

**PONDICHERRY UNIVERSITY**  
**PUDUCHERRY**



**ACADEMIC CURRICULUM**  
**(SYLLABUS AND REGULATIONS)**

**FOR**

**B.Voc – SOFTWARE DEVELOPMENT AND MACHINE LEARNING**

**BACHELOR OF VOCATIONAL DEGREE**  
**CHOICE BASED CREDIT SYSTEM**

**(from the Academic Year 2022-23 onwards)**

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## **1. Introduction**

### **1.1. About B.Voc**

Realizing the importance and the necessity for developing skills among students, and creating work ready manpower on large scale especially to meet the demand-supply mismatch in the Indian Economy, the University Grants Commission (UGC), Ministry of HRD, Government of India had launched a scheme on 27 February 2014 for skills development based higher education as part of college/university education, leading to Bachelor of Vocation (B.Voc). In these courses, the institute will conduct general education content and sector-specific skills will be imparted by Skill Knowledge Providers/ Training Providers/ Industries.

## **2. Eligibility for Admission:**

Candidates for admission to B.Voc (Software Development & Machine Learning) shall be required to have passed 10+2 or 10+ITI (2 years) or its equivalent from a recognized board of examination.

## **3. Medium:**

The medium of instruction shall primarily be English.

## **4. Key Features:**

### **Objectives**

- To ensure integral development of skills, competencies, and inner capacities. Specifically, skills related to their program, competencies to use skills to create empowering cultures at home and work, and to know their inner capacity of the values they stand for in life.
- To ensure that the students are adequately developed at each exit point of the program.
- To provide flexibility to the students by means of pre-defined entry and multiple exit points.
- To address the National Skills Qualifications Framework (NSQF) within the undergraduate level of higher education by developing the five minds of the future to enhance the impact of the students when they are engaged in an industry or when they create their own enterprise.
- Providing vertical mobility to students admitted in such vocational courses through certification levels will lead to Diploma/Advanced Diploma/B. Voc. A degree in Software development and machine learning will be offered by Pondicherry University.
- Students may be awarded Level Certificate/Diploma/Advanced Diploma /Degree as outlined in the Table:

<b>Award</b>	<b>Course</b>	<b>Duration after class XII or equivalent</b>	<b>Corresponding NSQF level</b>
Level 4 Certificate	Certificate	06 Months (30 Credits)	<b>4</b>
Level 5 Certificate	Diploma	1 Year (60 Credits)	<b>5</b>
Level 6 Certificate	Advance Diploma	2 Year (120 Credits)	<b>6</b>
<b>Level 7 Certificate</b>	<b>B.Voc Degree</b>	<b>3 Year (180 Credits)</b>	<b>7</b>

## 5. Course Objectives

The course aims to develop the integral personality of an individual as needed at the highest level of NSQF in stages. After completing the vocational course, the student would not only have acquired relevant appropriate, and adequate technical knowledge to work in high-end jobs like software development and machine learning, but also have competencies not just to take up gainful employment, but to create a healthy environment in the workplace and some will even be able to start their enterprise.

### A. Understanding of

- The relevant concepts and principles in essential science and Mathematics. So that he/she can understand the different vocational subjects.
- The concepts and principles of different programming languages
- The concepts of object-oriented programming language, graphical user interface, operating system, machine learning, and data processing visualization
- Understanding of the software development life cycle process

### B. Adequate Professional Skills and Competencies in

- 1) Apply the knowledge of programming, mathematics, machine learning for complex problem-solving.
- 2) Design the solution for complex engineering problems and design the system components or processes that meet the specific needs with appropriate consideration for public health and safety and cultural societal, and environmental considerations in alignment with personal and organizational values.
- 3) Create, select, and apply appropriate modern IT tools including prediction.
- 4) Apply ethical principles and commit responsibility to the engineering practice.

### **C. A Healthy and Professional Attitude so that He/ She has**

- 5) An analytical approach while working on a job.
- 6) An open mind learning new IT tools/ programming language
- 7) Respect for working with his/her own hands.
- 8) Respect for honesty, punctuality, and truthfulness

### **D. NSQF compliant skills in Qualification developed by sector skill council in Capital Goods Sector.**

## **6. Course Structure**

The course will consist of a combination of theory, practice, hands-on skills, and integral development of the personality. The curriculum of the past where there are separate theories and practical's is replaced by immediate application to build a disciplined mind. Each item needs to be understood, practiced and remembered for this. Further, there is a need to synthesize so that the learning can be increased and does not get lost as the students continue to grow their skills and knowledge. In addition, the development of leadership and agency in students will help the program be effective.

### **Skill Development Components:**

- The focus of skill development components shall be to equip students with appropriate knowledge, practice, and attitude, to become work-ready. The skill development components will be relevant to the industry as per its requirements.
- The overall design of the skill development component along with the job roles selected will be such that it leads to a comprehensive specialization in a few domains.
- The curriculum will focus on work-readiness skills in each of the years of training.
- Adequate attention will be given in curriculum design to practical work, on-the-job training, development of student portfolios, and project work.

### **General Education Component:**

- The general education component adheres to the normal senior secondary and university standards. It will emphasize and offer courses that provide holistic development. However, it will not exceed 40% of the total curriculum.
- Adequate emphasis is given to language and communication skills.

The curriculum should be designed in a manner that at the end of year-1, year-2 and year-3, students can meet the below-mentioned level descriptors for level 5, 6 and 7 of NSQF, respectively which are as given below:

Level	Process required	Professional Knowledge	Professional skill	Core skill	Responsibility
<b>Level 5</b>	Job that requires well developed skill, with clear choice of procedures in familiar context	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools materials and information	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning
<b>Level 6</b>	Demands wide range of specialized technical skill, clarity of knowledge and practice in broad range of activity involving standard/ non-standard practices	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Reasonably good in mathematical calculation, understanding of social, political and reasonably good in data collecting organizing information, and logical communication	Responsibility for own work and learning and full responsibility for other's works and learning
<b>Level 7</b>	Requires a command of wide ranging specialized theoretical and practical skill, involving variable routine and non-routine context	Wide ranging, factual and theoretical knowledge in broad contexts within a field of work or study	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Good logical and mathematical skill understanding of social political and natural environment good in collecting and organizing information, communication and presentation skill	Full responsibility for output of group and development

## ELIGIBILITY FOR APPEARING FOR SEMESTER EXAMINATION:

Although having 100% overall attendance in all of the courses throughout a semester is desirable, a student must have at least 75% overall attendance in order to be eligible to take the exam. A student who has an overall attendance rate of less than 75% but a semester attendance rate of 60% or above may only be authorised to present for the semester examination on medical grounds after submitting the required condonation fee and a medical certificate issued by a medical officer.

If a student's overall attendance for a semester is less than 60%, they are not allowed to take the semester exam and therefore cannot continue to the next semester. Those students have to enroll in the course again the following academic year in the same semester.

## 7. Assessment

### a. Theory Courses

All theory courses shall be assessed as follows:

Assessment Method	Marks
Continuous Assessment (Internal)	40
Semester Examination (External)	60
Total	100

#### *Continuous Assessment (Internal)*

Continuous Assessment (Internal)	Marks
Attendance	05
Internal Assessment Test	25
Assignments	10
Total	40

Attendance carries 5 marks (5 marks for 100% to 95% attendance, 4 marks for 94% to 90% attendance, 3 marks for 89% to 85% attendance, 2 marks for 84% to 80% attendance and 1 mark for 79% to 75% attendance), cycle test carries 25 marks. Performance in the best two of the three tests will be taken for assessment. Assignments carrying 10 marks, shall be in the form of problems, small projects, quizzes, design problems, etc., depending upon the subject content.

### ***Semester Examination***

The pattern of Semester Examination question papers for theory courses is as follows:

- a) The duration of the examination shall be 3 hours with a maximum of 60 marks.
- b) Section A contains 5 compulsory questions each carrying 2 marks. Only one question shall be selected from each unit. This section carries 10 marks in total.
- c) Section B contains five questions, one question from each unit with '*either*' '*or*' choice. Each question carries ten marks. Based on necessity, each question may contain sub-divisions. This section carries 50 marks in total.

### **b. Practical Courses:**

All practical courses shall be assessed as follows:

<b>Assessment Method</b>	<b>Marks</b>
Continuous Assessment	40
Semester Examination	60
Total	100

### ***Continuous Assessment (Internal)***

<b>Continuous Assessment (Internal)</b>	<b>Marks</b>
Attendance	05
Model examination	15
Regular Laboratory Work	20
Total	40

Attendance carries 5 marks (5 marks for 100% to 95% attendance, 4 marks for 94% to 90% attendance, 3 marks 89% to 85% attendance, 2 marks for 84% to 80% attendance and 1 mark for 79% to 75% attendance). The regular performance in the practical class (Observation and Record) will be evaluated for 20 marks. Performance in the Model examination conducted at the end of the semester will be evaluated for 15 marks. The pattern of the Model Examination will be similar to the Semester Examination.



