distributed Lag and Transfer Functions - An ADL of Terrorism in Italy - Limits to Structural Multivariate Estimation - Introduction to Vector Auto Regression Analysis - Estimation and Identification - The Impulse Response Function - Testing Hypotheses - Example of a Simple VAR: Domestic and Transnational Terrorism - Structural VARs - Examples of Structural Decompositions - Overidentified Systems - The Blanchard–Quah Decomposition - Decomposing Real and Nominal Exchange Rates: An Example.

TEXT BOOKS:

1. Enders .W, "Applied Econometric Time Series," John Wiley & Sons, Fourth Edition,2014.
2. Terence C. Mills, Raphael N. Markellos, "The Econometric Modelling of Financial Time Series", Cambridge University Press, Third Edition, 2008.

REFERENCES:

1. Kocenda, Evzen, Cerny, Alexandr"Elements of Time Series Econometrics: an Applied Approach", Karolinum Press, 2015.
2. Richard A. Ashley," Fundamentals of Applied Econometrics", Wiley, 2012.
3. Helmut Lutkepohl, Markus Kratzig, Peter C. B. Phillips, "Applied Time Series Econometrics", Cambridge University Press, 2004.
4. K. D. Patterson, "An Introduction to Applied Econometrics: A Time Series Approach, Macmillan", 2000.

COURSE OUTCOMES:

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

1. Understand and solve difference equations.
2. Use stationary time-series models for solving real world problems.
3. Exhibit the knowledge in modeling volatility**.**
4. Analyze the Deterministic and Stochastic models.
5. Apply multiequation time-series models.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	1	1	-	-	-	-	-	-	-	-
CO4	1	-	-	-	2	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

DSPESCN	**RECOMMENDER SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the students abreast with importance of Recommender systems.
- To acquire the knowledge on various methodologies used on Recommender systems.
- To study about Content and Knowledge based Recommender system.
- To discuss the features of Recommender System.

UNIT - I Introduction

Goals of Recommender Systems - Basic Models of Recommender Systems - Domain-Specific Challenges in Recommender Systems - Context-Based Recommender Systems, Time-Sensitive Recommender Systems, Location-Based Recommender Systems, Social Recommender Systems-Advanced Topics and Applications - The Cold-Start Problem in Recommender Systems, Attack-Resistant Recommender Systems, Group Recommender Systems, Multi-Criteria Recommender

Systems, Active Learning in Recommender Systems, Privacy in Recommender Systems, Application Domains.

UNIT – II Neighborhood-Based Collaborative Filtering

Introduction - Key Properties of Ratings Matrices - Predicting Ratings with Neighborhood-Based Methods - Item-Based Neighborhood Models, Efficient Implementation and Computational Complexity, A Unified View of User-Based and Item-Based Methods - Clustering and Neighborhood-Based Methods - Dimensionality Reduction and Neighborhood Methods - A Regression Modeling View of Neighborhood Methods - Graph Models for Neighborhood-Based Methods

UNIT – III Content and Knowledge based Recommender System

Preprocessing and Feature Extraction - Feature Representation and Cleaning- Collecting User Likes and Dislikes- Supervised Feature Selection and Weighting- Learning User Profiles and Filtering - Content-Based Versus Collaborative Recommendations- Constraint-Based Recommender Systems- Case-Based Recommenders-Similarity Metrics, Critiquing Methods, Explanation in Critiques - Persistent Personalization in Knowledge-Based Systems.

UNIT – IV Ensemble-Based and Hybrid Recommender Systems

Ensemble Methods from the Classification Perspective- Weighted Hybrids- Switching Hybrids- Cascade Hybrids- Feature Augmentation Hybrids- Feature Combination Hybrids- Evaluating Recommender Systems-Evaluation Paradigms- General Goals of Evaluation Design- Design Issues in Offline Recommender Evaluation- Accuracy Metrics in offline Evaluation– Limitations of Evaluation Measures.

UNIT – V Social and Trust-Centric Recommender Systems

Multidimensional Models for Social Context- Network-Centric and Trust-Centric Methods– MoleTrust Algorithm- TrustWalker Algorithm- Link Prediction Methods- Matrix Factorization Methods- Social-Tagging Recommenders with Ratings Matrix- Attack-Resistant Recommender Systems- Understanding the Trade-offs in Attack Models- Types of Attacks- Detecting Attacks on Recommender Systems- Strategies for Robust Recommender Design- Designing Robust Recommendation Algorithms.

TEXT BOOK:

1. Charu C. Agarwal, “Recommender Systems: The Textbook”, Springer, 2016.

REFERENCES:

1. Francesco Ricci·LiorRokach·BrachaShapira· Paul B. Kantor, “Recommender Systems, Handbook”, Springer, 2011.
2. DietmarJannach, Alexander Felfernig, Gerhard Friedrich “Recommender Systems : An Introduction”, Cambridge University Press, 2011.
3. Francesco Ricci, LiorRokach and BrachaShapira, “Introduction to Recommender Systems Handbook”, Springer Science Business Media, LLC 2011.

COURSE OUTCOMES :

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

1. Understand the basic concepts of Recommender Systems.
2. Illustrate the significance of Neighborhood-Based Collaborative Filtering and Content and Knowledge based Recommender Systems.

3. Acquire knowledge on Ensemble-Based and Hybrid Recommender Systems.
4. Explicate the role of Social and Trust-Centric Recommender Systems.
5. Identify the various attacks on Recommender Systems.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-
CO4	1	1	-	-	2	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

DSPESCN	**HEALTH CARE ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide a platform for interdisciplinary researchers to learn about the fundamental principles, algorithms, and applications of intelligent data acquisition, processing, and analysis of healthcare data.
- To understand the vast number of analytical techniques for healthcare problems and their relationships with one another.
- To explain specific techniques and required combinations of tools to design effective ways of handling, retrieving, analyzing, and making use of healthcare data.
- To facilitate the development of new computing technologies for Health care analytics

UNIT - I An Introduction to Healthcare Data Analytics

Basics - Healthcare Data Sources and Basic Analytics - Advanced Data Analytics for Healthcare - Applications and Practical Systems for Healthcare - Resources for Healthcare Data Analytics - Healthcare Data Sources and Basic Analytics: Electronic Health Records: A Survey - History of HER - Components of HER - Coding Systems - Benefits of HER - Barriers to Adopting EHR - Challenges of Using EHR Data - Phenotyping Algorithms.

UNIT – II Biomedical Image Analysis

Biomedical Imaging Modalities - Object Detection - Image Segmentation - Image Registration - Feature Extraction - Mining of Sensor Data in Healthcare: A Survey - Challenges in Healthcare Data Analysis - Sensor Data Mining Applications - Nonclinical Healthcare Applications - Biomedical Signal Analysis: Types of Biomedical Signals - ECG Signal Analysis - DE noising of Signals - Multivariate Biomedical Signal Analysis - Cross-Correlation Analysis.

