



**PACE INSTITUTE OF TECHNOLOGY AND SCIENCES  
ONGOLE**

**ACADEMIC REGULATIONS (R21)**

For

**MASTER OF TECHNOLOGY**

**Two Year Degree Programme**

(Applicable for the batches admitted from the **A.Y. 2021-22**)

**PACE INSTITUTE OF TECHNOLOGY AND SCIENCES**

**NH-16, Near Valluramma Temple, ONGOLE-523272  
ANDHRA PRADESH, INDIA**

## ACADEMIC REGULATIONS (R21) FOR M.Tech. (REGULAR)

Applicable for students of Master of Technology (Regular)  
from Academic Year 2021-22 onwards

Pace Institute of Technology and Sciences, Ongole, 2021 Regulations (R21 Regulations) applicable for all the students admitted into first year of Master of Technology programme from the academic year 2021-22.

### 1. ELIGIBILITY FOR ADMISSIONS:

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

### 2. AWARD OF M. Tech DEGREE:

A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

The student shall register for all 68 credits and secure all the 68 credits.

The minimum instruction days in each semester are 90.

### 3. PROGRAMME OF STUDY:

The following specializations are offered at present for the M. Tech Programme of study.

Sl No	Programme
1	Structural Engineering (SE)
2	VLSI & Embedded Systems (VLSI&ES)
3	Computer Science and Engineering (CSE)

### 4. ATTENDANCE:

4.1 A student shall be eligible to write semester end examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects/courses, and with minimum 50% in each and every course including practicals.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

4.3 Shortage of Attendance **below** 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.

4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

4.5 A prescribed fee shall be payable towards condonation of shortage of attendance.

4.6 A student shall not be promoted to the next semester unless, he satisfies the attendance requirement of the present semester, as applicable. They may seek re-admission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for re-admission into the same class.

### 5. EVALUATION:

The performance of the candidate in each semester shall be evaluated subject-wise, with a

maximum of 100 marks for theory and 100 marks for practical, on the basis of Internal Evaluation and Semester End Examination.

- 5.1 For the theory subjects 70 marks shall be awarded based on the performance in the Semester End Examination and 30 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 90 minutes with 3 questions (without choice) each question for 10 marks. Semester End Examination is conducted for 70 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).
- 5.2 For practical subjects, 70 marks shall be awarded based on the performance in the Semester End Examinations and 30 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-5 marks, record- 5 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with breakup marks of Procedure-20, Experimentation-30, Results-10, Viva-voce-10.
- 5.3 For Mini Project with Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Mini Project with Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.
- 5.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.
- 5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to re-appear for the End semester Examination in that subject. A candidate shall be given **one** chance to re-register for each subject provided the internal marks secured by a candidate **are less than 50% and has failed in the end examination**. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt shall stands cancelled. For re- registration the candidates have to apply to the Chief Controller of Examinations through the department by paying the requisite fees and get approval from the Chief Controller of Examinations before the start of the semester in which re-registration is required.
- 5.6 In case the candidate secures less than the required attendance in any re-registered subject(s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.
- 5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the second examiner shall be appointed by the Chief Controller of Examinations from the panel of examiners submitted by the respective department.

## 6. EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

- 6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members in the department.
- 6.2 Registration of Dissertation/Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.
- 6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).
- 6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
- 6.5 Continuous assessment of Dissertation-I and Dissertation-II during the Semester(s) will be monitored by the PRC.
- 6.6 A candidate shall submit his status report in two stages to the PRC, at least with a gap of 3 months between them.
- 6.7 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate has to pass all the theory and practical subjects.
- 6.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.
- 6.9 The thesis shall be adjudicated by one examiner selected by the Chief Controller of Examinations. For this, Head of the department shall submit a panel of 4 examiners, eminent in that field, with the help of the guide concerned and head of the department.
- 6.10 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and completes the project within the stipulated time after taking the approval from the Chief Controller of Examinations.
- 6.11 The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.

- 6.12 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for a maximum of 100 marks as one of the following:

% Marks	Letter Grade	Grade Point	Level
≥ 90	O	10	Outstanding
80 to <90	S	9	Excellent
70 to <80	A	8	Very Good
60 to <70	B	7	Good
50 to <60	C	6	Pass
<50	F	0	Fail
--	AB	0	Absent

- 6.13 If the report of the Viva-Voce is unsatisfactory (ie, < 50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Chief Controller of Examinations.

## 7. Cumulative Grade Point Average (CGPA)

A letter grade and grade points will be awarded to a student in each course based on his performance as per the grading system given below.

Marks Range Theory / Laboratory (Max – 100)	Marks Range Mini Project/ Project Work or Dissertation (Max – 100)	Letter Grade	Level	Grade Point
≥ 90	≥ 90	O	Outstanding	10
80 to <90	80 to <90	S	Excellent	9
70 to <80	70 to <80	A	Very Good	8
60 to <70	60 to <70	B	Good	7
50 to <60	50 to <60	C	Satisfactory	6
<50	<50	F	Fail	0
			Absent	0

### A. Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average(SGPA) and Cumulative Grade Point Average(CGPA):

The **SGPA** is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$\text{SGPA (S}_i\text{)} = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

Where  $C_i$  is the number of credits of the  $i^{\text{th}}$  course and  $G_i$  is the grade point scored by the student in the  $i^{\text{th}}$  course.

### B. Computation of CGPA

The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a Programme, i.e.

$$\text{CGPA} = \sum (C_i \times S_i) / \sum C_i$$

**Where  $S_i$  is the SGPA of the  $i^{\text{th}}$  semester and  $C_i$  is the total number of credits in that semester**

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

$$\text{Equivalent Percentage} = (\text{CGPA} - 0.75) \times 10$$

## 8. AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M.Tech Degree he shall be placed in one of the following three classes:

Class Awarded	CGPA to be secured	From the CGPA secured From 68 Credits.
First Class with Distinction	$\geq 7.75$ (without Supplementary appearance)	
First Class	$\geq 6.75$	
Second Class	$\geq 5.75$ to $< 6.75$	

The Grades secured, Grade points and Credits obtained will be shown separately in the

## 9. WITHHOLDING OF RESULTS

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

## 10. TRANSITORY REGULATIONS (for R21)

Discontinued or detained candidates are eligible for re-admission into same or equivalent subjects at a time as and when offered.

The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per R18 academic regulations.

## 12 GENERAL

Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

The academic regulation should be read as a whole for the purpose of any interpretation.

In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

The college may change or amend academic regulations or syllabi at any time subject to approval of the competent authority and the changes or may apply the amendments made to all students with effect from the dates notified.

## MALPRACTICES RULES

### DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

Sl. No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. a.	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
b.	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.



10.	Comes in a drunken condition to the examinationhall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence,such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all othersubjects the candidate has appeared including practical examinations and project work of that semester/yearexaminations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Chief Controller of Examinations for further action and impose suitable punishment.	

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# Ragging

## Prohibition of ragging in educational institutions Act 26 of 1997

### Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student.