### ***Semester Examination***

The Semester Examination of the practical courses will be evaluated for 60 marks by a panel of examiners comprising an internal examiner and an external examiner. The Break-up of marks is as follows:

Algorithm	: 10 marks
Practical work and calculations	: 40 marks
Viva-Voce	: 10 marks

### **c. Project Work**

- i) The Project work carried out in the seventh and eighth semesters- shall be assessed as follows:

<b>Assessment Method</b>	<b>Marks</b>
Continuous Assessment (Internal Evaluation)	60
Semester Examination (External Evaluation)	40
Total	100

- ii) Marks allocated for *Continuous Assessment* are distributed as given in the following table.

<b>Assessment Method</b>	<b>Marks</b>
Guide	25
Project Evaluation Committee	35
Total	60

- a) The guide shall evaluate the student for 25 marks based on the work carried out.
- b) The Project Evaluation Committee comprising the Head of the Department and two other faculty members shall evaluate the project for 35 marks. The evaluation will be carried out through three reviews. The Project Evaluation Committee is constituted by the Head of the Department.
- iii) The final *Semester Examination* of the Project Work will be conducted by a panel of examiners comprising an internal examiner and an external examiner. The Break-up of marks is as follows:

Project report	: 15 marks
Presentation	: 15 marks
Viva-Voce	: 10 marks

#### d. Theory Cum Practice Courses

All theory cum practice courses shall be assessed as follows:

Assessment Method	Marks
Continuous Assessment (Internal)	40
Semester Examination (External)	60
Total	100

##### *Continuous Assessment (Internal)*

Continuous Assessment (Internal)	Marks
Attendance	05
Internal Assessment (Cycle Test + Model Exam)	20
Regular Laboratory work	15
Total	40

Attendance carries 5 marks (5 marks for 100% to 95% attendance, 4 marks for 94% to 90% attendance, 3 marks for 89% to 85% attendance, 2 marks for 84% to 80% attendance, and 1 mark for 79% to 75% attendance), Internal Assessment test comprises of cycle test carries 10 marks (Performance in the best two of the three tests will be taken for assessment) and the model examination conducted at the end of the semester which carries 10 Marks, and regular performance in the practical class (Observation and Record) will be evaluated 15 marks.

##### *Semester Examination*

The *Semester Examination* will be conducted as Semester Examination theory and semester Examination Practical each carrying 30 Marks.

The pattern of Semester Examination question papers for theory courses is as follows:

- The duration of the examination shall be 2 hours with a maximum of 30 marks.
- Section A contains five questions, one question from each unit with 'either' 'or' choice. Each question carries six marks. Based on necessity, each question may contain sub-divisions.

The Semester Examination of the practical courses will be evaluated for 30 marks by a panel of examiners comprising an internal examiner and an external examiner. The Break-up of marks is as follows:

Procedure	: 10 marks
Practical work and calculations	: 15 marks
Viva-Voce	:05 marks

#### **e. On-Job Training**

Depending on the job role (Qualification Packs) that the students have chosen in the industries, the assessment for on-the-job training will be carried out in accordance with the relevant Skill Sector Council.

#### **f. Declaration of Results**

##### **Examination Passing Criteria:**

- i. A student is declared to have *passed* a course if he gets 40% marks and above in the Semester Examination and 50% marks and above overall (Semester Exam marks and Continuous Assessment marks put together).
- ii.If a student fails to clear the semester examination of a theory course after three consecutive attempts, the passing criteria from the fourth attempt onwards will be based on the marks earned by the student in the end-semester examination only. The student is deemed to have passed the course if the mark scored in the end semester examination is 50% and above and he will be awarded only a **C grade** irrespective of the mark scored.

#### **g. Award of grades**

The performance of students in a course is expressed in terms of Letter Grades, each carrying certain Grade Points. A total of Six passing Grades namely O, A+, A, B+, B, and C is awarded. Total marks (*sum of Continuous Assessment and Semester Examination marks*) secured by a student in a course are used for computing his Grade by fitting the mark into the Range of Marks assigned for each Grade shown in the table below.

Range of Marks	Letter Grade	Grade Points
91 to 100	O	10
81 to 90	A+	9
71 to 80	A	8
61 to 70	B+	7
56 to 60	B	6
50 to 55	C	5
0 to 49	F	0
Absent	FA	0

- b. A student who has secured an 'F' and 'FA' grade shall reappear for the examination in the following semesters. A student who has scored a passing grade other than an "F" and "FA" cannot reappear for the examination.
- c. A student securing an 'F' grade in an elective course may reappear for the examination in the following semester or drop the elective course and subsequently register for another elective course in the following semester in place of the dropped elective course.
- d. *Grade Point Average* (GPA) indicates the performance of a student in all the examinations appeared him in a particular semester. GPA score will appear in all the Semester Examination Grade Cards. The *Grade Point Average* (GPA) for a particular semester is calculated as the ratio of the sum of the products of the number of Credits of a course ( $C_i$ ) and the Grade Points scored in that course ( $GP_i$ ), taken for all the courses, to the sum of the number of credits of all the courses ( $n$ ) registered in that semester.

$$GPA = \frac{\sum_1^n C_i GP_i}{\sum_1^n C_i}$$

where  $n$  is the number of courses registered in that semester. For a student who has partially withdrawn from writing examinations of courses in a semester,  $n$  is counted as the total number of courses that appeared in that semester minus the number of courses partially withdrawn.

- e. *Cumulative Grade Point Average* (CGPA) indicates the performance of a student in all the examinations appeared by him up to a particular semester. CGPA score will appear in all the Semester Examination Grade Cards starting from the first semester. The *Cumulative Grade Point Average* (CGPA) up to a particular semester is calculated as follows:

$$CGPA = \frac{\sum_1^n C_i GP_i}{\sum_1^n C_i}$$

where  $C_i$  is the Credit of a course,  $GP_i$  is the Grade Point obtained by the student in that course and  $n$  is the total number of courses registered up to that semester starting from the first-semester

## **CURRICULUM**

Below Table shows cumulative credits awarded to the learners in skill-based vocational courses.

NSQF Level	Skill Component Credits	General Education Credits	Total Credits for Award	Normal Duration	Exit Points/ Awards
4	18	12	30	One Semester	Certificate
5	36	24	60	Two Semesters	Diploma
6	72	48	120	Four Semesters	Advanced Diploma
7	108	72	180	Six Semesters	B.Voc Degree

NSQF Level 4 SEMESTER - I							
Sl. No	Course Code	Course Title	Category	L	T	P	C
<b>THEORY</b>							
1		Introduction to Programming	VC	4	0	0	4
2		Fundamentals of Web Design	VC	3	0	0	3
3		English - I	GSH	3	0	0	3
4		Applied Mathematics	GSH	3	0	0	3
<b>LABORATORY</b>							
5		Programming and Web Designing Lab	VC	0	0	8	4
6		Operating system (Theory and Practice)	VC	2	0	4	4
7		Arduino programming in Python	VG	0	0	6	3
8		Essential Science (Theory and practice)	GSH	2	0	2	3
9		Indian culture and universal values	GSH	1	0	4	3
<b>TOTAL CREDITS</b>							<b>30</b>

NSQF Level 5 SEMESTER - II							
Sl. No	Course Code	Course Title	Category	L	T	P	C
<b>THEORY</b>							
1		Introduction to AI and Machine Learning	VC	4	0	0	4
2		English - II	GSH	3	0	0	3
3		Mathematics of Machine Learning - I	GSH	3	0	0	3
<b>LABORATORY</b>							
4		AI and Machine Learning Lab	VC	0	0	6	3
5		Interactive Python Programming (Theory and Practice)	GSH	2	0	4	4
6		Integral yoga & value embodied leadership - I	GSH	1	0	4	3
<b>ON-JOB-TRAINING (OJT)</b>							
7		On the Job Training					10
<b>TOTAL CREDITS</b>							<b>30</b>

NSQF Level 6 SEMESTER - III							
Sl. No	Course Code	Course Title	Category	L	T	P	C
<b>THEORY</b>							
1		Data Structures and algorithms	VC	4	0	0	4
2		Software Engineering	VC	4	0	0	4
3		Mathematics for Machine Learning - II	GSH	3	0	0	3
4		Basic Indian Language	GSH	3	0	0	3
<b>LABORATORY</b>							
5		Information Security (Theory and Practice)	VG	2	0	4	4
6		Data Structures and algorithm Lab	VC	0	0	6	3
7		Frontend programming (Theory and Practice)	VC	2	0	4	4
8		Mobile Application Development	GSH	1	0	4	3
9		Integral yoga & value embodied leadership I - Refresher	GSH	1	0	4	3
<b>TOTAL CREDITS</b>							<b>30</b>

NSQF Level 6 SEMESTER - IV							
Sl. No	Course Code	Course Title	Category	L	T	P	C
<b>THEORY</b>							
1		Machine Learning Algorithms - I	VC	4	0	0	4
2		Foreign Language (German/French)	GSH	3	0	0	3
3		Discrete Mathematics	GSH	3	0	0	3
<b>LABORATORY</b>							
4		Database Systems (Theory and Practice)	VC	2	0	4	4
5		Machine Learning Algorithms Lab - I	VC	0	0	6	3
6		Integral yoga & value embodied leadership II	GSH	1	0	4	3
<b>ON-JOB-TRAINING</b>							
7		On the Job Training					10
<b>TOTAL CREDITS</b>							<b>30</b>