UNIT – III Genomic Data Analysis for Personalized Medicine

Introduction - Genomic Data Generation - Methods and Standards for Genomic Data Analysis - Types of Computational Genomics Studies towards Personalized Medicine - Genetic and Genomic Studies to the Bedside of Personalized Medicine - Natural Language Processing and Data Mining for Clinical Text : Natural Language Processing - Mining Information from Clinical Text - Challenges of Processing Clinical Reports - Clinical Applications.

UNIT – IV Mining the Biomedical Literature

Introduction - Resources - Terminology Acquisition and Management- Information Extraction - Discourse Interpretation - Discourse Relation Recognition - Functional Discourse Annotation - Text Mining Environments – Applications - Integration with Clinical Text Mining.- Forest Conservation Act - Issues involved in enforcement of environmental legislation.

UNIT – V Social Media Analytics for Healthcare

Introduction - Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks – Outbreak Detection - Analyzing and Tracking Outbreaks - Syndromic Surveillance Systems Based on Social Media - Social Media Analysis for Public Health Research – (Topic Models for Analyzing Health-Related Content - Detecting Reports of Adverse Medical Events and Drug Reactions - Characterizing Life Style and Well-Being)Analysis of Social Media Use in Healthcare.

TEXT BOOKS:

1. Chandan K. Reddy, Charu C. Aggarwal, "HealtHcare Data analytics", CRC press, Taylor and Fransis series, 2015.
2. Amirian, Pouria, Lang, Trudie, van Loggerenberg, "Big Data in Healthcare Extracting Knowledge from Point-of-Care Machines", Francois (Eds.), Springer , 2017.

REFERENCES:

1. Amirian, Pouria, Lang, Trudie, van Loggerenberg, Francois, "Big Data in Healthcare Extracting Knowledge from Point-of-Care Machines", Springer, 2017.
2. P. Amirian et al. (eds.), "Big Data in Healthcare", Springer Briefs in Pharmaceutical Science & Drug Development", 2017.
3. B. Shen (ed.), "Healthcare and Big Data Management, Advances in Experimental Medicine and Biology", Springer Nature Singapore Pte Ltd., 2017.
4. Ashwin Belle, RaghuramThiagarajan, S.M.RezaSoroushmehr, FatemehNavidi, "Big Data Analytics in Healthcare", Article *in* Journal of Biomedicine and Biotechnology, January 2015.

COURSE OUTCOMES:

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

1. Explain the different format of data and Electronic Health Records
2. Describe the concepts of Biomedical Image and signal Analysis
3. Acquire the Knowledge about Genomic Data Analysis for Personalized Medicine
4. Apply the principles of Mining for Biomedical Literature
5. Understand the Social Media Analytics for Healthcare

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	1	-	-	-	-	-	-	2
CO2	2	2	1	-	1	-	-	-	-	-	-	-
CO3	-	2	-	-	-	1	-	-	-	-	-	-
CO4	-	1	-	-	1	2	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	2

DSPESCN	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts and trends in Business Analytics.
- To understand the design problems and facilitate decision making for that problem.
- To study the visualization methods.
- To identify business analytics Application.

UNIT-I Introduction to Business Analytics

What Is Business Analytics-Evolution of Business Analytics-Impacts and Challenges-Scope of Business Analytics- Software Support -Data for Business Analytics -Data Sets and Databases- Big Data - Metrics and Data Classification-Data Reliability and Validity-Models in Business Analytics-Decision Models -Uncertainty and Risk-Prescriptive Decision Models -Problem Solving with Analytics Recognizing a Problem-Defining the Problem- Structuring the Problem- Analyzing the Problem -Implementing the Solution.

UNIT-II Visualizing and Exploring Data

Data Visualization- Tools and Software for Data Visualization-Creating Charts in Microsoft Excel Column and Bar Charts - Data Labels and Data Tables Chart-Line Charts-Pie Charts -Data Queries: Tables-Sorting-Filtering .

UNIT-III Prescriptive Analytics

Linear Optimization-Building Linear Optimization Models-Identifying Elements for an Optimization Model -Translating Model Information into Mathematical Expressions-More about Constraints-Characteristics of Linear Optimization Model-Implementing Linear Optimization Models on Spreadsheets-Excel Functions to Avoid in Linear Optimization-Solving Linear Optimization Models-Using the Standard Solver-Parameter Analysis in Analytic Solver Platform.

UNIT-IV Applications of Linear Optimization

Types of Constraints in Optimization Models-Process Selection Models-Spreadsheet Design and Solver Reports-Solver Output and Data Visualization-Blending Models-Dealing with Infeasibility-Portfolio Investment Models-Evaluating Risk versus Reward-Scaling Issues in Using Solver-Transportation Models-Formatting the Sensitivity Report-Degeneracy-Multiperiod Production Planning Models-Building Alternative Models-Multiperiod Financial Planning Models

UNIT-V Decision Analysis

Formulating Decision Problems-Decision Strategies without Outcome Probabilities-Decision Strategies for a Minimize Objective- Decision Strategies for a Maximize Objective- Decisions with Conflicting Objectives-Decision Strategies with Outcome Probabilities-Average Payoff Strategy-Expected Value Strategy-Evaluating Risk DecisionTrees-Decision Trees and Risk-Sensitivity Analysis in Decision Trees-The Value of Information-Decisions with Sample Information-Bayes's Rule-Utility and Decision Making -Constructing a Utility Function-Exponential Utility Functions.

TEXT BOOKS:

1. James R. Evans , "Business Analytics'', Pearson Education, 2nd edition, 2015.
2. U. Dinesh Kumar , "Business Analytics", Wiley Publications, 1st edition, 2017.

REFERENCES:

1. Ramesh Sharda , "Business Intelligence & Analytics", Pearson Education, 10th edition 2017.
2. Albright , Winston , "Business Analytics", Cengage Learning India Pvt Ltd, 5th edition, 2015.
3. Marc J. Schniederjans "Business Analytics Principles, Concepts and application", PearsonEducation, 1st edition, 2014.

COURSE OUTCOMES:

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

1. Apply the principles of Business Analytics in real world.
2. Solve problems by making optimized decision and implement the solutions.
3. Perform basic creation of charts in Microsoft excel.
4. Develop the Knowledge and interest for life-long learning and continual professional development in business environment.
5. Analyze applications of optimization models in real time scenario.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	1	1	-	-	-	-	-	-	-	2
CO4	1	-	-	-	2	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

OE- OPEN ELECTIVES

DSOESCN	**SOFT COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the various soft computing frame works.
- To be familiar with design of various neural networks.
- To be exposed to fuzzy logic.
- To learn genetic programming.

UNIT - I Artificial neural network Introduction

Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: Cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT - II Learning Networks

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN-associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, ART network.