	<b>Imprisonment upto</b>	+	<b>Fine Upto</b>
Teasing, Embarrassing and Humiliation	 6 Months	+	<b>Rs. 1,000/-</b>
Assaulting or Using Criminal force or Criminal intimidation	 1 Year	+	<b>Rs. 2,000/-</b>
Wrongfully restraining or confining or causing	 2 Years	+	<b>Rs. 5,000/-</b>
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	 5 Years	+	<b>Rs. 10,000/-</b>
Causing death or abetting suicide	 10 Months	+	<b>Rs. 50,000/-</b>

**In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288**

**LET US MAKE JNTUK A RAGGING FREE UNIVERSITY**



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA**  
KAKINADA - 533 003, Andhra Pradesh, India  
For Constituent Colleges and Affiliated Colleges of JNTUK



# Ragging

ABSOLUTELY  
NO TO RAGGING

- 1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.**
- 2. Ragging entails heavy fines and/or imprisonment.**
- 3. Ragging invokes suspension and dismissal from the College.**
- 4. Outsiders are prohibited from entering the College and Hostel without permission.**
- 5. Girl students must be in their hostel rooms by 7.00 p.m.**
- 6. All the students must carry their Identity Cards and show them when demanded**
- 7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.**



**Jawaharlal Nehru Technological University Kakinada**  
For Constituent Colleges and Affiliated Colleges of JNTUK

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**M.TECH COURSE STRUCTURE**  
**(Computer Science & Engineering)**  
**R21 REGULATIONS**

<b>I YEAR I SEMESTER</b>								
<b>S.No</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Internal</b>	<b>External</b>
1	PP21CST01	AdvancedData Structures& Algorithms	3	0	0	3	30	70
2	PP21CST02	Advanced Computer Networks	3	0	0	3	30	70
<b>Professional Elective-I</b>								
3	PP21CSE01	<b>Artificial Intelligence &amp; Machine Learning</b>	3	0	0	3	30	70
	PP21CSE02	Design Patterns						
	PP21CSE03	Blockchain Technology						
<b>Professional Elective-II</b>								
4	PP21CSE04	<b>Advanced Web Technologies</b>	3	0	0	3	30	70
	PP21CSE05	Advanced Operating Systems						
	PP21CSE06	Soft Computing						
5	PP21CST03	Research Methodology and IPR	2	0	0	2	30	70
6	PP21CSL01	Advanced Data Structures & Algorithms Lab	0	0	4	2	30	70
7	PP21CSL02	Advanced Computing Lab-I	0	0	4	2	30	70
8	PP21CSA01	Audit Course-1	2	0	0	0	100	--
<b>Total</b>			<b>16</b>	<b>0</b>	<b>8</b>	<b>18</b>	<b>310</b>	<b>490</b>

<b>I YEAR II SEMESTER</b>								
<b>S.No</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Internal</b>	<b>External</b>
1	PP21CST05	Data Science Applications with Python	3	0	0	3	30	70
2	PP21CST06	Mean Stack Technologies	3	0	0	3	30	70
<b>Professional Elective-III</b>								
3	PP21CSE07	<b>Internet of Things</b>	3	0	0	3	30	70
	PP21CSE08	Social Network Analysis						
	PP21CSE09	Service Oriented Architecture						
<b>Professional Elective-IV</b>								
4	PP21CSE10	<b>Cloud Computing</b>	3	0	0	3	30	70
	PP21CSE11	Bigdata Analytics						
	PP21CSE12	GPU Programming						
5	PP21CSL03	Data Science with Python Lab	0	0	4	2	30	70
6	PP21CSL04	Advanced computing Lab – II	0	0	4	2	30	70
7	PP21CSMP S01	Mini Project with Seminar	2	0	0	2	0	100
8	PP21CSA02	Audit Course-2	2	0	0		100	
<b>Total</b>			<b>1</b>	<b>0</b>	<b>8</b>	<b>18</b>	<b>280</b>	<b>520</b>

### List of Audit Courses -1&2

<b>S.No</b>	<b>Course Code</b>	<b>Title of the Course</b>
1	PP21AC001	English for research paper writing
2	PP21AC002	Disaster mitigation and management
3	PP21AC003	Sanskrit for technical knowledge
4	PP21AC004	Value education
5	PP21AC005	Indian constitution & fundamental rights
6	PP21AC006	Pedagogy studies
7	PP21AC007	Stress Management by Yoga
8	PP21AC008	Personality Development through Life Enlightenment Skills

II YEAR I SEMESTER								
S.No	Course Code	Course Name	L	T	P	Credits	Internal	External
<b>Professional Elective-V</b>								
1	PP21CSE13	<b>Deep Learning</b>	3	0	0	3	30	70
	PP21CSE14	DevOps						
	PP21CSE15	MOOCs-1 (NPTEL/SWAYAM) 12 Week Programme which is not Listed in the Course Structure						
<b>Open Elective-I</b>								
2	PP21CSOE1	MOOCs-2 (NPTEL/SWAYAM) 12 Week Course on Engineering/Mathematics/ Management offered by other than Parent Department	3	0	0	3	30	70
		<b>Open Elective</b>						
3	PP21CSP01	Dissertation-1/Industrial Project	0	0	20	10	100	
<b>Total</b>			<b>6</b>	<b>0</b>	<b>20</b>	<b>16</b>	<b>160</b>	<b>140</b>

II YEAR II SEMESTER								
S.No	Course Code	Course Name	L	T	P	Credits	Internal	External
3	PP21CSP02	Dissertation-2	0	0	20	10	100	100
<b>Total</b>			<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>100</b>	<b>100</b>

**ADVANCED DATA STRUCTURES & ALGORITHMS**

**Internal Marks: 30**

**External marks: 70**

**Course Code: PP21CST01**

**Course Prerequisites:** Data Structures & Mathematics

**Course Objectives:**

1. Student will learn about advanced data structures.
2. Practice the algorithms for manipulating advanced data structures, and how to analyze the time and memory requirements of them.
3. Student will master some complex searching and sorting algorithms and their data structures, advanced types of trees, basic computational geometry procedures, and graph representations and graph algorithms.
4. Student will learn when and how to use techniques for developing algorithms, such as divide-and-conquer and dynamic programming.
5. Student will also become skilled in algorithmic analysis and algorithm development using the latest techniques.

**Course Outcomes:**

1. Could be able to write programs and class libraries given a specification.
2. Implement various data structures.
3. Implement and analyze various sorting algorithms.
4. Understand abstract data types.
5. Know how they are implemented in C++ programming language.

**UNIT- I**

(11 Lectures)

Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists- Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

**UNIT-II**

(13 Lectures)

Searching-Linear and Binary Search Methods Sorting-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort. Trees- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees(Infix, prefix, postfix).Graphs-Basic Concepts, Storage Structures and Traversals.

**UNIT- III**

(11 Lectures)

Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, Open Addressing-Linear Probing, Double

Hashing.

**UNIT- IV**

(12 Lectures)

Priority queues- Definition, ADT, Realizing a Priority Queue using Heaps, Definition, Insertion, Deletion, Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.

**UNIT –V**

(13 Lectures)

Search Trees- AVL Trees, Definition, Height of AVL Tree, Operations, Insertion, Deletion and Searching. Search Trees- Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

**Text Books :**

1. Data Structure, APseudocode Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon,Cengage
2. Data Structures, Algorithms and Applications in java, 2/e, SartajSahni, UniversityPress
3. Data Structures And Algorithm Analysis, 2/e, Mark Allen Weiss,Pearson.

**References Books:**

1. Data Structures And Algorithms, 3/e, Adam Drozdek,Cengage.
2. C and Data Structures, A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad, S Chand &Co,2009.

**Web References:**

1. <https://www.coursera.org/specializations/data-structures-algorithms>
2. <https://www.geeksforgeeks.org/data-structures/>
3. <https://www.studytonight.com/data-structures/>



**ADVANCED COMPUTER NETWORKS**

**Internal Marks: 30**

**External marks: 70**

**Course Code: PP21CST02**

**Course Prerequisites:** Computer Networks

**Course Objectives**

1. To study the problematic of service integration in TCP/IP networks focusing on protocol design, implementation and performance issues.
2. To debate the current trends and leading research in the computer networking area.