NSQF Level 7 SEMESTER - V							
Sl. No	Course Code	Course Title	Category	L	T	P	C
<b>THEORY</b>							
1		Machine Learning Algorithms - II	VC	4	0	0	4
2		Computer Networks	VG	4	0	0	4
3		Vocational Elective-I	VE	3	0	0	3
4		Vocational Elective -II	VE	3	0	0	3
5		Soft Skill Development – I	GSH	3	0	0	3
<b>LABORATORY</b>							
6		Machine Learning Algorithms Lab - II	VC	0	0	8	4
7		Integral yoga & value embodied leadership II - Refresher	GSH	1	0	4	3
<b>EMPLOYABILITY/ENTREPRENEURSHIP ENHANCEMENT COURSE</b>							
8		Project Phase- I					6
<b>TOTAL CREDITS</b>							<b>30</b>



NSQF Level 7 SEMESTER - VI							
Sl. No	Course Code	Course Title	Category	L	T	P	C
<b>THEORY</b>							
1		Deep Learning	VC	4	0	0	4
2		Vocational Elective -III	VE	3	0	0	3
3		Soft Skill Development – II	GSH	1	2	0	3
<b>LABORATORY</b>							
4		Cloud Computing (Theory and Practice)	VC	2	0	4	4
5		Deep Learning Lab	VC	0	0	8	4
6		Indian culture and universal values	GSH	1	0	4	3
7		Innovative and Design Thinking	GSH	1	0	4	3
<b>EMPLOYABILITY/ENTREPRENEURSHIP ENHANCEMENT COURSE</b>							
8		Project Phase- II					6
<b>TOTAL CREDITS</b>							<b>30</b>

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/ her vocational skills.

**PROGRAMME TOTAL CREDITS = 180**

**GENERAL SCIENCE AND HUMANITIES (GHS)**

Sl. No	Course Code	Subject	Semester	Credits
1		English - I	I	3
2		Applied Mathematics	I	3
3		Essential Science (Theory and Practice)	I	3
4		Indian culture and universal values	I	3
5		English - II	II	3
6		Mathematics of Machine Learning - I	II	3
7		Interactive Python Programming (Theory and Practice)	II	4
8		Integral yoga & value embodied leadership - I	II	3
9		Mathematics for Machine Learning - II	III	3
10		Basic Indian Language (Hindi)	III	3
11		Mobile Application Development	III	3
12		Integral yoga & value embodied leadership I - Refresher	III	3
13		Foreign Language (German/French)	IV	3
14		Discrete Mathematics	IV	3
15		Integral yoga & value embodied leadership II	IV	3
16		Soft Skill Development – I	V	3
17		Integral yoga & value embodied leadership II - Refresher	V	3
18		Soft Skill Development – II	VI	3
19		Indian culture and universal values	VI	3
20		Innovative and Design Thinking	VI	3
		<b>TOTAL CREDITS</b>		<b>61</b>

### VOCATIONAL GENERAL (VG)

Sl. No	Course Code	Subject	Semester	Credits
1		Arduino programming in Python	I	3
2		Information Security (Theory and Practice)	III	3
3		Computer Networks	V	4
		<b>TOTAL CREDITS</b>		<b>10</b>

### VOCATIONAL CORE COURSES (VC)

Sl. No	Course Code	Subject	Semester	Credits
1		Introduction to Programming	I	4
2		Fundamentals of Web Design	I	3
3		Programming and Web Designing Lab	I	4
4		Operating system (Theory and Practice)	I	4
5		Introduction to AI and Machine Learning	II	4
6		AI and Machine Learning Lab	II	3
7		Data Structures and algorithms	III	4
8		Software Engineering	III	4
9		Data Structures and algorithm Lab	III	3
10		Frontend Programming (Theory and Practice)	III	4
11		Machine Learning Algorithms - I	IV	4
12		Database Systems (Theory and Practice)	IV	4
13		Machine Learning Algorithms Lab - I	IV	3
14		Machine Learning Algorithms - II	V	4
15		Machine Learning Algorithms Lab - II	V	4
16		Deep Learning	VI	4
17		Cloud Computing (Theory and Practice)	VI	4
18		Deep Learning Lab	VI	4
19		<b>TOTAL CREDITS</b>		<b>68</b>

### VOCATIONAL ELECTIVE COURSES (VE)

Sl. No	Course Code	Subject	Semester	Credits
1		Intelligent Database Systems	V	3
2		IoT Cloud And Data Analytics	V	3
3		Social Network Analytics	V	3
4		Software Testing	V	3
5		Programming For Problem Solving	V	3
6		High-Performance Computing	V	3
7		Communication Network	V	3
8		Mobile Computing	V	3
9		Image and Video Processing	VI	3
10		High-Performance Computing	VI	3
11		Organizational Behaviour	VI	3
12		Wireless Computing	VI	3
13		Software Project Management	VI	3
		<b>TOTAL CREDITS</b>		<b>9</b>

### EMPLOYABILITY/ENTREPRENEURSHIP ENHANCEMENT COURSES (EEC)

Sl. No	Course Code	Subject	Semester	Credits
1		Project Phase- I	V	6
2		Project Phase- II	VI	6
		<b>TOTAL CREDITS</b>		<b>12</b>

### ON JOB TRAINING COURSE (OJT)

Sl. No	Course Code	Subject	Semester	Credits
1		On the Job Training	II	10
2		On the Job Training	IV	10
		<b>TOTAL CREDITS</b>		<b>20</b>

### CREDIT DISTRIBUTION

SEMESTER	I	II	III	IV	V	VI	CREDIT
General Science and Humanities (GHS)	12	13	12	9	6	9	61
Vocational General (VG)	3		3		4		10
Vocational Core (VC)	15	7	15	11	8	12	68
Vocational Elective (VE)					6	3	9
Employability Enhancement Courses (EEC)					6	6	12
On Job Training Course (OJT)		10		10			20
<b>TOTAL CREDITS</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>180</b>

### NON CGPA COURSES DETAILS

	I	II	III	IV	V	VI	VII
Sports	√	√	√	√	√	√	√
Industry Supported Course	√	√	√	√	√	√	√

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Introduction to Programming	4	0	0	4
PREREQUISITES:					
Fundamentals knowledge of computer					
COURSE OBJECTIVES:					
1	To learn principles of basic programming and interactive programming with a visual programming language like Scratch 3 (MIT).				
2	To provide knowledge in various programming languages and choice of Python as a first programming language.				
3	To understand variables, data types, and expressions.				
4	To learn about conditional coding and loops.				
5	To learn about modular programming with functions.				
UNIT	TITLE				PERIODS
1	PROGRAMMING PRINCIPLES THROUGH VISUAL PROGRAMMING				18
Using visual programming (Scratch3, MIT) to explore principles of programming, control structures (if/then/else, loops - repeat, wait until, for, repeat until, forever, cloning), events (responding to keyboard, broadcast), motion and movement, animation looks and sounds, interactive gaming and sensing (user input, responding to mouse, callbacks), operators and variables, lists, blocks.					
UNIT	TITLE				PERIODS
2	Why Python and getting started Using Python				6
Motivation of learning Python - ease and diversity of application.					
UNIT	TITLE				PERIODS
3	Variables, Data Types, and Expressions				16
Variables, Data Types (strings, numbers, lists, tuples, dictionaries), expressions with each of them, basic functions for Strings (concatenation, reverse, etc), numbers and functions available for numbers.					
UNIT	TITLE				PERIODS
4	Conditional Code and Functions				18
Control and conditional code in Python boolean variables, if/else, if/elif/else, loops, range function, list comprehension, and conditional list comprehension, Creating functions for modularity and code reusability, generalization with input parameters to allow for code to be used in different situations.					
UNIT	TITLE				PERIODS

5	Object Oriented Programming in Python	14
Class - Object(object) - instantiation (initialization), methods, data encapsulation - Inheritance.		
TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Learn principles of basic programming and interactive programming with a visual programming language like Scratch 3 (MIT)	
CO2:	Know various programming languages and choice of Python as a first programming language.	
CO3:	Understand variables, data types, and expressions.	
CO4:	Learn about conditional coding and loops and modular programming with functions.	
CO5:	Learn about OOPS in Python.	
REFERENCE COURSES:		
1	Games by Jon Woodcock, "Coding Projects in Scratch: A Step-by-Step Visual Guide to Coding Your Own Animations", DK Children publications,2016.	
2	Adam Stewart "Python Programming, Python Programming for Beginners, Python Programming for Intermediates", Createspace Independent Publications,2017.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Fundamentals of Web Design	3	0	0	3
PREREQUISITES:					
Knowledge in Computer Programming					
COURSE OBJECTIVES:					
1	To learn the Basic principles of website development				
2	To learn the Planning process and style sheet				
3	To learn Page design, Design concept				
4	To learn multiple syntax of programing language				
UNIT	TITLE				PERIODS
1	Introduction to web technology				11
Introduction to Internet – Resources of the internet – H/W & S/W requirements of Internet – Domain Naming system – Registering our Domain name – URL – Protocol – Server name – Port – Relative URLs – Overview of web browsers – ISDN Dial Up or Leased Line Connection – Internet service providers – Internet Services – Protocols concepts – Internet Client and Internet Server – Introduction to WWW, HTTP, TCP/IP, FTP, SMTP, POP3					
UNIT	TITLE				PERIODS
2	UX/UI				10
Concept of Ux, Design Process, Information Design and Data Visualization, Information Architecture, elements and Widgets,Design Testing Methods and Techniques					
UNIT	TITLE				PERIODS
3	HTML				11
Html Essentials,Get started,Document Structure,Linking page,Adding media to webpage(Image,Audio Files,video files,Heading,Lists,Bold & Italic,Special character,Semantic Structure elements,Navigation					
UNIT	TITLE				PERIODS
4	CSS				11
Introduction,Selectors,Text Fonts,Box Model,Floats,Syntax,color Background Cursor,List Tables,Display Positioning					
UNIT	TITLE				PERIODS
5	JavaScript				11