UNIT – III Membership Function

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT – IV Genetic Algorithm and Search Space

General genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem- advances in GA.

UNIT – V Neuro- Fuzzy Hybrid Systems

Genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

TEXT BOOKS:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education, 2004.
2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCES:

1. Randy L. Haupt and sue Ellen Haupt“Practical Genetic Algorithms”, John Willey & Sons, 2002.
2. J.-S. R. Jang, C.-T. Sun, and E. Mizutani,”Neuro-Fuzzy and soft Computing”, PHI Learning, 2009.
3. Simon Haykin,”Neural Networks and Learning Machines”, PHI Learning, 3rd Edn.,2011.
4. S.Rajasekaran and G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
5. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.

COURSE OUTCOMES:

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

1. Apply various soft computing frame works.
2. Design various neural networks.
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
4. Apply genetic algorithms to combinatorial optimization problems.

5. Applications of soft computing to solve problems in varieties of application domains.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSOESCN	**MOBILE APP DEVELOPMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To demonstrate the understanding of the fundamentals of Android operating systems.
- To demonstrate the skills of using Android software development tools.
- To demonstrate the ability to develop software with reasonable complexity on mobile platform.
- To demonstrate the ability to debug programs running on mobile devices.

UNIT – I Android

An Open Platform for Mobile Development - Native Android Applications - Android SDK features - Understanding the Android Software Stack - The Dalvik Virtual Machine -Android Application Architecture - Android Libraries - Creating the Android Application - Types of Android Applications - Android Development Tools - Externalizing the Resources - The Android Application Lifecycle.

UNIT – II Building User Interface

Fundamental Android UI design - Android User Interface fundamentals - Layouts - Linear - Relative - Grid Layouts - Fragments - Creating new fragments - The Fragments Lifecycle - Introducing the Fragment Manager - Adding Fragments to Activities - Interfacing between Fragments and Activities.

UNIT – III Intents and Broadcasts Receivers

Introducing Intents - Using intents to launch Activities - Introducing Linkify - Using Intents to Broadcast Events - Introducing the Local Broadcast Manager - Introducing pending intents - Using Intent filters to service implicit Intents - Using Intent Filters for Plugins and extensibility - Listening for Native Broadcast Intents - Monitoring Device State Changes Using Broadcast Intents.

UNIT – IV Files, Saving State And Preferences

Saving Simple Application Data - creating and Saving Shared Preferences - Retrieving Shared Preferences – Introducing the Preference Framework and the Preference Activity – Working with the File System – Introducing Android Databases - Introducing SQLite – Content Values and Cursors – Working with SQLite Databases - Creating Content Providers, Using Content Providers.

UNIT – V Advanced Topics

Alarms - Creating and using alarms - Using Location Based Services – Using the Emulator with Location-Based Services - Finding the Current Location – Using the Geocoder - Creating Map-Based Activities.

TEXT BOOKS:

1. Reto Meier, "Professional Android 4 Application Development", John Wiley & Sons Inc., India, (Wrox), 4th edition, 2012.
2. James C Sheusi, "Android Application Development for Java Programmers", Course Technology Cengage Learning, 1st edition, 2013.

REFERENCES:

1. Wei-Meng Lee, "Beginning Android 4 Application Development", Wiley India (Wrox), 2013.
2. Wei – Meng Lee," Beginning Android Application Development", Wiley, 2011.
3. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", Dream Tech., 2012.

COURSE OUTCOMES:

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

1. Understand the existing state of mobile app development via researching existing apps, meeting with industry professionals, and formulating new ideas.
2. Display proficiency in coding on a mobile programming platform.
3. Understand the limitations and features of developing for mobile devices.
4. Create a complete Mobile app with a significant programming component, involving the sensors and hardware features of the phone.
5. Understand the economics and features of the app marketplace by offering the app for download.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	-	1	-	-	-	-	-	-	-
CO2	3	2	1	-	1	-	-	-	-	-	-	-
CO3	3	1	1	-	1	-	-	-	-	-	-	-
CO4	3	2	1	2	2	-	-	-	1	-	-	1
CO5	2	2	1	2	2	-	-	-	1	-	-	1

DSOESCN	**CYBER SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the legal and social issues in Cyber Security.
- To understand the need for Cyber security and its related threats and attacks.
- To learn methods to become secure in the cyber world and communicate on it.
- To study about the Indian IT Act 2000, amendments and IT Audit standards.

UNIT – I Introduction to Cyber Security

Computer Ethics - Moral and legal issues, descriptive and normative claims, Professional Ethics, code of ethics and professional conduct, Privacy - Computers and privacy issue, Digital Evidence Controls, Evidence Handling Procedures, Legal Policies, legislative background. Introduction to Cyber Security - Overview, Internet Governance – Challenges and Constraints, Cyber Threats - Cyber Warfare, Cyber Crime, Cyber terrorism and Cyber Espionage.

UNIT – II Intellectual Property Rights, Security and Services

Intellectual Property Rights - Copyrights, Jurisdiction Issues and Copyright Infringement, Multimedia and Copyright issues, WIPO, Intellectual Property Rights, Understanding Patents, Understanding Trademarks, Trademarks in Internet, Domain name registration, Software privacy, Legal Issues in Cyber Contracts, Authorship, Document Forgery. Security and Servers - Introduction, Basic security for HTTP Applications and Services, Securing Web Application, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

UNIT - III Cyber Security Vulnerabilities and Safeguards

Cyber Security Vulnerabilities - Overview, vulnerabilities in software, System administration, Complex Network Architectures, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection. Cyber Security Safeguards - Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection and Prevention Techniques, Network based Intrusion detection Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT – IV Cyberspace Law and Cyber Forensics

Cyberspace Law –Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards, Indian Cyberspace, National Cyber Security Policy 2013. Introduction to Cyber Forensics - Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, tracing memory in real time.

UNIT – V Indian IT Act and Standards

Indian Information Technology Act -Overview of Indian Legal System, Introduction to IT Act 2000, Indian IT Act 2008, Amendments in IT Act, IT Audit standards - ISO/IEC 27000 Series, COBIT, HIPPA, SOX, System audit, Information security audit, ISMS, Statement of Applicability, Business Continuity Plan, Disaster Recovery, Risk Analysis/Assessment.

TEXT BOOKS:

1. Charles J. Brooks, Philip Craig and Donald Short, “Cyber Security Essentials”, SYBEX Publisher,First Edition, 2018.
2. SunitBelapure and Nina Godbole, “Cyber Security”, Wiley India, 2011.

REFERENCES:

1. Deborah G Johnson, “Computer Ethics”, Prentice Hall, USA,Fourth Edition, 2009.
2. Vivek Sood “Cyber Law Simplified” Mcgraw Hill Ltd., Fifth Edition, 2017.