**Course Outcomes**

1. To identify and discuss the concepts underlying IPv6 protocol, and their main Characteristics and functionality.
2. To understand the principles and functionality of mobile IP.
3. To recognize the need for service integration and discuss how it can be Accomplished;
4. To explain and exemplify current QoS architectures and mechanisms, and the QoS support challenges in future networks.
5. To understand the MANET's and Security

**UNIT-I**

(13 Lectures)

Network layer: Network Layer design issues: store-and forward packet switching, services provided transport layers, implementation connection less services, implementation connection oriented services, comparison of virtual –circuit and datagram subnets. Routing Algorithm – shortest path routing, flooding, distance vector routing, link state routing, Hierarchical routing, Broadcast routing, Multicasting routing, routing for mobiles Hosts, routing in Adhoc networks- congestion control algorithms-Load shedding, Congestion control in Data gram Subnet.

**UNIT-II**

(12 Lectures)

IPV4 Address address space, notations, classful addressing, classless addressing network addressing translation(NAT) , IPV6 Address structure address space, Internetworking need for network layer internet as a data gram, internet as connection less network. IPV4 datagram, Fragmentation, checksum, options. IPV6 Advantages, packet format, extension Headers, Transition form IPV4 to IPV6.

**UNIT-III**

(13 Lectures)

Process to process delivery: client/server paradigm, multiplexing and demultiplexing connectionless versus connection oriented services, reliable versus reliable. UDP: well known ports for UDP, user data gram, check sum, UDP operation, and uses of UDP

TCP: TCP services, TCP features, segment, A TCP connection, Flow control, error control, congestion control. Quality Of Service: flow characteristics, flow classes

#### **UNIT –IV**

(11 Lectures)

Multimedia: introduction digital audio , Audio compression, streaming audio, internet radio, voice over IP, introduction to video, video compression, video on demand, the MB one the multicast back bone

#### **UNIT –V**

(11 Lectures)

Emerging trends Computer Networks: Mobile Ad hoc networks: applications of Ad hoc networks, challenges and issues in MANETS,MAC layers issues, routing protocols in MANET, transport layer issues, Ad Hoc networks security. Wireless sensors networks: WSN functioning, operation system support in sensor devices, WSN Characteristics, sensor network operation, sensor Architecture: cluster management.

#### **Text Books :**

1. Data communications and networking 4th edition, Behrouz A Fourzan, TMH
2. Computer networks 4th edition Andrew S Tanenbaum, Pearson
3. Computer networks, Mayank Dave, CENGAGE

#### **Reference Books :**

1. Computer networks, A system Approach, 5th edition, Larry L Peterson and Bruce S Davie, Elsevier.

#### **Web References :**

1. [http://library.aceondo.net/ebooks/Computer\\_Science/Data\\_Communication\\_and\\_Networking\\_by\\_Behrouz.A.Forouzan\\_4th.edition.pdf](http://library.aceondo.net/ebooks/Computer_Science/Data_Communication_and_Networking_by_Behrouz.A.Forouzan_4th.edition.pdf)
2. <https://www.cse.iitk.ac.in/users/dheeraj/cs425/>

**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**  
**(Professional Elective-I)**

**Course code: PP21CSE01**

**Course Prerequisites: None**

**Internal Marks: 30**

**External Marks: 70**

**Course Objectives:**

1. To have a basic proficiency in a traditional AI
2. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics.
3. Familiarity with a set of well-known supervised, unsupervised and semi-supervised learning algorithms.
4. The ability to implement some basic machine learning algorithms.
5. Understanding of Genetic Algorithms.

**Course Outcomes:**

1. Appraise the theory of Artificial intelligence.
2. Illustrate the working of AI Algorithms.
3. Demonstrate the applications of AI.
4. Recognize the characteristics of machine learning that make it useful to real-world Problems.
5. Demonstration of Genetic Algorithms.

**UNIT I:** (10 Lectures)

**Introduction to artificial intelligence:** Introduction ,history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI.

**UNIT-II:** (13 Lectures)

**Problem solving:** state-space search and control strategies, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening A\*.

**Problem reduction and game playing:** Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games

**UNIT III:** (13 Lectures)

**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR knowledge representation using frames.

**UNIT IV:** (12 Lectures)

**Supervised Learning** :Regression Analysis, Linear Regression, Simple Linear Regression, Multiple Linear Regression, Backward Elimination, Polynomial Regression.

**Classification** : Classification Algorithm , Logistic Regression, K-NN Algorithm, Support Vector Machine Algorithm.

**Artificial Neural Network:** Introduction, NN representation, Appropriate problems, Perceptron, Back propagation algorithm. **Bayesian Learning:** Introduction, Bayes theorem, Bayes theorem and concept learning.

**UNIT V:** (12 Lectures)

**Genetic Algorithms:** Different search methods for induction-Explanation-based Learning: using prior knowledge to reduce sample complexity.

**Dimensionality reduction:** feature selection, principal component analysis, linear discriminant analysis, factor analysis, independent component analysis, multidimensional scaling, manifold learning.

**Text Books:**

1. Saroj Kaushik. Artificial Intelligence. Cengage Learning. 2011(UNIT-I, UNIT-II,UNIT-III).
2. Machine Learning: The art and science of algorithms that make sense of data, Peter Flach, Cambridge. (UNIT-IV).
3. Machine Learning, Tom M. Mitchell, MGH.(UNIT-IV)
4. Tom Michel, Machine Learning, McGraw Hill, 1997.(UNIT-V)
5. Trevor Hastie, Robert Tibshirani & Jerome Friedman. The Elements of Statistical Learning, Springer Verlag, 2001.(UNIT-V)

**References:**

1. Elaine Rich, Kevin K and SB Nair,“Artificial Intelligence”, 3rd Edition,McGraw Hill Education, 2017
2. Machine Learning in Action, Peter Harington, 2012, Cengage.

**Web References:**

1. [https://www.tutorialspoint.com/artificial\\_intelligence/index.htm](https://www.tutorialspoint.com/artificial_intelligence/index.htm)
2. <https://www.javatpoint.com/artificial-intelligence-tutorial>
3. <https://lecturenotes.in/subject/128/artificial-intelligence-ai>

**M. Tech- I Year I Semester**

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**DESIGN PATTERNS**  
**(Professional Elective-I)**

**Internal Marks: 30**

**Course Code: PP21CSE02**

**External marks: 70**

**Course Objectives:**

1. Understand the concept of Design patterns and its importance .
2. Understand the behavioral knowledge of the problem and solutions.
3. Relate the Creational, Structural , behavioral Design patterns.
4. Apply the suitable design patterns to refine the basic design for given context.

**Course Outcomes:**

- 1) Identify the appropriate design patterns to solve object oriented design problems..
- 2) Develop design solutions using creational patterns.
- 3) Apply structural patterns to solve design problems.
- 4) Construct design solutions by using behavioral patterns.

**UNIT 1**

**Introduction:** What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

**UNIT 2**

**A Case Study:** Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation.

**UNIT 3**

**Creational Patterns:** Abstract Factory, Builder, Factory Method, Prototype, Singleton.

**UNIT 4**

**Structural Patterns:** Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.

**UNIT 5**

**Behavioral Patterns:** Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, Strategy, Template Method, Visitor.

**Conclusion:**

What to Expect from Design Patterns, The Pattern Community.

**Learning Resource**

**Text Books**

1. Design Patterns By Erich Gamma, Pearson Education
2. Design Patterns Explained By Alan Shalloway, Pearson Education..
3. Meta Patterns designed by Wolf gang , Pearson.

**References**

1. Head First Design Patterns By Eric Freeman-Oreilly-spd
2. JAVA Enterprise Design Patterns Vol-III By Mark Grand ,Wiley DreamTech.
3. Pattern"s in JAVA Vol-I By Mark Grand ,Wiley DreamTech.
4. Pattern"s in JAVA Vol-II By Mark Grand ,Wiley DreamTech.