Introduction to Javascript, Function Fundamentals, Basic Program Structure, Statement, Loops, Object Data Structure, Array, Object, Built-in Data, Regular Expression	
<b>TOTAL PERIODS: 54</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	The characteristics, systematic methods, model for developing web applications.
<b>CO2:</b>	Understand the web development process
<b>CO3:</b>	Build the application using all the necessary web components
<b>CO4:</b>	Create the own web data for customer application
<b>REFERENCE COURSES/BOOKS:</b>	
1	AlokRanjan,AbhilashaSinha, Ranjit Battered, "JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript ll", 1st Edition,BPB Publications,2020.
2	D. Flanagan, "Java Script", O'Reilly Publications , 6th Edition, 2011.
3	Jon Duckett, "Beginning Web Programming", Wrox publications, 2nd Edition, 2008.
4	Elisabeth Freeman and Eric Freeman, "Head First HTML with CSS and XHTML", Head First, O' Reilly, publications, 2005.

Course Code	Course Title	Periods per week			Credits
	English - I	L	T	P	
		3	0	0	
PREREQUISITES:					
Knowledge in English Language, vocabulary					
COURSE OBJECTIVES:					
1	To encourage the students to speak English				
2	To enable students to use English in day-to-day communication				
3	To build up their confidence in the usage of English				
4	To expose them to light prose and poetry				
5	To develop their written and communicative competence				
6	To re-introduce them to the basics of grammar				
UNIT	TITLE				PERIODS
1	Prose				11
The Bet- Anton Chekhov - With The Photographer- Stephen Leacock The Portrait of a Lady- Khushwant Singh - On The Face of It- Susan Hill - The Proposal- Anton Chekhov (Play)					
UNIT	TITLE				PERIODS
2	Poetry				11
Say Not The Struggle Naught Availeth-Arthur Hugh Clough - Abu Ben Adhem -James Leigh Hunt -Where the Mind is Without Fear- Rabindranath Tagore-Daffodils:William Wordsworth-Stopping By Woods On A Snowy Evening-Robert Frost					
UNIT	TITLE				PERIODS
3	Spoken Communication				11
Meeting People,Exchanging Greetings,Taking leave-Introducing Yourself- Introducing People To Others-Answering The Phone And Asking For Others-Discussing Hobbies,Likes And Dislikes					
UNIT	TITLE				PERIODS
4	Grammar And Vocabulary				10
Articles-Modal Auxiliaries-Prepositions					
UNIT	TITLE				PERIODS
5	Creating Compositions				11
Report Writing-Summarizing					

TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Read and appreciate poems on their own.	
CO2:	Analyze poetic texts using appropriate terms such as diction, tone, imagery, figures of speech, etc.	
CO3:	Interpret a poem based on contextual evidence	
CO4:	Analyze various types of novels and stories and pieces of prose with reference to thematics and other approaches.	
CO5:	Read and comprehend better.	
CO6:	Communicate in English orally and in writing.	
CO7:	Refer to the dictionary for synonymous expressions and grammar.	
CO8:	Enlarge the vocabulary and understand the structure of sentences and grasp the idea of the author.	
REFERENCE COURSES/BOOKS:		
1	Hornby. A.S," Guide To Patterns And Usage In English(ELBS)", Oxford publisher, 2016.	
2	Corder, S.Pit," An Intermediate English Practice Book", Orient Longman Publications, Paperback,1974.	
3	Vallins, G.D "Better English", Macmillan publications,1959.	
4	Zandvoort," A Handbook Of English Grammar(ELBS)", Longman publications,1975.	
5	Wood. F.T, "A Remedial English Grammar For Foreign Students", Trinity Publications, 1965.	
6	Dowling, Dave," Oxford Guide To Effective Writing And Speaking", Oxford University Press; 2nd edition,2005.	

Course Code	Course Title	Periods per week			Credits
	Applied Mathematics	L	T	P	
		3	0	0	
PREREQUISITES:					
Basic Concepts of numbers system, Vector Calculus					
COURSE OBJECTIVES:					
1	To learn to revisit mathematical concepts visually.				
2	To learn to interpret integration and differentiation through their application.				
3	To learn matrices and their application.				
4	To learn vector algebra and calculus.				
UNIT	TITLE				PERIODS
1	Mathematical concept through IKS (Indian Knowledge Systems)				10
Bhramagupta's rules of integers. Rajju Ganit (Rope Mathematics) - revisiting circles, measuring perimeter, measuring angles in radians, dividing a circle into any number of parts desired, trigonometry using circles. Visual proofs of "Pythagoras theorem". Pythagoras' theorem and application in - coordinate geometry, equation of circles, and complex numbers.					
UNIT	TITLE				PERIODS
2	Visual Algebra				11
Plotting algebraic expressions, Geogebra (the relation between algebra and geometry), functions - linear, quadratic, cubic functions, exponential, logarithmic. Zeros of an equation (factorization in algebra) as understood and solved visually. Linear algebra and solution of simultaneous equations in 2 D.					
UNIT	TITLE				PERIODS
3	Visual Calculus				11
Differentiation as slope at a point and integration as areas of curves. Application to constant acceleration to get velocity and distance through integration. Integration in continuous time (electronics)/discrete-time (computer science), Integration calculation in computers as FEM. Differentiation application to find the location of peaks and troughs in curves and second differentiation to find if they are peaks or troughs. Differentiation of polynomial, exponential, and logarithmic expressions.					
UNIT	TITLE				PERIODS
4	Vector algebra and vector calculus				11

Vector algebra: scalar and vector products; scalar and vector triple products; geometric applications. Vectors as viewed by mathematicians, physicists, and computer scientists. Differentiation of a vector function; scalar and vector fields. Gradient, divergence, and curl - definitions and physical interpretations; product formulae; curvilinear coordinates. Gauss' and Stokes' theorems and evaluation of integrals over lines, surfaces, and volumes.		
UNIT	TITLE	PERIODS
5	Graph Theory	11
Graph Theory - Representation of graphs, Breadth-first search, Depth-first search, Applications of BFS and DFS; Directed Acyclic Graphs - Complexity of BFS and DFS, Topological sorting.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Demonstrate mathematical concepts visually.	
CO2:	Interpret integration and differentiation visually and through their application.	
CO3:	Understand vector algebra and calculus	
REFERENCE COURSES/BOOKS:		
1	Stephen Roberts,"Vector Algebra and Calculus", University of Oxford,2013.	
2	T. K. Manicavachagom Pillay, T. Natarajan, S. Ganapathy," Algebra – Vol. II", S. Viswanathan Printers & Publishers Pvt. Ltd,11th Revised edition, 2004.	
3	Visual perspectives on Mathematics <a href="https://www.3blue1brown.com/topics/calculus">https://www.3blue1brown.com/topics/calculus</a> <a href="https://www.3blue1brown.com/topics/linear-algebra">https://www.3blue1brown.com/topics/linear-algebra</a>	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Programming and Web Designing Lab	0	0	8	
4					

**PREREQUISITES:**

Fundamentals of Web Design

**COURSE OBJECTIVES:**

1	To learn principles of basic programming and interactive programming with a visual programming language like Scratch 3 (MIT).
2	To learn principles of basic programming with Python
3	To learn key principles of interactive programming and creating games and problem-solving tasks
4	To learn the various ways to run the program on Windows, and Linux. Suggested editors and integrated development environment
5	To learn to work with various data types including string, list, tuples, dictionaries, Boolean and more. How to use variables based on the requirement

TITLE	PERIODS
LABORATORY	144

**Scratch**

1. Sprites, stage, blocks, saving and loading projects, using mouse. Sprite options. Costume, sound, background options - code, backdrop, sounds. Basic events, control Challenge

2. Advanced Events, control, sensing of different types, basic operators Challenge: Interactive Q & A game, Make a maze game

3. Blocks help avoid repeat code and take parameters, variables help generalize code and add memory functionality, use of random number generator Challenge: Add scores to earlier programs, reduce lines of code with blocks, generalize Q & A e.g. cube root of a number questions generated on their own.