3. Lester Evans, "Cyber security", Amazon Digital Services LLC, 2018.
4. https://meity.gov.in/content/information-technology-act-2000

COURSE OUTCOMES:

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

1. Understand about security ethics, issues and threats.
2. Know the intellectual property rights and secure the copyrights.
3. Identify the cyber security vulnerabilities and safeguards.
4. Understand the cyberspace law and forensics.
5. Know the Indian IT, amendments act and standards.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	1	-	-	-	-	-	-	2
CO2	2	2	1	-	1	-	-	-	-	-	-	-
CO3	-	2	-	-	-	1	-	-	-	-	-	-
CO4	-	1	-	-	1	2	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	2

DSOESCN	BIG DATA FOR BIOINFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of the introduction and application areas of bioinformatics, with a focus on how bioinformatics data is stored and organized.
- To explain how to locate and extract data from key bioinformatics databases and also from NCBI, EMBL, DDBJ and PDB resources.
- To learn how to develop sequence Alignment and multiple sequence alignment using POA and PSSM.
- To understand the methods and approaches for prediction of protein structure.

Unit – I Introduction to Bioinformatics

History of Bioinformatics, Role of Bioinformatics in biological sciences-scope of bioinformatics. Introduction to internet: WWW- network basics, LAN & WAN standards. Network topologies and protocols: ftp- http. Introduction to Database: Types of database. Biological Database: Need of biological database- Sequence and Structure database – (NCB- EMBL-DDBJ-and PDB)-other databases – KEGG- PubMed-OMIM-PubChem-NCI-ZINC-Drug Bank,-Ligand. Format of Databases: GenBank and PDB flat file.

Unit –II Protein Structure and Sequence Alignment

Protein Structure Visualization: RasMol- PyMol- Jmol- CN3- Swiss PDB view e- Chimera and Discovery Studio visualizer. Protein Structure Comparison: Intra-molecular Method- Intermolecular method, combined method. Protein Structure Comparison: SCOP and CATH. Pairwise Alignment: Dot Matrix Method- Dynamic programming - (Local and Global Alignment) Gap Penalties, POA Alignment. Scoring Matrices: Amino acid scoring matrices-PAM,- BLOSUM. Database Similarity Searching: BLAST. BLAST variants. BLAST output format. FASTA.

Unit–III Multiple Sequence Alignment and Motif, Domain Prediction

Multiple Sequence Alignment: Scoring function-exhaustive algorithms-and Heuristic algorithms. PSSM, Markov Model and Hidden Markov Model. Protein Motif and Domain Prediction: Motif and Domain Databases PROSITE. Sequence Logos and Web-logo.

Unit –IV Gene and Promoter Prediction

Gene Prediction in Prokaryotes: Conventional determination of Open Reading Frames (ORF)-Markov model and HMM. Gene Prediction in Eukaryotes: Ab Initio based program-Neural Networks. Promoter and Regulatory Element Prediction: Prokaryotes and Eukaryotes. Introduction to Phylogenetic: Phylogenetic Basics-Terminologies. Phylogenetic Tree construction Methods: Distant based method - (UPGMA, NJ) Character Based Method – (MP and ML)-Phylogenetic Tree Evaluation: Bootstrapping.

Unit-V Protein Structure Prediction

Globular Proteins: Ab-Inition-Homology Based- Neural networks method. Transmembrane Proteins: Prediction of Helical membrane- β-barrel membrane proteins. RNA Structure Prediction: Ab Initio approach- dot matrices. Introduction to Homology modeling: Model refinement-model evaluation-homology model databases. Threading and fold recognition, CASP.

TEXT BOOKS:

1. David W Mount, “Bioinformatics sequence and Genome analysis, Cold Spring Harbor Laboratory Press”, Second Edition, 2013.
2. Attwood T K, D J Parry-Smith, “Introduction to Bioinformatics”, Pearson Education, 2005.

REFERENCES:

1. Neil C. Jones and Pavel A. Pevzner, “An Introduction to Bioinformatics Algorithms”, MIT Press, 2005.
2. https://.nptel.ac.in/noc/individual_course.php?id=noc18-bt01 (YouTube videos)
3. nptel.ac.in/courses/102106065 Tutorials.

COURSE OUTCOMES:

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

1. Describe the contents and properties of the most important bioinformatics databases.
2. Locate and use the databases in NCBI, EMBL, DDBJ and PDB resources to know the difference between databases, tools, repositories to extract specific information.
3. Explain the major steps in pairwise and multiple sequence alignment
4. Explain the methods for gene and promoter prediction.
5. Predict the secondary and tertiary structures of protein sequences.

Mapping of Course Outcomes with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	2	-	-	-	-	-	-	-	-
CO3	2	1	-	2	1	-	-	-	-	-	-	-
CO4	1	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-

DSOESCN	DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To present the mathematical, statistical and computational challenges of building neural networks.
- To study the concepts of deep learning.
- To introduce dimensionality reduction techniques.
- To examine the case studies of deep learning techniques.

UNIT - I Introduction

Introduction to machine learning- Linear models (SVMs and Perceptron, logistic regression) - Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT - II Concepts of Deep Learning

History of Deep Learning- a Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi supervised Learning

UNIT - III Metric Learning

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization

UNIT - IV Optimization

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT - V Advanced Techniques

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection-BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions

TEXT BOOKS:

1. CosmaRohillaShalizi, “Advanced Data Analysis from an Elementary Point of View”, 2015.
2. Deng & Yu, “Deep Learning: Methods and Applications”, Now Publishers, 2013.

REFERENCES:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press, 2015.

COURSE OUTCOMES:

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

1. Describe the challenges in Neural networks.
2. Explain the fundamental concepts of deep learning.
3. Train deep learning networks.
4. Apply the methods for optimization in deep learning.

5. Comprehend and develop applications using the concepts of deep learning.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	1	1	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	1	1	-	-	-	-	-	-	-	-
CO4	2	1	2	2	2	-	-	-	-	-	-	-
CO5	1	2	2	2	3	-	-	-	-	-	-	-

DSOESCN	**INFORMATION RETRIEVAL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basics of Information Retrieval.
- To understand machine learning techniques for text classification and clustering.
- To understand various search engine system operations.
- To learn different techniques of recommender system.

UNIT - I Introduction

Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes – The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces.

UNIT - II Basic IR models

Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.

UNIT - III Classification, Searching and Indexing

A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing.

UNIT - IV Web – Search Engine Architectures

The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations — Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

UNIT - V Content-based Recommender Systems

Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighborhood models.

TEXT BOOKS:

1. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", ACM Press Books, 2nd edition, 2011.
2. Ricci, F, Rokach, L. Shapira, B.Kantor, ―Recommender Systems Handbook, 1st edition, 2011.

REFERENCES:

1. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010.