**BLOCKCHAIN TECHNOLOGY**  
**(Professional Elective-I)**

**Internal Marks: 30**

**Course Code: PP21CSE03**

**External marks: 70**

**Course Prerequisites:** Basic concepts in networking.

**Course Objectives:**

- The students should be able to understand a broad overview of the essential concepts of blockchain technology.
- To familiarize students with Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.
- Students should be able to learn about different types of blockchain and consensus algorithms

**Course Outcomes:**

After completion of this course, students would be able:

- To explain the basic notion of distributed systems.
- To use the working of an immutable distributed ledger and trust model that defines blockchain.
- To illustrate the essential components of a blockchain platform.

**UNIT 1**

**Basics:** The Double-Spend Problem, Byzantine Generals' Computing Problems, Public-Key Cryptography, Hashing, Distributed Systems, Distributed Consensus.

**UNIT 2**

**Technology Stack:** Blockchain, Protocol, Currency. Bitcoin Blockchain: Structure, Operations, Features, Consensus Model, Incentive Model.

**UNIT 3**

**Ethereum Blockchain:** Smart Contracts, Ethereum Structure, Operations, Consensus Model, Incentive Model.

**UNIT 4**

**Tiers of Blockchain Technology:** Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Types Detailed Syllabus for Computer Science & Engineering with Specialization in Block Chain Technology of Blockchain: Public Blockchain, Private Blockchain, Semi-Private Blockchain, Sidechains.

**UNIT 5**

**Types of Consensus Algorithms:** Proof of Stake, Proof of Work, Delegated Proof of Stake, Proof Elapsed Time, Deposite-Based Consensus, Proof of Importance, Federated Consensus or Federated Byzantine Consensus, Practical Byzantine Fault Tolerance. Blockchain Use Case: Supply Chain Management.

**Text Books**

1. Kirankalyan Kulkarni, Essentials of Bitcoin and Blockchain, Packt Publishing.
2. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House.
3. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.
4. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (2017).

**References**

1. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher O'Reilly Publisher Media; 1st edition (2015).
2. Mastering Bitcoin: Programming the Open Blockchain by Andreas Antonopoulos.



**ADVANCED WEB TECHNOLOGIES**  
**(Professional Elective-II)**

**Internal Marks: 30**

**Course Code: PP21CSE04**

**External marks: 70**

**Course Prerequisites:**

**Course objective**

- Able to create Static Web pages using basic HTML & apply CSS
- Able to apply JavaScript features for form validations and event handling
- Able to create databases using MYSQL and apply JDBC concepts to connect to a database.
- Able to create dynamic web pages using servlets & JSP
- Must be able to design WEB site considering the user interface, navigation and interaction with database using project-based LABS

**UNIT –I**

**Introduction to Web, Technologies for Web Development, Introduction to HTML5:** Headings, Linking, Images, Lists, Tables, Frames, Forms and Input types. **Cascading Style Sheets (CSS3):** Introduction, Inline Styles, Embedded Style Sheets, Linking External Style Sheets, positioning Elements.

**UNIT-II**

**JavaScript:** Introduction to Scripting Languages, JavaScript- Control Statements- (if, if-else, switch, while, do-while, for), Document Object Model –objects and collections, Event Handling.

**UNIT-III**

**Database Access with JDBC (Oracle/MYSQL):** Introduction to JDBC architecture, Connection Object, working with statements, Creating and executing SQL statements, working with Result Set.

**UNIT-IV**

**Servlets & Java Server Pages:** Servlet Basics: Handling the Client Request, Generating the Server Response, Overview of JSP Technology, JSP Scripting Elements, Implicit Objects, Accessing MYSQL/Oracle Database with JDBC.

**UNIT-V**

Developing Sample Web Applications using HTML5, CSS3, JavaScript, Servlets/JSP & MYSQL.

**Text books:**

Deitel & Nieto, —Internet & World Wide Web – How to Program, PEA, Fifth Edition.2010.  
Falkner & Jones," Servlets and Java Server Pages: The J2EE Technology Web Tier", 1/e,  
Addison-Wesley Professional, 2008.

**Reference Books:**

1. Chris Bates, —Web Programming Building Internet Applications, 3rd Edition, Wiley India, 2006.
2. Anders Moller, Michael Schwartzbach.
3. An Introduction to XML and Web Technologies, 1st Edition, Pearson Education, 2006.
4. Ivan BayRoss, —Web Enabled Commercial Application Development using HTML, DHTML, JavaScript, Perl, BPB Publication, 3rd Edition, 2005.
5. Uttam K Roy, —Web Technologies, OXFORD University Press, 2012.

**M. Tech- I Year I Semester**

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**ADVANCED OPERATING SYSTEMS**  
**(Professional Elective-II)**

**Internal Marks: 30**

**Course Code: PP21CSE05**

**External marks: 70**

**Course Prerequisites:**

**Course objective**

- Understand Operating system structuring
- Understand Synchronization, communication and scheduling in parallel systems
- Analyze the Distributed systems, their communication mechanisms, distributed objects and middleware
- Identifying the Failures and recovery management
- Understand System support for Internet-scale computing

**Course outcomes**

1. Understand the design approaches of advanced operating systems
2. Analyze the design issues of distributed operating systems.
3. Evaluate design issues of multi processor operating systems.
4. Identify the requirements Distributed File System and Distributed Shared Memory.
5. Formulate the solutions to schedule the real time applications.

**UNIT-1**

**Architectures of Distributed Systems:**

System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.

**Theoretical Foundations:**

Inherent Limitations of a Distributed System, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.

**UNIT-2 Distributed Mutual Exclusion:**

The Classification of Mutual Exclusion Algorithms.

**Non-Token – Based Algorithms:**

Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm.

**Token-Based Algorithms:**

Suzuki-Kasami's Broadcast Algorithm, Singhal's Heuristic Algorithm, Raymond's Heuristic Algorithm.

**UNIT-3**

**Distributed Deadlock Detection:**

Preliminaries, Deadlock Handling Strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control Organizations for Distributed Deadlock Detection, Centralized- Deadlock – Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms



#### **UNIT-4**

##### **Multiprocessor System Architectures:**

Introduction, Motivation for multiprocessor Systems, Basic Multiprocessor System Architectures

##### **Multi Processor Operating Systems:**

Introduction, Structures of Multiprocessor Operating Systems, Operating Design Issues, Threads, Process Synchronization, Processor Scheduling.

##### **Distributed File Systems:**

Architecture, Mechanisms for Building Distributed File Systems, Design Issues

#### **UNIT-5**

##### **Distributed Scheduling:**

Issues in Load Distributing, Components of a Load Distributed Algorithm, Stability, Load Distributing Algorithms, Requirements for Load Distributing, Task Migration, Issues in task Migration

##### **Distributed Shared Memory:**

Architecture and Motivation, Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues

##### **Text Book :**

1. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata McGraw-Hill Edition 2001

##### **References:**

1. Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall, Edition – 2, 2007

**SOFT COMPUTING**  
**(Professional Elective-II)**

**Internal Marks: 30**

**External marks: 70**

**Course Code: PP21CSE06**

**Course Prerequisites:**

**Course objective**

The objective of this course is to

1. familiarize with soft computing concepts
2. introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based on human experience
3. introduce and use the concepts of Genetic algorithm and its applications to soft computing using some applications.

**Course outcomes**

On completion of this course, the students will be able to

1. identify and describe soft computing techniques and their roles in building intelligent machines
2. recognize the feasibility of applying a soft computing methodology for a particular problem
3. apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems, genetic algorithms to combinatorial optimization problems and neural networks to pattern classification and regression problems
4. effectively use modern software tools to solve real problems using a soft computing approach and evaluate various soft computing approaches for a given problem.