4. Advanced operators and lists to remember the sequence of data and its processing Challenge: Enter a list of 10 names and the program tests you to tell them backwards. Given an angle, the program calculates the cosine of the angle in degrees/radians.

**Python**

5. Using online interpreters for learning python3 - printing a string

6. Guess the number game with feedback of higher and lower (for loop, if conditions)

7. Implementing rock, paper, lizard, scissor, spock (with functions)

8. Creating a complex number class and creating methods to return the real, complex, magnitude, argument and inverse of a complex number.

9. Creating functions that takes two complex number and returns a complex number that returns their sum, difference, and product

10. Operator overload so '+', '-', '\*' operators work for complex number class

**Web Design**

11. Create an HTML document giving details of your [Name, Age], [Address, Phone], and [Register Number, Class] aligned in the proper order using alignment attributes of the Paragraph tag.

12. Write HTML code to design a page containing some text in a paragraph by giving a suitable heading style.

13. Create a web page using embedded CSS and multimedia Procedure

14. Coming up with a problem Problem statement and requirement analysis for the specific problem statement. Create personas at least 3 and draw task procedures for a complete solution

15. Design the Screen flow for problem statement

<b>TOTAL PERIODS:</b>	<b>144</b>
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<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Learn principles of basic programming and interactive programming with a visual programming language like Scratch 3 (MIT).
<b>CO2:</b>	Become comfortable doing small projects from scratch 3.
<b>CO3:</b>	Skill to develop applications with real-time application
<b>CO4:</b>	Ability to work in programming skills in python
<b>CO5:</b>	The fundamentals of how to store, retrieve, and process data efficiently.
<b>REFERENCE COURSES/BOOKS:</b>	
1	Michael H Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
2	Yashavant Kanetkar, Aditya Kanetkar, "Let us Python", BPB publication, 1st Edition, 2019.
3	Ashok Kamthane, Amit Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education (India) Publications, 2018.
4	<a href="https://www.auraauro.com/learn/learn-scratch/">Challenges to learn scratch</a> <a href="https://www.auraauro.com/learn/learn-scratch/">https://www.auraauro.com/learn/learn-scratch/</a>

Course Code	Course Title	Periods per week			Credits
	Operating System (Theory and Practice)	L	T	P	
		2	0	4	
PREREQUISITES:					
Knowledge in Computer Programming					
COURSE OBJECTIVES:					
1	To understand design of an operating system and service				
2	To understand the structure and organization of the file system				
3	To understand processes synchronization and scheduling				
4	To understand system calls and memory management				
THEORY					
UNIT	TITLE				PERIODS
1	Concepts of Operating Systems				12
Computer system overview, concept of an operating system, batch system, multiprogramming, multiprocessing, multi user, time sharing, personal system, parallel system, real time system, simple monitors, general system architecture, System components, operating system services, system calls,system programs, system structure, Approaches to OS design and implementation: Microkernel,Layered, Kernel Approach					
UNIT	TITLE				PERIODS
2	Processes and Threads				12
Concept of process, process states, process state transitions, process control block, operations on processes, threads, concurrent processes, mutual exclusion and synchronization, principles of deadlocks, integrated deadlocks strategy, scheduling levels, scheduling criteria, Inter process synchronization, Inter process communication, Linux, IPC Mechanism, Remote procedure calls, RPC exception handling, security issues.					
UNIT	TITLE				PERIODS
3	Memory Management and Data Management				12
Logical and physical address space, storage allocation and management techniques, swapping concepts of multi programming, paging, segmentation, virtual storage management strategies, demand paging, page replacement algorithm, thrashing, File organization, record blocking, access method, directory structure, protection file system structure, allocation methods, free space management, directory implementation, disk structure, disk scheduling, disk management,buffering, swap space management, RAID levels					
TITLE					PERIODS
LABORATORY					72



1.Ubuntu operating system installation and setup. 2.User account creation and setting user permissions. 3.static and dynamic network setting using commands. 4. Install,upgrade,remove software packages in Linux operating system. 5. File management- File listing(ls),creating file (touch,vi),Display the file content(cat),Copying the file (cp,scp),Moving file and Rename the file(mv),Delete the file(rm). 6. Disk Utilities(Fdisk,sfdisk,cfdisk,parted,lsblk,blkid,hwinfo,df,pydf). 7.Write a shell script to list all of the directory files in a directory. 8.Write a Shell Script that accepts a filename, starting and ending line numbers as arguments and displays all lines between the given line numbers. 9.Write a shell script that displays a list of all files in the current directory to which the user has read, write and execute permissions. 10.Write a shell script that deletes all lines containing the specified word in one or more files supplied as arguments to it. 11.Write a shell script to count no of files in the current directory with full permissions. 12.Write a shell script to display list of currently logged users 13.Implement memory management techniques like paging or segmentation. 14.Implement any file allocation technique (Linked, Indexed or Contiguous). 15.mount, umount users +, chown, chmod, getuid, setuid. 16.Use the following system calls of UNIX operating system: fork, wait, exec, exit, kill, getpid, brk, nice, sleep, trace, open, close, read, write, lseek, stat, sync 17.Use the following system calls of the UNIX operating system: signals, pipe, socket, accept,recv, connect.	
<div> <div>TOTAL PERIODS:</div> <div>108</div> </div>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Installation Linux os and dual boot enable and operating system recovery
<b>CO2:</b>	Understand the basics of an operating system and its major components.
<b>CO3:</b>	Understand and implement shell programming.
<b>CO4:</b>	Purpose of the system files and usage
<b>CO5:</b>	Create and/or modify concurrent programs.
<b>REFERENCE MATERIAL: BOOKS, ONLINE REFERENCES &amp; OTHER DOCUMENTATION</b>	
1	Ekta Walia,"Operating System Concepts", Khanna Book Publications,2020.
2	Dhamdhare,"Operating Systems- A Concept Based Approach", TMH publisher,2006
3	William Stallings,"Operating systems Internals and design principles",Pearson Education publications,2012

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Arduino programming in python	0	0	6	3
PREREQUISITES:					
Knowledge in python Programming					
COURSE OBJECTIVES:					
1	Understanding programming interface with hardware				
2	Learn basics of python programming				
3	Understanding the basic electronics circuits				
UNIT	TITLE				PERIODS
1	Set Up And First Example				108
1.IDE for python Software for Arduino download, installing, 2.Set up and GUI Interfacing, 3.Blink program - first compilation, troubleshooting set up issues 4.Blink program - change frequency, duty cycle, 5.Python program for seven segment display, 6.Python program to create multiple segments 99-sec timer with switch, 7.Python program and libraries - Reading Accelerometer sensor (I2C) 8.Python program and libraries - Lack of motion alarm - using accelerometer 9.Python program - data logger - recording temperature of a room in an SD card 10.Python program - Control servo with Buttons 11.Python program - Automatic Door sensor using PIR 12.Python program - Working with shift register to controller led 13.Python Program - Relay shield to control bulb.					
TOTAL PERIODS:					108
COURSE OUTCOMES:					
Upon completion of this course, a student will be able to:					
CO1:	Program an Arduino to drive an output pin, accept analog inputs and respond to interrupt				
CO2:	Understand communication Protocols via the example of I2C and SPI				
CO3:	Understand the concept of Data Logging by implementing it				
REFERENCE MATERIAL: BOOKS, ONLINE REFERENCES & OTHER DOCUMENTATION					
1	Richard Blum,"Arduino Programming in 24 hours",Sams publications,2014.				
2	Online reference: Jeremy Blum's Arduino Tutorials on YouTube				

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Essential Science (Theory and practice)	2	0	2	3
PREREQUISITES:					
Fundamental knowledge of Physics					
COURSE OBJECTIVES:					
1	To learn to explain the macro physical phenomenon using atomic model				
2	To learn to interpret and model physical phenomena using calculus				
UNIT	TITLE				PERIODS
1	Atomic and molecular physics				18
Atomic picture of matter, atoms as building blocks. Using atoms to understand - everyday phenomena - air pressure, dynamic equilibrium, states of matter, melting and boiling point, things expand on heating, evaporation, diffusion, and sound.					
UNIT	TITLE				PERIODS
2	Interpret and model physical phenomenon with calculus				18
Rates and derivatives, straight-line kinematics - the relationship between distance, speed, and acceleration. Integration to work backward from acceleration, speed, and distance. Description of the distance covered by a falling object as a function of time. Being able to draw this visually. Potential energy, kinetic energy, and conservation of energy. Address other physical phenomena with derivatives including voltage and current of a capacitor.					
LABORATORY					36
1.Building lattice structure (tetrahedron) for Carbon, 2. Silicon used in semiconductors - Air pressure experiments(macro phenomenon based on atomic structure): - with a balloon ,- sheets of paper, etc 3. States of matter experiment: heating experiment, evaporation, and condensation - 4. Diffusion experiment: ink and water. - Ink drop in hot and cold water ,-Puncture of the balloon - Understanding rate -- water from a tap. What is the rate of flow? 5. Measuring constant speed and distance and checking repeatability (use Incline slope for different speeds) - Measuring speed of falling objects using video camera - Potential energy: changing mass, changing distance determining impact with stress gauge - Pendulum - potential to kinetic energy and conservation of energy with stress gauge - Conservation of energy through conservation of momentum (football and tennis ball) - Tracing the voltage of a capacitor with constant current (simulation or setup).					
TOTAL PERIODS:					72
COURSE OUTCOMES:					
Upon completion of this course, students will be able to:					