COURSE OUTCOMES:

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

1. Understand the basics of Information Retrieval and its models.
2. Use an open source search engine framework and explore its capabilities.
3. Apply appropriate method of classification or clustering.
4. Design and implement innovative features in a search engine.
5. Design and implement a recommender system.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

DSOESCN	**BLOCK CHAIN TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To describe the current state of block chain technology and the potential of the technology beyond financial transactions.
- To demonstrate the concepts and features of block chain technology that might be broadly extensible to a wide variety of situations.
- To provide a conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
- To understand how blockchain technology is for the decentralization of markets.

UNIT - I Cryptography

Cryptography – Encryption and Decryption – Cryptographic Hash Functions – Hash Pointers and Data Structures – Digital Signatures – Cryptocurrencies – Bitcoin – Bitcoin's Ecosystem – Predecessors – Storing Bitcoins – Software Wallets – Hardware Wallets – Exchanges – Ethereum Smart Contracts – Ethereum Ecosystem – Digital Tokens.

UNIT – II Blockchain Technology

The Trust Protocol – How the Worldwide Ledger Works – A Rational Exuberance for the Blockchain – Achieving Trust in the Digital Age Promise and Peril of the New Platform- The Seven Design Principles – Networked Integrity – Distributed Power – Value as Incentive – Security – Privacy – Rights preserved – Inclusion - Blockchain Technology – Trust – Types of Blockchain – Blockchain Implementations – Hyperledger.

UNIT – III Transactions

Transactions – Blocks - Mining and consensus - Blockchain – Bitcoin Transactions – Transaction Inputs and Outputs – Transaction Chains – Making Change – Common Transaction Forms – Constructing a Transaction – Bitcoin Mining – Mining Transactions in Blocks – Spending the Transaction – Blockchain 1.0: Currency – Technology Stack – eWallet Services and Personal Cryptosecurity - Blockchain 1.0 in Practical Use.

UNIT –IV Block chain: Contracts

Financial Services – Crowdfunding – Bitcoin Prediction Markets – Smart Property – Smart contracts – Blockchain 2.0 Protocol Projects, Blockchain 3.0: Justice Applications beyond Currency, Economics and Markets – Digital Identity Verification – Digital Art – Blockchain Government.

UNIT – V Security

Technical Challenges – Business Model Challenges – Scandals and Public Perception – Government Regulation – Privacy Challenges for Personal Records – Decentralization Trends - likely to persist – Blockchain Technical Challenges – Bugs in the Core Code – Denial-of- Service Attacks – Security in Smart Contracts – Scaling – Sharding.

TEXT BOOKS:

1. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015.
2. Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly, 2017.

REFERENCES:

1. Joseph J. Bambara, Paul. R. Allen, KedarIyer, Rene Madsen, Solomon Lederer, Michael Wuehler, "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill, 2018.
2. Don Tapscottand Alex Tapscott, "Blockchain Revolution: How the Technology behind Bitcoin and Other Crytpocurrencies is Changing the World", Portfolio-Penguin, 2016.
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction". Princeton University Press, 2016.
4. Antony Lewis, "The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers them", Mango Publishers, 2018.

COURSE OUTCOMES:

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

1. Understand the technical foundations of digital currencies and cryptographic concepts.
2. Know the concepts, features and principles of blockchain and use the blockchain for automated tracking of all digital endeavors.
3. Analyze how the transactions are verified and recorded in a block.
4. Explore what constitutes a smart contract, its legal implications and what it can and cannot do, now and in the near future.
5. Extract knowledge on how security and privacy issues are handled within a blockchain.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

DSOESCN	**DIGITAL FORENSICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the fundamentals and importance of digital forensics
- To know the methods for data acquisition and storing digital evidence
- To understand the various windows system artifacts useful for digital forensics
- To provide knowledge on legal aspects of digital forensics

UNIT – I Introduction

Forensic Fundamentals: Definition of Forensic Science – Digital Forensics – Uses of Digital Forensics - Digital Forensic Process – Key Technical Concepts: Bits, Bytes, and Numbering Schemes - File Extensions and File Signatures- Computers and DataStorage - Random Access Memory - Volatility of Data - The Difference between Computer Environments - Active, Latent, and Archival Data - The Difference between Allocated and Unallocated Space - Computer File Systems.

UNIT – II Collecting Evidence

Network Evidence Collection: Preparation – Network Device Evidence – Packet Capture – Evidence Collection - Documenting the Scene and the Evidence - Establishing and Maintaining the Chain of Custody - Forensic Cloning of Evidence - Dealing with Live Systems and Dead Systems - Using Hashing to Verify the Integrity of Evidence - Drafting the Examiner's Final Report.

UNIT – III Windows System Artifacts

Finding Deleted Data - Hibernation Files - Examining the Windows Registry - Print Spooling Evidence - Recycle Bin Operation - Metadata: Definition and use - Thumbnail Images as Evidence - Most Recently Used Lists: Creation and their forensic Value - Working with Restore Points and Shadow Copies - Examining Prefetch and Link Files.

UNIT – IV Labs and Tools

Laboratories - The Role and Organization of Forensic Laboratories - The Purpose of Policies and Procedures in Forensic Laboratories - The Role of Quality Assurance in Forensics - Digital Forensic Hardware and Software - Accreditation versus Certification.

UNIT – V Legal Aspects of Digital Forensics

The Legal Aspects of Digital Forensics - The Fourth Amendment and Its Impact on Digital Forensics - Electronic Discovery - Duty to Preserve Potential Digital Evidence in Civil Cases - Private Searches and Establishing the Need for Offsite Analysis - Overview of Electronic Communications Privacy Act - Searching Digital Evidence With and Without a Search Warrant.

TEXT BOOKS:

1. John Sammons, "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics", Syngress, 1st Edition, 2012.
2. Gerard Johansen, "Digital Forensics and Incident Response: An Intelligent way to respond Attacks", Packt Publishing Ltd, 1st Edition, 2017.

REFERENCES:

1. Bill Nelson, and Christopher Steuart, "Guide to Computer Forensics and Investigation", Amelia Phillips, Cengage Learning, 4th Edition, 2010.
2. Clint P. Garrison, "Digital Forensics for Network, Internet and Cloud Computing: A Forensic Evidence Guide for Moving Targets and Data", Syngress, 2010.
3. JoakimKavrestad, "Guide to Digital Forensics: A Concise and Practical Introduction" (SpringerBriefs in Computer Science), Springer; 1st Edition, 2017.
4. John Sammons, "Digital Forensics: Threatscape and Best Practices", Syngress, 1st Edition, 2015.
5. Anthony T.S.Ho and Shujun Li, "Handbook of Digital Forensics of Multimedia Data and Devices", Wiley-IEEE Press, 1st Edition, 2015.