**Unit I:**

**Artificial Neural Networks**

Basic-concepts-single layer perception-Multi layer perception-Supervised and unsupervised learning back propagation networks, Application.

**Unit II:**

**Fuzzy Systems**

Fuzzy sets and Fuzzy reasoning-Fuzzy matrices-Fuzzy functions-decomposition-Fuzzy automata and languages- Fuzzy control methods-Fuzzy decision making, Applications.

**Unit III:**

**Neuro-Fuzzy Modeling**

Adaptive networks based Fuzzy interfaces-Classification and Representation trees-Data dustemp algorithm –Rule base structure identification-Neuro-Fuzzy controls

**Unit IV:**

**Genetic Algorithm**

Survival of the fittest-pictures computations-cross over mutation-reproduction-rank method-rank space method, Application.

### **Unit V:**

#### **Artificial Intelligence**

AI Search algorithm-Predicate calculus rules of interface – Semantic networks-frames-objects-Hybrid models, applications.

#### **TEXT BOOKS**

1. E – Neuro Fuzzy and Soft computing – Jang J.S.R., Sun C.T and Mizutami, Prentice hall New Jersey, 1998
2. Fuzzy Logic Engineering Applications – Timothy J.Ross, McGraw Hill, NewYork, 1997.
3. Fundamentals of Neural Networks – Laurene Fauseett, Prentice Hall India, New Delhi, 1994.

#### **REFERENCE BOOKS**

1. Introduction to Artificial Intelligence – E Charniak and D McDermott, Pearson Education
2. Artificial Intelligence and Expert Systems – Dan W. Patterson, Prentice Hall of India.

**RESEARCH METHODOLOGY AND IPR**  
**(Professional Elective-II)**

Course Code: PP21CST03

**Internal Marks: 30**  
**External marks: 70**

**RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS**

Internal Marks: 100

**Course Objectives:**

1. Understand some basic concepts of research and its methodologies.
2. Identify appropriate research topics.
3. Select and define appropriate research problem and parameters.
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner.
6. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.

**Course Outcomes:**

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of
6. Individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

**UNIT- I (7 Lectures)**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

**UNIT-II (6 Lectures)**

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

**UNIT-III (6 Lectures)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.



**UNIT-IV (5 Lectures)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**UNIT-V (6 Lectures)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**Text Books :**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008 References

**Books :**

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.

**Web References:**

1. <https://www.isical.ac.in/~palash/research-methodology/RM-lec4.pdf>
2. [http://www.bitspilani.ac.in/uploads/Patent\\_ManualOct\\_25th\\_07.pdf](http://www.bitspilani.ac.in/uploads/Patent_ManualOct_25th_07.pdf)
3. <https://my.cumbria.ac.uk/media/MyCumbria/IPR-notes-and-guidance.pdf>

**ADVANCED DATA STRUCTURES & ALGORITHMS LAB**

**Course Code: PP21CSL01**

**Internal Marks: 30**

**External marks: 70**

**Prerequisite :** C Programming

**Course Objectives:**

1. To teach efficient storage mechanisms of data for an easy access.
2. To design and implementation of various basic and advanced data structures.
3. To introduce various techniques for representation of the data in the real world.
4. To develop application using data structures.

**Course Outcomes:**

1. Student will be able to choose appropriate data structure as applied to specified problem definition.
2. Student will be able to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
3. Students will be able to use linear and non-linear data structures like stacks, queues , linked list etc

**List of Experiments**

1. To implement Stacks& Queues using Arrays & Linked Lists
2. To implement Double Linked List.
3. To implement Circular Linked List.
4. To implement Binary Tree Traversals.
5. To perform various operations on Binary Search Tree.
6. To implement BFS & DFS for a graph
7. To implement Merge & Heap sort of given elements
8. To perform various operations on AVL trees
9. To implement Krushkal's algorithm to generate a min-cost spanning tree
10. To implement Prim's algorithm to generate min-cost spanning tree.
11. To implement functions of Dictionary using Hashing

**ADVANCED COMPUTING LAB-I**

**Internal Marks: 30**

**Course Code: PP21CSL02**

**External marks: 70**

**List of Experiments:**

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
5. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
6. Write a program to Implement Bankers algorithm for Dead Lock Avoidance.
7. Write a program to Producer-consumer problem Using semaphores.
8. Write a program of bit stuffing used by Data Link Layer.
9. Write a program to configure a Network using Distance Vector Routing protocol.
10. Write Javascript to validate the following fields in a registration form:
  - Name should contain alphabets and length should not be less than 6 characters.
  - Password should not be less than 6 characters.
  - Email id should be in a valid format.
  - Phone number should contain 10 digits only
11. Write a JSP which Authenticate the user when he submits the login form using the user name and password from the database.
12. Write a JSP to insert the student's semester wise percentages and calculate aggregate and insert into database.
13. Write a JSP to search the students according to their aggregate and produce sorted list or according to their Enroll number.
14. Create a servlet to retrieve name and branch details from a html page and print the same using the servlet.

**ENGLISH FOR RESEARCH PAPER WRITING**

**Internal Marks: 100**

**Course Code: PP18CSA01**

**External marks: --**

**Course Prerequisites:** None

**Course Objectives:**

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission.

**UNIT-I**

(7 Lectures)

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

**UNIT-II**

(6 Lectures)

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

**UNIT-III**

(5 Lectures)

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**UNIT-IV**

(5 Lectures)

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

**UNIT-V**

(7 Lectures)

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

**Text Books :**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

**References Books:**

1. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .

2. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**DATA SCIENCE APPLICATIONS WITH PYTHON**

**Course Code: PP21CST05**

**Internal Marks: 30**

**External marks: 70**

**Course Objectives**

The course enables students to

1. Know the fundamentals of programming.
2. Understand the importance of different data types in programming
3. Analyse how data extraction is possible using regular expression
4. Use file concepts when retrieving or storing data is required in python
5. Know how object oriented concepts helps in organizing the coding structure.

**Course Outcomes**

After successful completion of the course students be able to

1. Demonstrate proficiency in handling of loops and creation of functions.
2. Identify the methods to create and manipulate lists, tuples and dictionaries.
3. Discover the commonly used operations involving regular expressions and file system.
4. Interpret the concepts of Object-Oriented Programming as used in python

**UNIT-1**

**12 HOURS**

Data Structures and OOP Python Program Execution Procedure – Statements – Expressions – Flow of Controls – Functions – Numeric Data Types – Sequences – Strings – Tuples – Lists – Dictionaries. Class – Constructors – Object Creation – Inheritance – Overloading. Text Files and Binary Files – Reading and Writing.

**UNIT-2**

**10 HOURS**

Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p-values.

**UNIT-3**

**12 HOURS**

Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples

**UNIT-4**

**12 HOURS**

Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study.

## **UNIT-5**

**Data Wrangling** Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String manipulations – Regular Expressions.

### **Web Resources:**

- [www.anaconda.com](http://www.anaconda.com)
- [www.python.org](http://www.python.org)
- [www.w3schools.com](http://www.w3schools.com)
- <https://www.learnpython.org/>

### **REFERENCES:**

1. Gowrishanker and Veena, “Introduction to Python Programming”, CRC Press, 2019.
2. Python Crash Course, 2nd Edition, By Eric Matthes, May 2019
3. NumPy Essentials, By Leo Chin and Tanmay Dutta, April 2016
4. Joel Grus, “Data Science from scratch”, O'Reilly, 2015.
5. Wes Mc Kinney, “Python for Data Analysis”, O'Reilly Media, 2012.
6. Kenneth A. Lambert, (2011), “The Fundamentals of Python: First Programs”, Cengage Learning
7. Jake Vanderplas. Python Data Science Handbook: Essential Tools for Working with Data 1st Edition.