<b>CO1:</b>	Understand the macro physical phenomenon using atomic model
<b>CO2:</b>	Interpret and model physical phenomena using calculus
<b>REFERENCE COURSES:</b>	
<b>1</b>	Balaji Sampath,"The Aha Guide to Atoms", AhaGuru Education Technology publications,Third Edition,2015.
<b>2</b>	Yannis Tsididis,"Operation and Modeling of the MOS Transistor", Oxford Press Publications,1999.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Indian culture and universal values	1	0	4	3
PREREQUISITES:					
NIL / Course Code – Course Title / Topics					
COURSE OBJECTIVES:					
1	To understand the evolutionary steps of nature and man				
2	To learn different systems of yoga and their significance				
3	To learn Radical Transformational Leadership tools and distinctions and to apply what I stand for (care about) in my everyday life.				
4	To learn systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment with universal values.				
THEORY					
UNIT	TITLE				PERIODS
1	Introduction to Yoga				6
Meaning & relevance of yoga in human life; Fundamentals of yoga					
UNIT	TITLE				PERIODS
2	Evolution: Progressive self-manifestation of Nature in man				6
Bodily life, mental life, beyond mental life: higher life; Planes of consciousness; Involution					
UNIT	TITLE				PERIODS
3	Integral Yoga				6
Introduction to parts of the being, Aim of Integral Yoga					
TOTAL :					72
LABORATORY					

1. Sourcing inner capacities 2. My Four Profiles 3. Distinction: Courage and Bravery 4. Background Conversations & Listening 5. Watch 12 Angry Men and listing leadership traits 6. “You are my Hero” Noticing & Transforming disempowering cultural norms. Read the book; discuss in Pairs. 7. Systems principles-Film: Story of Stuff 8. Architecture for Equitable Change: Partial & Conscious-Full Spectrum Response Model 9 Designing my breakthrough Initiative using CFSR 10.Designing my breakthrough Initiative---Beyond Problem-solving--Realize & respond 11. Background Conversations & Leadership 12. Speaking powerfully to inspiring others to commit to an action— speaking about my BTI 13. Giving feedback to foster growth 14. Complaints as a commitment for action	
<b>TOTAL PERIODS:</b>	
<b>90</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Be able to explain the evolutionary steps of nature and man
<b>CO2:</b>	To know different systems of yoga and their significance and limitations and understand the synthesis in Integral Yoga in its essence
<b>CO3:</b>	To apply Radical Transformational Leadership tools and distinctions and to apply what I stand for (care about) in my everyday life.
<b>CO4:</b>	To use systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment with universal values.
<b>REFERENCE COURSES/BOOKS:</b>	
1	Sri Aurobindo,” The Synthesis of Yoga”, Sri Aurobindo Ashram Publications, 1921.
2	<a href="https://infinityinadrop.net/infinityfiles/0-4-3-evo-longterm.php">Indian Psychology Institute. https://infinityinadrop.net/infinityfiles/0-4-3-evo-longterm.php</a>
3	<a href="https://infinityinadrop.net/infinityfiles/0-3-1d-cons-integral.php">Indian Psychology Institute. https://infinityinadrop.net/infinityfiles/0-3-1d-cons-integral.php</a>
4	Monica Sharma,” Radical Transformational Leadership: Strategic Action for Change”, North Atlantic Publications, Berkeley, California, 2017.

Course Code	Course Title	Periods per week			Credits
	Introduction to AI and Machine Learning	L	T	P	
		4	0	0	
PREREQUISITES:					
Basic Programming Concepts					
COURSE OBJECTIVES:					
1	Understand the overview of AI concepts, terminology, applications and ethics in the world				
2	Understand key supervised machine learning algorithms				
3	Understand key unsupervised machine learning algorithms				
UNIT	TITLE				PERIODS
1	Introduction to AI				16
What is AI? AI Concepts, Turing test, Terminology, and Application Areas.Concepts: Machine Learning, Deep Learning, Neural Networks Applications: Voice assistants, Natural Language Processing, Sentiment analysis, Image Tagging, Computer Vision, Self-driving cars AI: Issues, Concerns and Ethical Considerations: AI and Bias, Data privacy, Ethical choices in self-driving cars. Jobs in AI.					
UNIT	TITLE				PERIODS
2	Search spaces				14
Placing search in the landscape of AI. State space search- Blind/uninformed - DFS,BFS. Heuristic - Hill Climbing,Best FS,Greedy search, A* search					
UNIT	TITLE				PERIODS
3	Introduction to Machine Learning				10
Concepts. Algorithms - Supervised, Unsupervised, Reinforcement learning and applications.					
UNIT	TITLE				PERIODS
4	Role of data in AI and ML				10
Training, testing and cross-validation. Data preparation for supervised learning. Data gathering for unsupervised learning - searching, creating, modification					
UNIT	TITLE				PERIODS
5	Data Cleaning, Preparation And Visualization				22
Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers-String Manipulation: Vectorized String Functions. Plotting: Line Plots, Bar Plots, Histograms, and Density Plots, Scatter or Point Plots.					

TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Understand the overview of AI concepts, terminology, applications and ethics in the world	
CO2:	Understand key supervised machine learning algorithms	
CO3:	Understand key unsupervised machine learning algorithms	
REFERENCE COURSES/BOOKS:		
1	Dr.Dheeraj Mehrotra, "Basics of Artificial Intelligence & Machine Learning",Notion Press Publication,2019.	
2	Laurence Moroney,"AI and Machine Learning for Coders",O'Reilly Media Publications, 2020.	
3	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press Publications, PHI, 3rd Edition, 2014	
4	Tom M. Mitchell, "Machine Learning", McGraw Hill Publications,Indian Edition, 2017.	



Course Code	Course Title	Periods per week			Credits
		L	T	P	
	English II	3	0	0	
PREREQUISITES:					
English I					
COURSE OBJECTIVES:					
1	To encourage the students to speak English				
2	To enable students to use English in day-to-day communication				
3	To build up their confidence in the usage of English				
4	To expose them to light prose and poetry				
5	To develop their written and communicative competence				
6	To re-introduce them to the basics of grammar				
UNIT	TITLE				PERIODS
1	Prose				11
How much Land Does A Man Need: Leo Tolstoy-Penalty: Premchand -The Painter Of Signs: R K Narayan-Arms And The Man: George Bernard Shaw (Play)					
UNIT	TITLE				PERIODS
2	Poetry				11
Do Not Go Gentle Into That Good Night: Dylan Thomas-If : Rudyard Kipling-Ozymandias: Percy Bysshe Shelley-Ode To Autumn: John Keats-The Dungeon: Samuel Taylor Coleridge					
UNIT	TITLE				PERIODS
3	Spoken Communication				11
The Art Of Public Speaking-Ability To Explain A Topic To Your Peers-Ability To understand Native Speakers And Repeat Sentences					
UNIT	TITLE				PERIODS
4	Grammar And Vocabulary				10
Tenses, punctuation ,voices					
UNIT	TITLE				PERIODS
5	Creating Compositions				11
Essay Writing-Formal Letter Writing					
TOTAL PERIODS:					54

<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Read and appreciate poems on their own.
<b>CO2:</b>	Analyze poetic texts using appropriate terms such as diction, tone, imagery, figures of speech, etc.
<b>CO3:</b>	Interpret a poem based on contextual evidence
<b>CO4:</b>	Analyze various types of novels and stories and pieces of prose with reference to thematics and other approaches.
<b>CO5:</b>	Read and comprehend better.
<b>CO6:</b>	Communicate in English orally and in writing.
<b>CO7:</b>	Refer to the dictionary for synonymous expressions and grammar.
<b>CO8:</b>	Enlarge the vocabulary and understand the structure of sentences and grasp the idea of the author.
<b>REFERENCE COURSES/BOOKS:</b>	
1	Hornby A.S., "A Guide to Patterns and Usage in English", ELBS Eight Impression Publications, London, 1962
2	Corder, S. Pit, "An Intermediate English Practice Book", Orient Longman Publications, 1988.
3	Vallins. G. D., "Good English: How To Write It", Pan Macmillan Publications, 1951.
4	Vallins. G. D., "Better English", Pan Publications, 1959.
5	Zandvoort, "A Handbook Of English Grammar (ELBS) 1975.
6	Wood. F. T., "A Remedial English Grammar For Foreign Students", Trinity Publications, 1965.
7	Dowling Dave, "Oxford Guide To Effective Writing And Speaking", Oxford University Publications, 2013.