COURSE OUTCOMES:

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

1. Explain and document the process of digital forensics analysis
2. Present the evidence and conclusion of an investigation in report format
3. Identify the methods for data recovery
4. Analyze various digital forensics tools and techniques
5. Understand the trade-offs and differences between various forensic tools

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	2	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-	-

HONORS ELECTIVE COURSES

DSHESCN	BIG DATA TESTING TOOLS	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES:

- To describe the Big Data Tools with MapReduce Concepts.
- To understand the principles of ETL Testing processes.
- To describe an approach for Testing using Hive and HQL.
- To establish the knowledge about administration and various testing on distributed environment.

UNIT –I Introduction to Hadoop with MapReduce

Analyzing the data with Unix Tools / Hadoop - Map and Reduce – Scaling out – Hadoop streaming – Design of Hadoop Distributed File System (HDFS) – Anatomy of MapReduce Job Run: classic MapReduce and YARN – Failures – Job Scheduling – Task Execution – MapReduce Types and Formats – MapReduce Features

UNIT –II Big Data and ETL Testing Fundamentals

Data Concepts - Big Data Concepts - Transactional vs. Analytical Databases vs. Big Data Stores - Big Data Concepts - Hadoop Ecosystem - Hadoop Process Big Data – Introduction to ETL - Principles of ETL Testing - Data Mapping Document - Testing methods - Testing incremental loads - Multiple Sources - Data Permutations - Test Data Sampling - Test Points - Test Plan - ETL Manual Test Creation - ETL Automated Test Creation - Transformation Types - Testing Process - Defect Types

UNIT –III Big Data Testing using Hive and HQL

Big Data Overview - Understanding Hadoop Architecture - Understanding the challenges of Big Data Testing - Big Data Testing Comparison Methods - One-to-One Mapping Transformation Test - HQL commands for returning data - One-to-One Mapping with Filters Transformation Test - HQL commands for filtering data - HQL commands for sorting data - Join Mapping Transformation Test - Field Merging and Splitting Transformation Test - Type Casting with Formatting Transformation Test - Translation and Lookup Transformation Test - Statistical Tests

Unit – IV Testing on MongoDB

Application Administration: Finding problematic operations – killing operations –preventing phantom operations-Data administration – Authentication setting –creating and deleting indexes – preheating data – compacting data – Monitoring mongoDB – Tracking Page faults - Tracking performance – Monitoring replication

Unit - V Testing Scala and Spark Applications

Testing in distributed environment – Challenges of testing in distributed environment - Testing Spark applications: Testing scala method –unit testing –Integration Testing -Testing scala code - Debugging on Eclipse as scala debug – Debugging spark jobs as local and standby mode – Debugging spark applications on YARN

TEXT BOOKS:

1. Tom White, “Hadoop The Definitive Guide”,O’Reilly Publication, Third Edition, 2012.

2. Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage", O'Reilly Media, Inc. 2013.

REFERENCES:

1. Eric Sammer, Hadoop Operations, **"**A Guide for Developers and Administrators", O'Reilly Publication, 2012.
2. Rudy Lai, BartłomiejPotaczek, "Hands-On Big Data Analytics with PySpark: Analyze large datasets and discover techniques for testing, immunizing, and parallelizing Spark jobs", Packt Publishing Ltd, 2019.
3. Md. Rezaul Karim and Sridhar Alla, "Scala and Spark for Big Data Analytics: Explore the concepts of functional programming, data streaming, and machine learning", Packtpunblising Ltd., 2017.
4. Ralph Kimball, Joe Caserta, "The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data", John Wiley &Sons. 2011.

COURSE OUTCOMES:

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

1. Understand a Performance of Hadoop with Map and Reduce.
2. Describe the principles of ETL Testing.
3. Recognize the Big Data Testing Comparison Methods.
4. Describe the Application Administration and Monitoring mongoDB.
5. Conclude the testing methods through the testing tools on distributed environment.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSHESCN	**BIG DATA ANALYTICS TOOLS**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**

COURSE OBJECTIVES:

- To understand the tools and practices for working with big data
- To introduce the features of Apache Flink and Kafka
- To learn about real-time data and stream computing
- To develop applications using Neo4j

UNIT – I Apache Flink

Apache Flink - Consequences of Not Doing Streaming Well - Goals for Processing Continuous Event Data - Evolution of Stream Processing Technologies - First Look at Apache Flink - Flink in Production - Where Flink Fits - Stream-First Architecture - Traditional Architecture versus Streaming Architecture - Message Transport and Message Processing - The Transport Layer: Ideal

Capabilities - Streaming Data for a Micro services Architecture - Beyond Real-Time Applications - Geo-Distributed Replication of Streams - What Flink Does - Different Types of Correctness - Hierarchical Use Cases: Adopting Flink in Stages.

UNIT – II Advanced features of Apache Flink

Handling Time - Counting with Batch and Lambda Architectures - Counting with Streaming Architecture - Notions of Time - Windows - Time Travel - Watermarks - A Real-World Example: Kappa Architecture at Ericsson - Stateful Computation - Notions of Consistency - Flink Checkpoints: Guaranteeing Exactly Once - Savepoints: Versioning State - End-to-End Consistency and the Stream Processor as a Database - Flink Performance: the Yahoo! Streaming Benchmark - Batch Is a Special Case of Streaming - Batch Processing Technology - Case Study: Flink as a Batch Processor.

UNIT – III Introduction to Neo4j

Neo4j - Graph data in a relational database - Graph data in Neo4j - SQL joins versus graph traversal on a large scale - Neo4j in NoSQL space - Neo4j: the ACID-compliant database - Data model for Neo4j - Domain modelling - Modelling graph data structures - Using the Neo4j API - Node labels - Traversing using the Neo4j Core Java API - Traversing using the Neo4j Traversal API - Creating the index entry - Finding the user by their email - Automatic indexing - The cost/benefit trade-off of indexing.

UNIT – IV Application Development with Neo4j

Introduction to Cypher - Cypher syntax basics - Updating your graph with Cypher - Advanced Cypher - Transaction basics - Transactions in depth - Integration with other transaction management systems - Transaction events - Traversal ordering - Expanding relationships - Managing uniqueness - Bidirectional traversals.

UNIT – V Kafka

Meet Kafka - Publish/Subscribe Messaging - Enter Kafka – Reasons to use Kafka - The Data Ecosystem – Kafka's Origin - Producer Overview - Constructing a Kafka Producer - Sending a Message to Kafka - Configuring Producers - Serializers - Partitions - Old Producer APIs - Kafka Consumer Concepts - Creating a Kafka Consumer - The Poll Loop - Configuring Consumers - Commits and Offsets - Rebalance Listeners - Deserializers - Standalone Consumer - Older Consumer APIs.

TEXT BOOKS:

1. Ellen Friedman and Kostas Tzoumas, "Introduction to Apache Flink - Stream Processing for Real Time and Beyond", O'Reilly Media, Inc., First Edition, 2016.
2. AleksaVukotic, Nicki Watt, "Neo4j in Action", Manning Publications, 2015.