**MEAN STACK TECHNOLOGIES**

**Course Code: PP21CST06**

**Internal Marks: 30**

**External marks: 70**

**Course Objectives:**

This course is designed to introduce students to learn how to design both the front and back end of web applications. The course will introduce web-based media-rich programming tools for creating interactive web pages.

**Course Outcomes:**

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

1. Apply Angular8 to develop web applications.
2. Make use of Forms and Services.
3. Utilize Node.js to create Server Side Applications.
4. Make use of Express to deploy web applications.
5. Experiment with NoSQL using MongoDB.

**UNIT-I:**

(12 Lectures)

**Introduction to Web:** Internet and World Wide Web, Domain name service, Protocols: HTTP, FTP, SMTP. Html5 concepts, CSS3, Anatomy of a web page.

**JavaScript:** The Basic of JavaScript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions. Angular Java Script Angular JS Expressions: ARRAY, Objects, \$eval, Strings, Angular JS Form Validation & Form Submission, Single Page Application development using Angular JS.

**Unit-II:**

(12 Lectures)

**Angular8:** Introduction, Installation, Creating First Angular8 Application, Architecture, Angular Components and Templates, Data Binding, Directives, Pipes, Services and Dependency Injection

**UNIT-III**

(12 Lectures)

**Angular8:** Reactive Programming, HTTP Client Programming, Angular Material, Routing and Navigation, Forms, Form Validation, CLI Commands.

**Node.js:** Introduction, Node.js Process Model, Node.js Console, Node.js Basics,

**UNIT-IV**

(12 Lectures)

**Node.js Contd. & Express.js:** Node.js Modules, Local Modules, Export Module, Node Package Manager, Node.js Web Server., Node.js File System, Node.js EventEmitter,

**Express.js:** Express.js Web App, Serving Static Resources



## **UNIT-V**

(12 Lectures)

**MongoDB:** Access MongoDB in Node.js, Connecting and Creating Database in MongoDB, Insert Documents, Update Documents, Delete Documents, Query Database.

**Deploying Applications:** Web hosting & Domains, Deployment Using Cloud Platforms.

### **Text Books:**

1. Node.js, MongoDB and Angular Web Development by Brad Dayley, Brendan Dayley- 2nd Edition – Addison –Wesley.
2. Getting MEAN with Mango, Express, Angular and Node by Simon Holmes, Clive Harber-2nd Edition - Manning Publications.
3. MEAN Cookbook by Nicholas McClay- Packt.
4. Web Technologies, Uttam K Roy, Oxford University Press

### **Reference Books:**

1. Node.js: Web Development for Beginners by Joseph Conner.
2. Mean Stack Developer by Camila Cooper.

### **Web References:**

1. <https://www.tutorialspoint.com/angular8/index.htm>.
2. <https://www.edx.org/course/introduction-to-mongodb-using-the-mean-stack>.
3. <https://www.simplilearn.com/full-stack-web-developer-mean-stack-certification-training>.
4. <https://www.tutorialsteacher.com/nodejs/expressjs-web-application>.

**INTERNET OF THINGS  
(Professional Elective-III)**

**Internal Marks: 30  
External Marks: 70**

**Course Code: PP21CSE07**

**Course Prerequisites:** Design for Data, Automation, IP Networking

**Course Objectives:**

1. To understand the fundamentals of Internet of Things.
2. To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
3. To apply the concept of Internet of Things in the real world scenario.

**Course Outcomes:**

1. Design a portable IOT using Arduino/ equivalent boards and relevant protocols.
2. Develop web services to access/control IOT devices.
3. Deploy an IOT application and connect to the cloud.
4. Analyze applications of IOT in real time scenario.

**UNIT- I**

(8 Lectures)

Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoTvs M2M.

**UNIT- II**

(10 Lectures)

IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

**UNIT -III**

(9 Lectures)

Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages –Web services.

**UNIT- IV**

(9 Lectures)

Interfaces - Arduino IDE – Programming - APIs and Hacks.

**UNIT- V**

(9 Lectures)

Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for IoT.

**Text Books :**

1. Arshdeep Bahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015. (Units- 1,2,3,4,5)
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen (Units-4,5)



**Reference Books :**

1. Manoel Carlos Ramon, “Intel Galileo and Intel Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress Open.
2. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing,2014.

**Web References :**

1. <https://iflaso-a6174.firebaseio.com/internet-of-things-a-hands-on-approach-by-arshdeep-bahga-vijay-madisetti.pdf>
2. <https://thebookee.net/net-amp-internet-of-things-ghi-electronics-pdf-dl4261946>

**SOCIAL NETWORK ANALYSIS**  
**(Professional Elective-III)**

**Course Code: PP21CSE08**

**Internal Marks: 30**

**External Marks: 70**

**Course Objectives:**

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

**Course Outcomes:** Upon completion of the course, the students should be able to:

- Develop semantic web related applications.
- Represent knowledge using ontology.
- Predict human behaviour in social web and related communities.
- Visualize social networks.

**UNIT - I : INTRODUCTION**

**Introduction to Semantic Web:** Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks

**UNIT - II :Modelling, Aggregating and Knowledge Representation**

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – **Modelling and aggregating social network data:** State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships

**UNIT - III :Extraction and Mining Communities in Web Social Networks**

Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for

detecting communities social network infrastructures and communities – Decentralized online social networks .

#### **UNIT - IV :Predicting Human Behaviour and Privacy Issues**

Understanding and predicting human behaviour for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation

#### **UNIT - V :Visualization and Applications of Social Networks**

Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, Visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

#### **TEXT BOOKS:**

1. Peter Mika, -Social Networks and the Semantic Web, First Edit ion, Springer 2007.
2. Borko Furht, -Handbook of Social Network Technologies and Applicat ions, 1st Edition, Springer, 2010.

#### **REFERENCES:**

1. Guandong Xu, Yanchun Zhang and Lin Li, Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo - Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, -The Social Semantic Web, Springer, 2009.

#### **WEB REFERENCES:**

1. <https://learnengineering.in/cs6010-social-network-analysis/>
2. [https://www.tutorialspoint.com/social\\_media\\_marketing/social\\_media\\_analysis.htm](https://www.tutorialspoint.com/social_media_marketing/social_media_analysis.htm)
3. <https://cse-notescorner.blogspot.com/2017/01/cs6010-social-network-analysis-syllabus.html>
4. [https://www.sagepub.com/sites/default/files/upm-binaries/35208\\_Chapter1.pdf](https://www.sagepub.com/sites/default/files/upm-binaries/35208_Chapter1.pdf)

**SERVICE ORIENTED ARCHITECTURE  
(Professional Elective-III)**

**Internal Marks: 30  
External Marks: 70**

**Course Code: PP21CSE09**

**Course Objectives:**

- To learn fundamentals of XML
- To provide an overview of Service Oriented Architecture and Web services and their importance
- To learn web services standards and technologies
- To learn service oriented analysis and design for developing SOA based applications

**Course Outcomes:**

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

- Understand XML technologies
- Understand service orientation, benefits of SOA
- Understand web services and WS standards
- Use web services extensions to develop solutions
- Understand and apply service modeling, service oriented analysis and design for application development

**UNIT I**

**XML**

XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath – XML Transformation and XSL – Xquery

**UNIT II**

**SERVICE ORIENTED ARCHITECTURE (SOA) BASICS**

Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures — Principles of Service Orientation – Service layers