Course Code	Course Title	Periods per week			Credits
	Mathematics of Machine Learning - I	L	T	P	
		3	0	0	
PREREQUISITES:					
Applied Mathematics Fundamental knowledge of linear					
COURSE OBJECTIVES:					
1	To understand Linear Regression and Fundamentals problems in ML.				
2	To understand computational efficiency and scalability.				
3	To understand statistics and probability				
UNIT	TITLE				PERIODS
1	Linear Regression				10
Problem Formulation-Parameter Estimation-Bayesian Estimation-Maximum Like hood as orthogonal Projection.					
UNIT	TITLE				PERIODS
2	Probability Distribution and Descriptive Statistics				11
Random variables, Mean and Variance, PDF and CDF, Probability distribution - Uniform distribution, Binomial, Poisson, Geometric, Exponential, Normal; Central Limit theory					
UNIT	TITLE				PERIODS
3	Optimization				11
Unconstrained and Constrained optimization, Numerical optimization techniques for constrained and unconstrained optimization: Newton's method, Steepest descent method, Penalty function method.					
UNIT	TITLE				PERIODS
4	Inferential statistics				11
Motivation for inferential statistics, two sample tests, Type1 and Type 2, Confidence Intervals, ANOVA and test of independence					
UNIT	TITLE				PERIODS
5	Spectral Decomposition				11
Spectral Decomposition, Singular Value Decomposition, Low Rank Approximations.					
TOTAL PERIODS:					54
COURSE OUTCOMES:					
Upon completion of this course, students will be able to:					
CO1:	Ability to find the pattern and structure in data by optimizing .				

<b>CO2:</b>	Skill to design the model to generate the data similar to the dataset given.
<b>CO3:</b>	Understand and estimate the statistics and probability.
<b>REFERENCE BOOKS/ COURSES:</b>	
1	Deisenroth et al," Mathematics for Machine Learning", Cambridge University Publications,2020 E-book available for free at: <a href="https://mml-book.github.io/book/mml-book.pdf">https://mml-book.github.io/book/mml-book.pdf</a>
2	<a href="https://drive.google.com/file/d/1Wh-b5hG5ZRE11PaiHhgjzG29QMsgiYDk/view">NPTEL NOC: Introduction to Data Analytics(Course sponsored by Aricent), IIT Madras</a> E-book available freely at: <a href="https://drive.google.com/file/d/1Wh-b5hG5ZRE11PaiHhgjzG29QMsgiYDk/view">https://drive.google.com/file/d/1Wh-b5hG5ZRE11PaiHhgjzG29QMsgiYDk/view</a>
3	W. Cheney, "Analysis for Applied Mathematics", Springer Science+Business Medias Publications, 2001.
4	S. Axler," Linear Algebra Done Right" (Third Edition), Springer International Publications,2015.

Course Code	Course Title	Periods per week			Credits
	AI and Machine Learning Lab - I	L	T	P	
		0	0	6	
3					
PREREQUISITES:					
AI and Machine Learning					
COURSE OBJECTIVES:					
1	To understand various search algorithm and usage				
2	To understand CSV file data processing				
3	To understand data clean-up and visualization				
TITLE					PERIODS
LABORATORY					108
1.Python Installation 2.Program to implement Blind/uninformed search algorithm 3.Program to implement Heuristic 2.File operations and learning to load csv files 3.Learning the use of Libraries Scikit Learn 4.Separating datasets into training and testing 5.Cleanup data with Pandas(With sample dataset) - Handling Missing values - Scaling and Normalization - Parsing Dates and other format - Character Encodings - Inconsistent Data Entry 6.Basic visualization with Seaborn - Line Plot, Bar Plot ,scatter plot, Density plot, Point plot					
TOTAL PERIODS:					108
COURSE OUTCOMES:					
Upon completion of this course, students will be able to:					
CO1:	Understand data pre-processing and visualization				
CO2:	Apply powerful data manipulations				
CO3:	Understand various search algorithm for data processing				
REFERENCE BOOKS/ COURSES:					
1	Ihab Ilyas and Xu Chu,“Data Cleaning”,ACM Books Publications,2019.				
2	Jake VanderPlas,"Python Data science Handbook: Essential Tools for working with Data",O'Reilly Publications,2017.				
3	Claus O. Wilke,“Fundamentals of Data Visualization,” O’ReillyMediaPublications,2019.				

Course Code	Course Title	Periods per week			Credits
	Interactive Python Programming (Theory and Practice)	L	T	P	
		2	0	4	
PREREQUISITES:					
Basic knowledge of programming					
COURSE OBJECTIVES:					
1	To Learn Create Desktop Applications				
2	To Learn How to use Tkinter and PySimpleGUI				
3	To Learn how to create a exe and distribute the exe				
4	To Learn design GUI design desktop application and make it in less time				
UNIT	TITLE				PERIODS
1	PySimpleGUI and Tkinter				12
GUI principles through PySimpleGUI, windows, widget,Button, Callback.Tkinter Introduction, Mapping Tcl/Tk to Tkinter, Win32 and Unix GUI, Tkinter class hierarchy, Tkinter widget, appearance.					
UNIT	TITLE				PERIODS
2	Display				12
Tkinter Widgets, Screen Layout, Event, binding and call back, Using classes, composites and special widgets, Dialogs and forms, Panel and machines, Graph and charts, Navigation, Window manager.					
UNIT	TITLE				PERIODS
3	Performance and Debug				12
Extended python, Debugging applications, Designing effective graphics applications, Programming performance, Thread, and asynchronous, Distributing Tkinter applications.					
TITLE					PERIODS
LABORATORY					72
1. Make a calculator application					
2. Make a weather app					
3. Create a digital clock					
4. Make a screenshot take					
5. Stopwatch					
6. Make your own dictionary application					
7. Make a language translator					
8. Create unit conversion calculator					

TOTAL PERIODS:		108
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Create a powerful desktop application	
CO2:	Understand the Multiple tk widget purposes and usage	
CO3:	Develop an efficient parallel algorithm to solve it.	
CO4:	Explain common tk architectures and programming models	
REFERENCE COURSES/BOOKS:		
1	John E.Grayson,"Python and Tkinter Programming",Manning Publications,1999.	
2	Tran Duc Loi,"Python For Desktop Applications: How to develop, pack and deliver Python applications with TkInter and Kivy",Tran Duc Loi Publications, Kindle Edition,2020	

Course Code	Course Title	Periods per week			Credits
	Integral yoga & value embodied leadership - I	L	T	P	
		1	0	4	
PREREQUISITES:					
COURSE OBJECTIVES:					
1	To incorporate aspects of integral yoga into life with meditation and reflection				
2	To incorporate aspects of integral yoga into life with surya namaskar				
3	To integrate Radical Transformational Leadership tools in everyday practice.				
4	To design projects for system and cultural shift from universal values				
5	To learn distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential				
UNIT	TITLE				PERIODS
1	Review of Integral Yoga Principles				9
Review Integral Yoga - physical, mental, vital alignment with psychic					
UNIT	TITLE				PERIODS
2	RTL (Radical Transformational Leadership) Book Reading				9
Understanding the praxis around the world around RTL					
TITLE					PERIODS
LABORATORY					72
1.To learn and incorporate daily meditation 2.To learn and incorporate Surya namaskar 3.To reflect weekly on the progress made physically and mentally 4.Reflection on the tools applied in day to day life. 5.Conversations for clarity and refreshers. 6.Refresher on design templates and design and refining the breakthrough initiative at college.					
TOTAL PERIODS					90
COURSE OUTCOMES:					
Upon completion of this course, students will be able to:					
1	Develop in meditation and reflection				
2	Develop physically through suryanamaskar				
3	Use Radical Transformational Leadership tools in everyday practice.				



4	Design projects for system and cultural shift from universal values
5	Notice distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential
<b>REFERENCE COURSES/BOOKS:</b>	
1	Daniel Goleman and Richard Davidson, "Altered Traits: Science Reveals How Meditation Changes Your Mind, Brain, and Body", Avery Publications, 2017.
2	Monica Sharma, "Radical Transformational Leadership: Strategic Action for Change", North Atlantic Publications, Berkeley, California, 2017.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Data Structures and algorithms	4	0	0	4
Knowledge in Programming language					
COURSE OBJECTIVES:					
1	To learn efficient storage mechanisms of data for easy access.				
2	To design and implement various basic and advanced data structures.				
3	To introduce various techniques for the representation of the data in the real world.				
4	To develop applications using the data structure.				
5	To improve the logical ability				
UNIT	TITLE				PERIODS
1	Time and space complexity, Data Structure				16
Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion, and search operations on the linear list, circular linked list implementation, Double linked list implementation, insertion, deletion and searching operations. Applications of linked lists, Introduction to algorithm analysis					
UNIT	TITLE				PERIODS
2	Stack and queue				16
Array and linked representations of the stack, stack applications -infix to postfix conversion, postfix expression evaluation, recursion implementation. Array and linked representations. Circular Queue operations, Dequeue, applications of queues.					
UNIT	TITLE				PERIODS
3	Searching and Sorting algorithm				15
Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort, shell sort, radix sort, Searching-linear and binary search methods, comparison of sorting and searching methods.					
UNIT	TITLE				PERIODS
4	Tree				12
Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, applications of trees.					
UNIT	TITLE				PERIODS