REFERENCES:

1. Neha Narkhede, Gwen Shapira, and Todd Palino, "Kafka: The Definitive Guide - Real-Time Data and Stream Processing at Scale", O'Reilly Media, Inc.,First Edition, 2017.
2. Fabian Hueske, VasilikiKalavri, "Stream Processing with Apache Flink: Fundamentals, Implementation, and Operation of Streaming Applications", O'Reilly Media, Inc., First Edition, 2019.
3. Sylvain Roussy, Nicolas Mervaillie, Nicolas Rouyer, "Neo4j - a Graph Project Story", D-Booker Editions, 2019.

4. Mark Needham, Amy E. Hodler, "Graph Algorithms: Practical Examples in Apache Spark" and Neo4j, O'Reilly Media, Inc., 2019.
5. Prashant Kumar Pandey, "Kafka Streams - Real-time Stream Processing", Learning Journal, 2019.

COURSE OUTCOMES:

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

1. Understand streaming architecture and compare with traditional architecture.
2. Analyze Flink performance.
3. Describe graph data use Neo4j.
4. Develop applications using Neo4j.
5. Explain publish or subscribe messaging through kafka.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSHESCN	**DATA MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide an overview of the opportunities and challenges in data management.
- To discuss the technical practices for data management.
- To introduce the risk security and visibility concerns in data management.
- To impart knowledge on implementation data management.

UNIT-I Introduction

Data and the Enterprise – The database architecture of an information system – Data Management – problems encountered without DM – DM responsibilities – Data Management activities – Roles within DM – Benefits of DM – Relationship b/w DM and enterprise architecture.

UNIT-II Meta Data and Master Data Management

Data administration – Corporate data modeling – data definition and naming – Metadata – Metadata for DM – Metadata for content management – Meta data for describing data values – Master Data Management – Master data – Problems with master data – How to manage master data.

UNIT-III Data Quality

Data Quality – Definition issues associated with poor data quality – Causes of poor data quality – Dimensions of data quality – Data model quality – Improving data quality.

UNIT-IV Data Governance

Analytics platform Framework – Data Management Body of Knowledge (DMBOK) – Data governance – Definition – Need – Data steward Responsibilities – Corporate governance – Case for Big Data governance.

UNIT-V Big Data Governance framework

Big Data governance best practices – Data Protection – Security Architecture for Data Lake – Data structure Design – Sandbox functionality overview – Split Data Design – Big Data governance Framework program – Overview – Components – Organization – Big Data Security, Privacy and compliance, Data usage Agreement – Security operations Considerations and Policies – Information life cycle management – Quality Standards Data Quality Reporting.

TEXT BOOKS:

1. Keith Gordan, "Principles of Data Management: Facilitating Information Sharing", BCS Learning and Development Ltd., Second Edition, 2013.
2. Peta K. Ghavami, "Big Data Governance: Modern Data management Principles for Hadoop, NoSQL and Big Data Analytics", Create Space Independent Publishing Platform, First Edition, 2015.

REFERENCES:

1. Judith Hurwitz, Alam Nugent, Dr.FernHalpar, Marcia Kaufman, "Big Data for Dummies", John Wiley &Sons , 2013.
2. Gerardus blokdyk, "Enterprise Data Management", Create Spacce Independent Publishing Platform, Third Edition, 2018 .
3. David Boddy, "Principles of Data Management", FT Prentice Hall, Third Edition, 2005.
4. Kenneth C. Laudon, Jane P. Laudon, "Management Information System", Pearson Education, Fifteenth Edition, 2018.

COURSE OUTCOMES:

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

1. Identify the key issues and opportunities in Data Management and its associated applications in intelligent Business and Scientific Computing.
2. Explain the Strategies and Approaches for Data Management.
3. Describe technical practices of Data Management.
4. Describe the View of Security and Risk Management for big data.
5. Define the mechanisms for implementing Data Management.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	2	2	1	1	-	-	-	-	-	-	-

DSHESCN	COGNITIVE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explore the area of cognitive computing and its implications for today's world of big data analytics and evidence-based decision making.
- To investigate data from inside and outside the enterprise, and to identify as well as to evaluate patterns in large and unstructured data sets.
- To train the students to explore human reasoning by evaluating data in context and to present relevant findings along with the evidence.
- To learn IBM's Watson as a cognitive system.

UNIT - I Introduction

Foundations of Cognitive Computing:Cognitive Computing as a new generation-Uses-Cognitive system-Gaining insights from data-AI as the foundation-Understanding cognition-Two systems of judgment and choice-Understanding Complex relationships-Elements of cognitive systems.

UNIT – II Design Principles

Design Principles for cognitive systems: Components-building corpus-bringing data into the cognitive system-machine learning: Finding patterns in data-supervised, unsupervised and reinforcement learning-hypotheses generation and scoring-visualization.

UNIT – III Cognitive Systems

NLP in support of a cognitive system: Role of NLP-Semantic web-applying NLP technologies to business problems. Big data and cognitive computing: Dealing with human generated data-defining big data-architectural foundation-analytical warehouses-Hadoop-data in motion and streaming data-Integrating big data and traditional data.

UNIT – IV Representing knowledge in Taxonomies and Ontologies

Representing knowledge-defining taxonomies and ontologies-explaining how to represent knowledge-models for knowledge representation. Applying advanced analytics to cognitive computing: Key capabilities in advanced analytics-using advanced analytics to create value-impact of open source tools on advanced analytics. Role of cloud and distributed computing in cognitive computing.

UNIT – V Cognitive Applications

Business implications of cognitive computing-IBM's Watson as a cognitive system: Watson defined-Preparing Watson for commercial applications-Components of DeepQA Architecture. Process of building a cognitive application-cognitive healthcare application-cognitive computing in Government-Emerging cognitive computing areas.

TEXT BOOKS:

1. Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Wiley, Indianapolis, 2005.
2. Peter Fingar, "Cognitive Computing: A Brief Guide for Game Changers", Meghan-Kiffer Press, USA, 2015.

REFERENCES:

1. Jerome R. Busemeyer, Peter D. Bruza, "Quantum Models of Cognition and Decision",

Cambridge University Press, 2014.
2. Emmanuel M. Pothos, Andy J. Wills, "Formal Approaches in Categorization", Cambridge University Press, 2011.
3. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
4. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, "Cognitive Science: An Introduction", MIT Press, 1995.

COURSE OUTCOMES:

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

1. Understand and discuss what cognitive computing is, and how it differs from traditional approaches.
2. Use the recent tools associated with cognitive computing.
3. Plan and execute a project that leverages cognitive computing.
4. Create the business implications of cognitive computing.
5. Build and explore the cognitive computing applications that are impacting the field of data science.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	-

DSHESCN	**HIGH PERFORMANCE BIG DATA ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the competitive advantages of High performance big data analytics.
- To understand the High performance big data technologies.
- To learn high performance data analysis network infrastructures.
- To learn stream computing and gain knowledge about grid, cloud and peer to peer system usage in high performance big data analytics.