**UNIT III**

**WEB SERVICES (WS) AND STANDARDS**

Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography

**UNIT IV**

**WEB SERVICES EXTENSIONS**

WS-Addressing – WS-ReliableMessaging – WS-Policy – WS-Coordination – WS -Transactions  
– WS-Security – Examples

## **UNIT V**

### **SERVICE ORIENTED ANALYSIS AND DESIGN**

SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines — Service design – Business process design – Case Study

### **TEXTBOOKS:**

1. Thomas Erl, — Service Oriented Architecture: Concepts, Technology, and Design, Pearson Education, 2005
2. Sandeep Chatterjee and James Webber, —Developing Enterprise Web Services: An Architect's Guide, Prentice Hall, 2004

### **REFERENCES:**

1. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, —Java Web Services Architecture, Elsevier, 2003.
2. Ron Schmelzer et al. — XML and Web Services, Pearson Education, 2002.
3. Frank P.Coyle, —XML, Web Services and the Data Revolution, Pearson Education, 2002



**CLOUD COMPUTING**  
**(Professional Elective-IV)**

**Course code: PP21CSE10**

**Internal Marks: 30**

**External marks: 70**

**Course Prerequisites:** Basic understanding of servers/computers

**Course Objectives:**

1. To impart fundamental concepts of cloud computing.
2. To differentiate Parallel and distributed computing.
3. To impart knowledge in design of cloud computing.
4. To impart knowledge in applications of cloud computing.
5. To impart knowledge in different aspects of security in cloud computing.

**Course Outcomes:**

1. Understanding the protocols and mechanisms that support cloud computing
2. Understanding the hardware necessary for cloud computing
3. Understanding Cloud Resource Virtualization
4. Understanding Cloud Resource Management and Scheduling
5. Understand cloud security

**UNIT- I**

(8 Lectures)

**Introduction:** Network centric computing, Network centric content, peer-to –peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing

**Parallel and Distributed Systems:** introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, model concurrency with Petri Nets.

**UNIT -II**

(9 Lectures)

**Cloud Infrastructure:** At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing.

**Cloud Computing :** Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, The Map Reduce Program model, HPC on cloud, biological research.

**UNIT- III**

(10 Lectures)

**Cloud Resource Virtualization:** Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades

**Cloud Resource Management and Scheduling:** Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling

#### **UNIT- IV**

(9 Lectures)

**Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system., ApacheHadoop, Big Table, Megastore ( text book 1), Amazon Simple Storage Service(S3) (Text book 2) Cloud Security: Cloud security risks, security – atop concern for cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks

#### **UNIT- V**

(9 Lectures)

**Cloud Application Development:** Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Installing Simple Notification Service on Ubuntu 10.04, Installing Hadoop on Eclipse, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming.

#### **Text Books :**

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MKElsevier
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, RobertElsenpeter, TMH

#### **Reference Books :**

1. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH

#### **Web References :**

1. <https://www.simplilearn.com/cloud-computing-architecture-article>
2. <https://cloudacademy.com/blog/cloud-computing-architecture-an-overview/>
3. <https://www.cloudcruiser.com/cloud-computing-architecture/>

**BIGDATA ANALYTICS  
(Professional Elective-IV)**

**Course code: PP21CSE11**

**Internal Marks: 30**

**External marks: 70**

**COURSE OBJECTIVES :**

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs • Provide hands on Hadoop Eco System
- Apply analytics on Structured, Unstructured Data.
- Exposure to Data Analytics with R.

**COURSE OUTCOMES:**

The students will be able to:

- Identify Big Data and its Business Implications.
- List the components of Hadoop and Hadoop Eco-System
- Access and Process Data on Distributed File System
- Manage Job Execution in Hadoop Environment
- Develop Big Data Solutions using Hadoop Eco System
- Analyze Infosphere BigInsights Big Data Recommendations.
- Apply Machine Learning Techniques using R.

**Pre- requisites :**

Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

**UNIT I :**

**INTRODUCTION TO BIG DATA AND HADOOP**

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

**UNIT II :**

**HDFS(Hadoop Distributed File System)**

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

**UNIT III :**

**Map Reduce**

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

#### **Unit IV :**

##### **Hadoop Eco System**

**Pig :** Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

**Hive :** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

**Hbase :** HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

**Big SQL :** Introduction

#### **UNIT V :**

##### **Data Analytics with R**

Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

#### **Text Books**

- Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
- Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

#### **References**

- Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007.
- Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press (2013)
- Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media (2013), Oracle press.
- Anand Rajaraman and Jeffrey David Ulman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
- Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
- Glen J. Myat, “Making Sense of Data”, John Wiley & Sons, 2007
- Pete Warden, “Big Data Glossary”, O’Reily, 2011.
- Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
- ArvindSathi, “BigDataAnalytics: Disruptive Technologies for Changing the Game”, MC Press, 2012
- Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform " , Tata McGraw Hill Publications, 2012.

**GPU PROGRAMMING**  
**(Professional Elective-IV)**

**Course code: PP21CSE12**

**Internal Marks: 30**

**External marks: 70**

**COURSE OBJECTIVES :**

- To understand the basics of GPU architectures
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

**COURSE OUTCOMES:**

Upon completion of the course, the students will be able to

- Describe GPU Architecture
- Write programs using CUDA, identify issues and debug them
- Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication
- Write simple programs using OpenCL
- Identify efficient parallel programming patterns to solve problems

**UNIT I**

**GPU ARCHITECTURE**

Evolution of GPU architectures – Understanding Parallelism with GPU – Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

**UNIT II**

**CUDA PROGRAMMING**

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

**UNIT III**

**PROGRAMMING ISSUES**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

**UNIT IV**

**OPENCL BASICS**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.



## **UNIT V**

### **ALGORITHMS ON GPU**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

### **TEXT BOOKS:**

1. Shane Cook, *CUDA Programming: —A Developer’s Guide to Parallel Computing with GPUs (Applications of GPU Computing)*, First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —*Heterogeneous computing with OpenCL*, 3rd Edition, Morgan Kauffman, 2015.

### **REFERENCES:**

1. Nicholas Wilt, —*CUDA Handbook: A Comprehensive Guide to GPU Programming*, Addison – Wesley, 2013.
2. Jason Sanders, Edward Kandrot, —*CUDA by Example: An Introduction to General Purpose GPU Programming*, Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, *Programming Massively Parallel Processors – A Hands-on Approach*, Third Edition, Morgan Kaufmann, 2016.
4. [http://www.nvidia.com/object/cuda\\_home\\_new.html](http://www.nvidia.com/object/cuda_home_new.html)
5. <http://www.openCL.org>

**DATA SCIENCE WITH PYTHON LAB**

**Internal Marks: 30**

**Course Code: PP21CSL03**

**External marks: 70**

**COURSE OUTCOMES:**

After the completion of this course the student should be able to

CO1: Develop programs using python

CO2: Develop programs using NumPy

CO3: Develop programs using Pandas

**LIST OF EXPERIMENTS**

1. The student has to experiment the given below programs:
  - a) To convert list of tuples into list of strings in python
  - b) To remove duplicate lists in tuples using comprehensions.
  - c) Write a python program to create and display all combinations of letters, selecting each letter from a different key in a dictionary.
2. Experiments in NumPy
  - a) create a 2X3 array using NumPy
  - b) create a 2X3 array in an array of 8 with random numbers
  - c) Create a list and convert into array using NumPy command
  - d) Find out shape and type of an array
3.
  - a) Operations between Arrays and Scalars
  - b) Create a 3d array, copy array to another array(old\_array) using copy command, restore old\_array
  - c) Boolean Indexing:  
create an array with names 'Bob', 'Joe', 'Will', 'Bob', 'Will', 'Joe', 'Joe'  
create a Boolean array by comparing names with 'Bob'  
create a random array of size (7,3), assume that each row belongs one person and display the rows corresponding to 'Bob'  
(Hint: use Boolean indexing)
  - d) Fancy Indexing  
Create an array like: array  
([[ 0., 0., 0., 0.],  
 [ 1., 1., 1., 1.],  
 [ 2., 2., 2., 2.],  
 [ 3., 3., 3., 3.],  
 [ 4., 4., 4., 4.],  
 [ 5., 5., 5., 5.],  
 [ 6., 6., 6., 6.],  
 [ 7., 7., 7., 7.]])  
Display rows as given below using fancy +ve indexing array  
([[ 4., 4., 4., 4.],  
 [ 3., 3., 3., 3.],  
 [ 0., 0., 0., 0.]])