UNIT - I The High-Performance Technologies For Big And Fast Data Analytics

Introduction - The Emergence of Big Data Analytics (BDA) Discipline - The Big Data Analytics (BDA) Challenges - The High-Performance Computing (HPC) Paradigms - The High-Performance Approaches Through Parallelism - Cluster Computing - Grid Computing - Cloud Computing - Heterogeneous Computing - Appliances for Big Data Analytics - The Emerging Data Sources for Precise, Predictive, and Prescriptive Insights - The Big Data Analytics: The Prominent Process Steps - Real-Time Analytics - Stream Analytics - Sensor Analytics.

UNIT - II Network Infrastructure for High-Performance Big Data Analytics

Network Infrastructure Limitations of Present-Day Networks - Approaches for the Design of

Network Infrastructures for High-Performance Big Data - Storage Infrastructures for High-Performance Big Data Analytics:- Getting Started with Storage Area Networks (SANs) - Storage Infrastructure Requirements for Storing Big Data - Fiber Channel Storage Area Network (FC SAN) - Internet Protocol Storage Area Network (IP SAN) - Network-Attached Storage (NAS) - Popular File Systems Used for High-Performance Big Data Analytics - Introduction to Cloud Storage.

UNIT – III Real-Time Analytics Using High-Performance Computing

Technologies That Support Real-Time Analytics - MOA: Massive Online Analysis - General Parallel File System (GPFS) -Machine Data Analytics Operational Analytics - Cloud Computing Centralized HPC - Requirements to Centralized HPC - HPC Remote Simulation - Architecture Models - SMP (Symmetric Multiprocessing) - Virtualization for HPC - FICON Mainframe Interface - Mainframe Mobile - Windows High-Performance Computing.

UNIT - IV In-Database Processing And In-Memory Analytics

Introduction - In-Database Analytics - Integrated Systems for Big and Fast Data Analytics - Converged Infrastructure (CI) for Big Data Analytics - High-Performance Analytics: Mainframes + Hadoop - In-Memory Platforms for Fast Data Analytics-The Cloud Infrastructures for High-Performance Big and Fast Data Analytics - Big File Systems for the Big Data World - Databases and Warehouses for Big and Fast Data Analytics - Streaming Analytics.

UNIT -V High-Performance Grids and Clusters

Cluster Computing - Grid Computing - Design Principles and Characteristics of High-Performance Peer-to-Peer Systems:- Peer-to-Peer System Architectures - High-Performance Peer-to-Peer Applications -Visualization Dimensions for High- Performance Big Data Analytics**:** Common Techniques - Data Visualization Tools and Systems

TEXT BOOK:

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High-Performance Big-Data AnalyticsComputing Systems and Approaches", Springer International Publishing Switzerland, 2015.

REFERENCES:

1. Chao Wang,"High Performance Computing for Big Data Methodologies and Applications", CRC Press, Taylor & Francis Group, 1st Edition, 2017.
2. Geoffrey Fox, Vladimir Getov, Lucio Grandinetti, Gerhard Joubert, Thomas Sterling, "New Frontiers in High Performance Computing and Big Data", IOS Press Ebooks, 2017.
3. Trovati, M., Hill, R., Anjum, A., Zhu, S.Y., Liu, L. (Eds.)," Big-Data Analytics and Cloud Computing: Theory, Algorithms and Applications" Springer, 1st ed., 2015.
4. Lucio Grandinetti, Gerhard Joubert, Marcel Kunze, Valerio Pascucci ,"Big Data and High Performance Computing" , IOS Press Ebooks, 2015.
5. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
6. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.

COURSE OUTCOMES:

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

1. Understand how to leverage the insights from high performance big data analytics.

2. Analyze various network infrastructure for high performance big data analytics.
3. Perform analytics on real-time streaming data.
4. Understand the analytics in Memory and database processing.
5. Understand the various NoSql alternative database models and to analyze of data into grid, cloud and peer to peer system.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	1	1	-	-	-	-	-	-	-	2
CO4	1	-	-	-	2	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

DSHESCN	**FINANCIAL ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To train students to use statistical methods for modeling and predicting financial crisis.
- To understand how to evaluate market sentiments and apply statistical models.
- To learn to improve the finance exchange strategies in foreign entries and exits.
- To identify the best working income statement portfolio with price statistics and apply binomial model for option data.

UNIT - I Financial Analytics

Financial Statistics: Financial Returns-Capital Asset Pricing Model-Financial Securities-Bond Investments-Stock Investments-The Housing Crisis-The Euro Crisis-Securities -Datasets and Visualization- Adjusting for Stock Splits-Securities in Data Importing-Data Cleansing-Quoting.

UNIT - II Gauging the Market Sentiment

Markov Regime Switching Model - Reading the Market Data-Bayesian Reasoning - The Beta Distribution -Prior and Posterior Distributions - Examining Log Returns for Correlation - Momentum Graphs.

UNIT - III Trading Strategies

Foreign Exchange Markets- Chart Analytics - Initialization and Finalization - Momentum Indicators -Bayesian Reasoning within Positions - Entries - Exits -Profitability -Short-Term Volatility -The State Machine.

UNIT - IV Prediction Using Fundamentals

Best Income Statement Portfolio -Reformatting Income Statement Growth Figures-Obtaining Price Statistics -Combining the Income Statement with Price Statistics-Prediction Using Classification Trees and Recursive Partitioning-Comparing Prediction Rates among Classifiers

UNIT - V Binomial Model for Options

Applying Computational Finance - Risk-Neutral Pricing and No Arbitrage -High Risk-Free Rate

Environment - Convergence of Binomial Model for Option Data - Put–Call Parity - From Binomial to Log-Normal.

TEXT BOOKS:

1. Mark J. Bennett , Dirk L. Hugen, "Financial Analytics with R", Cambridge University Press,2016
2. Erich A.Helfert, "Financial Analysis: Tools and Techniques- A Guide for Managers",McGraw Hill, 2010.

REFERENCES:

1. James C. Vanhorne, "Fundamentals of Financial Management", 11th Edition,PHI Learning,2012.
2. Brigham, Ehrhardt, "Financial Management Theory and Practice",Cengage Learning, 12th edition, 2010.
3. Prasanna Chandra, "Financial Management", Tata,9th edition, 2012.

COURSE OUTCOMES:

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

1. Describe the knowledge in financial statistics in terms of capital, returns, investment, bonds and financial risks.
2. Evaluate market sentiments.
3. Explain foreign exchange marketing strategies.
4. Predict best income strategies using classification Trees and Recursive partitioning techniques.
5. Apply binomial model for option data.

Mapping of Course Outcomes with Programme Outcomes												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	2
CO4	1	1	1	-	2	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-