[ 6., 6., 6., 6.])

Display rows as given below using fancy -ve indexing array

([[ 5., 5., 5., 5.],

[ 3., 3., 3., 3.],

[ 1., 1., 1., 1.]])

- e) do an experiment Expressing Conditional Logic as Array Operations?
  - f) Generate 5X4 Matrix and do some Mathematical and Statistical operations on that data.
  - g) Do an experiment on sort, unique and setlogic
  - h) LINEAR ALGEBRA MATRIX MULTIPLICATION Transpose inverse Experiments using pandas
4. Series using pandas
    - a) Load the car data into frame without headers using pandas
    - b) display top 5 rows
    - c) display last 10 rows
    - d) save the file into various formats (csv,excel, pdf,JSON, sql)
    - e) display data types of each column
  5. Perform different operations in dataframe using pandas
    - a)dropping
    - b)concatenating values
  6. Filtering data from csv file using pandas By using single condition filtering
  7. Draw a barplot graph in pandas using group by filter condition and also plot graph with series and dataframe.
  8. a) Find the data distributions using box and scatter plot.
    - b) Find the outliers using plot.
    - c) Plot the histogram, bar chart and pie chart on sample data.
  9. a) How to find a corelation matrix and plot the correlation on iris data set.
    - b) Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.

**ADVANCED COMPUTING LAB - II**

**Course Code: PP21CSL04**

**Internal Marks: 30**

**External marks: 70**

**COURSE OUTCOMES:**

1. Knowledge on concepts and features of Angular.
2. Identify the important issues of developing Web applications.
3. Organize the functionalities and components of Angular and Node.js to develop projects.

**LIST OF EXPERIMENTS:**

1. Write a Angular JS Program to print your Details
2. Write a Angular JS program to binding data and perform Expressions using ng-bind
3. Write a Angular JS program using Angular JS Directives?
4. Write a Angular JS Program for creating Tables
5. Write a Angular JS Program for creating forms and perform the validation
6. Write a Node.js Program to create a HTTP server using HTTP Module
7. Write a Node.js Program to Perform operations on files
  - a) Read files
  - b) Create files
  - c) Update files
  - d) Delete files
  - e) Rename files
8. (a) Implement the following file management tasks in Hadoop:
  - i. Adding files and directories
  - ii. Retrieving files
  - iii. Deleting files(b) Benchmark and stress test an Apache Hadoop cluster.
9. (a) Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
  - i. Find the number of occurrence of each word appearing in the input file(s)
  - ii. Performing a MapReduce Job for word search count (look for specific keywords in a file)
10. Implementing Matrix Multiplication with Hadoop Map Reduce.
11. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**

**Internal Marks: 100**

**Course Code: PP21CSA02**

**Course Prerequisites:** None

**Course Objectives:**

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom in students.

**Course Outcomes:**

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

**UNIT-I**

(6 Lectures)

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

**UNIT-II**

(5 Lectures)

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

**UNIT-III**

(6 Lectures)

Approach to day to day work and duties.

Shrimad BhagwadGeeta:

Chapter 2-Verses 41, 47,48

Chapter 3-Verses 13, 21, 27, 35

Chapter 6-Verses 5,13,17, 23, 35

Chapter 18-Verses 45, 46, 48.

**UNIT-IV**

(7 Lectures)

Statements of basic knowledge.

Shrimad BhagwadGeeta:

Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

**UNIT-V**

(6 Lectures)

Personality of Role model.

Shrimad BhagwadGeeta:

Chapter2-Verses 17,

Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

**References:**

1. “Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.

**DEEP LEARNING**

**Internal Marks: 30**

**External marks: 70**

**Course Code: PP21CSE13**

**Course Objectives:**

At the end of the course, the students will be expected to:

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Learn deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Know the open issues in deep learning, and have a grasp of the current research directions.

**Course Outcomes:**

After the completion of the course, student will be able to

- Demonstrate the basic concepts fundamental learning techniques and layers.
- Discuss the Neural Network training, various random models.
- Explain different types of deep learning network models.
- Classify the Probabilistic Neural Networks.
- Implement tools on Deep Learning techniques.

**UNIT- I**

(8 Lectures)

**Introduction:** Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques. Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network.

**UNIT-II**

(10 Lectures)

**Training Neural Network:** Risk minimization, loss function, back propagation, regularization, model selection, and optimization.

**Conditional Random Fields:** Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

**UNIT- III**

(9 Lectures)

**Deep Learning:** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolution Neural Network, Recurrent Neural Network, and Deep Belief Network.

**UNIT- IV**

(9 Lectures)

**Probabilistic Neural Network:** Hopfield Net, Boltzmann machine, RBMs, Sigmoid net, Auto encoders.

**UNIT –V**

(9 Lectures)

**Applications:** Object recognition, sparse coding, computer vision, natural language processing.

**Introduction to Deep Learning Tools:** Caffe, Theano, Torch..

**Text Books :**

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

**References Books :**

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

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## DEVOPS

Course Code: PP21CSE14

Internal Marks : 30

External Marks: 70

**Course Prerequisite:** Nil

### Course Objectives

- DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance

### Course Outcomes:

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

- Demonstrate the phases of software development life cycle.
- Outline the basic Fundamentals of DevOps.
- Adopt the DevOps technology into the project.
- Evaluate the CI/CD concepts and metrics to track CI/CD practices.
- Summarize the importance of DevOps maturity models.

### UNIT I:

(9 Lectures)

Phases of Software Development life cycle. Values and principles of agile software development.

### UNIT II:

(9 Lectures)

Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of Applications, DevOps delivery pipeline, DevOps eco system.

### UNIT III:

(9 Lectures)

DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes

### UNIT IV:

(9 Lectures)

CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICD practices

### UNIT V:

(9 Lectures)

Devops Maturity Model: Key factors of DevOps maturity model, stages of Devops maturity Model, DevOps maturity Assessment.

**TEXT BOOKS:**

1. Gene Kim , John Willis , Patrick Debois, “The DevOPS Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations” Jez Humble,O’Reilly Publications
2. Mike Loukides, “What is Devops? Infrastructure as code” O’Reilly publications.
3. Jez Humble and David Farley, “Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation”,
4. Dave Harrison, Knox Lively, “Achieving DevOps: A Novel About Delivering the Best of Agile, DevOps, and Microservices.
1. Joakim Verona , Packt, “Practical Devops”

**REFERENCE BOOKS:**

1. Mandi Walls, “Building a DevOps Culture”, O’Reilly publications
2. Viktor Farcic, “The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline With Containerized Micro services”

**WEB REFERENCES:**

1. <https://www.youtube.com/watch?v=hQcFE0RD0cQ>
2. [https://www.youtube.com/watch?v=YSkDtQ2RA\\_c](https://www.youtube.com/watch?v=YSkDtQ2RA_c)
3. <https://www.svrtechnologies.video/courses/devops-training-free/lectures/10955807>
4. [https://www.youtube.com/watch?v=MOZMw5\\_fBFA](https://www.youtube.com/watch?v=MOZMw5_fBFA)

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