5	Graph	13
Graphs – Representation of graphs – BFS, DFS – Topological sort – Shortest path problems. String representation and manipulations – Pattern matching, Applications.		
TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Students will be able to choose appropriate data structures as applied to specified problem definitions.	
CO2:	Students will be able to handle operations like searching, insertion, deletion, and traversing mechanism	
CO3:	Students will be able to apply concepts learned in various representation of graph	
CO4:	Students will be able to use linear and non-linear data structures like stacks, queues, and linked lists.	
REFERENCE COURSES/BOOKS:		
1	Daniel Goleman,“Data structures: A Pseudocode Approach with C”,Avery Publications,2nd edition,2004	
2	R.F.GilbergAndB.A.Forouzan,”Computer Science: A Structured Programming Approach Using C”,Cengage India Publications,2007	
3	Mark Allen Weiss,”Data structures and Algorithm Analysis in C”,Pearson Education India Publications,2002.	
4	A.M.Tanenbaum,Y. Langsam, M.J.Augenstein,”Data Structures using C, Pearson Publications,2015.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Software Engineering	4	0	0	4
PREREQUISITES:					
Knowledge in Computer programming					
COURSE OBJECTIVES:					
1	To comprehend the various software process models.				
2	To understand the types of software requirements and SRS documents.				
3	To know the different software design and architectural styles.				
4	To learn the software testing approaches and metrics used in software development.				
UNIT	TITLE				PERIODS
1	Introduction to Software Engineering				14
Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, Software myths.A Generic view of process: Software engineering- A layered technology, a process framework, Process patterns, process assessment.Process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process, Agility and Agile Process model, Extreme Programming, Other process models of Agile Development and Tools					
UNIT	TITLE				PERIODS
2	Software Requirements:				14
Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document.					
Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.					
System models: Context Models, Behavioral models, Data models, Object models, structured methods. UML Diagrams.					
UNIT	TITLE				PERIODS
3	Design Engineering				16
Design Engineering: Design process and Design quality, Design concepts, the design model. Creating an architectural design: Software architecture, Data design, Architectural styles and patterns, Architectural Design. Object-Oriented Design: Objects and object classes, An Object-Oriented design process, Design evolution.Performing User interface design: Golden rules, User interface analysis and design,interface analysis, interface design steps, Design evaluation.					
UNIT	TITLE				PERIODS

4	Testing Strategies	14
Testing Strategies: A strategic approach to software testing, test strategies for conventional software, BlackBox and White-Box testing, Validation testing, System testing, the art of Debugging.		
Product metrics: Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.		
Metrics for Process and Products: Software Measurement, Metrics for software quality.		
UNIT	TITLE	PERIODS
5	Risk management	14
Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.		
Quality Management: Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, The Capability Maturity Model Integration (CMMI), Software reliability, The ISO 9000 quality standards.		
TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	To compare and select a process model for a business system	
CO2:	To identify and specify the requirements for the development of an application	
CO3:	To develop and maintain efficient, reliable and cost effective software solutions	
CO4:	To critically think and evaluate assumptions and arguments of the client	
REFERENCE BOOKS/ COURSES:		
1	Pankaj Jalote,"Software Engineering: A Precise Approach",Wiley Publications, 2010.	
2	Waman S Jawadekar,"Software Engineering: A Primer",Tata McGraw-Hill Publications, 2008	
3	Diner Bjorner,"Software Engineering1: Abstraction and modelling", Springer International edition, 2006.	

Course Code	Course Title	Periods per week			Credits
	Mathematics for Machine Learning - II	L	T	P	
		3	0	0	
PREREQUISITES:					
Mathematics for Machine Learning -I					
COURSE OBJECTIVES:					
1	To learn how linear algebra is applied to data science				
2	To understand matrix decomposition algorithm				
3	To understand dimension decomposition algorithm				
4	To understand calculus,optimization				
UNIT	TITLE				PERIODS
1	Matrix Decomposition Algorithms				10
SVD: Properties and applications, low rank approximations, Gram Schmidt process, polar decomposition					
UNIT	TITLE				PERIODS
2	Dimensions Reduction Algorithms And JCF				11
Principal component analysis, linear discriminant analysis, minimal polynomial and Jordan canonical form Basic concepts of calculus: partial derivatives, gradient, directional derivatives, jacobian, hessian, convex sets, convex functions and its properties					
UNIT	TITLE				PERIODS
3	Multivariate calculus				11
Generalized functions of multiple variables, calculus tools to handle multivariable systems, linear algebra structures necessary for storing multivariate calculus analysis					
UNIT	TITLE				PERIODS
4	Regression				11
Least Square Approximation and Minimum Normed Solution, Linear and Multiple Regression, Logistic Regression.					
UNIT	TITLE				PERIODS
5	Support Vector Machine				11
Basic concepts of probability: conditional probability, Bayes' theorem, independence, theorem of total probability, expectation and variance, few discrete and continuous distributions, joint distributions, and covariance.Introduction to SVM, Error minimizing LPP, concepts of duality, hard and soft margin classifiers					

TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Linear algebra is applied to data science	
CO2:	Understand matrix decomposition algorithm using large data set	
CO3:	Understand dimension decomposition algorithm	
CO4:	Understand calculus, optimization	
REFERENCE BOOKS/ COURSES:		
1	W. Cheney," Analysis for Applied Mathematics", Springer Science+Business Medias Publications, 2001.	
2	S. Axler, "Linear Algebra Done Right",Springer International Publications,Third edition, 2015.	
3	J. Nocedal, S. J. Wright," Numerical Optimization", Springer Science+Business Media Publications,2006.	
4	S. Rosenthal, "A First Look at Rigorous Probability Theory",Singapore: World Scientific Publication,Second edition,2006.	

Course Code	Course Title	Periods per week			Credits
	Basic Indian Language(Hindi)	L	T	P	
		3	0	0	
PREREQUISITES:					
PREREQUISITES:					
NIL / Course Code – Course Title / Topics					
COURSE OBJECTIVES:					
1	To introduce the students to Hindi Alphabet and To encourage the students to speak Hindi				
2	To enable students to use Hindi in day-to-day communication				
3	To build up their confidence in the usage of Hindi				
4	To expose them to light poetry				
5	To introduce them to the basics of tenses				
THEORY					
UNIT	TITLE				PERIODS
1	Hindi script and sound system				11
Vowels-Consonants: Vocal Tract-Consonants: Voicing & Aspiration-Hindi Consonants 1-Hindī Consonants 2-Alphabetic Order and Transliteration Conventions for Devanagari					
UNIT	TITLE				PERIODS
2	Introduction to basic structures				11
Identifying and writing Hindi phrases and sentences - questions based on translating sentences from English.					
UNIT	TITLE				PERIODS
3	Grammar				11
Tenses-types of Tenses					
UNIT	TITLE				PERIODS
4	Poetry				11
Meri Rail - Chiriyon Ke The Bache Chaar- Titli Rani Bari Sayani - Chuk Chuk karti Railgari - Aao Ham Sab Jhula Jhoolen - Ek Baar Phir Se jai Bolo					
UNIT	TITLE				PERIODS
5	Functional Hindi				10



Identify and use conjuncts in names and house objects - use of singular/plural, masculine/feminine	
<b>TOTAL PERIODS:</b>	
<b>54</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Identify the Hindi alphabet.
<b>CO2:</b>	Write and speak Hindi words and phrases.
<b>CO3:</b>	Express their basic needs and interact with others
<b>CO4:</b>	Speak and express their ideas in Hindi
<b>TEXT BOOKS:</b>	
<b>1</b>	Rupert Snell, "Complete Hindi"; 1st Edition, Teach Yourself, 2014.
<b>2</b>	Richard Delacy and Sudha Joshi, "Elementary Hindi"; Tuttle Publishing, 2014.
<b>REFERENCE BOOKS/RESOURCES:</b>	
<b>1</b>	<a href="https://wp.nyu.edu/virtualhindi/house/">https://wp.nyu.edu/virtualhindi/house/</a>
<b>2</b>	<a href="http://hindistartalk.lrc.columbia.edu/lesson/rathore-family-introduction/">http://hindistartalk.lrc.columbia.edu/lesson/rathore-family-introduction/</a>
<b>3</b>	<a href="http://hindistartalk.lrc.columbia.edu/lesson/rajawat-family-introduction/">http://hindistartalk.lrc.columbia.edu/lesson/rajawat-family-introduction/</a> (0.00 -1.05)
<b>4</b>	<a href="http://www.learning-hindi.com/post/1156594856/lesson-51-possessive-pronouns-part-3-%E0%A4%95-kaa">http://www.learning-hindi.com/post/1156594856/lesson-51-possessive-pronouns-part-3-%E0%A4%95-kaa</a>
<b>5</b>	<a href="http://www.learning-hindi.com/post/6324812777/lesson-115-%E0%A4%AD-bhee-too-also">http://www.learning-hindi.com/post/6324812777/lesson-115-%E0%A4%AD-bhee-too-also</a>
<b>6</b>	<a href="http://hindistartalk.lrc.columbia.edu/lesson/rathore-family-our-home/">http://hindistartalk.lrc.columbia.edu/lesson/rathore-family-our-home/</a>
<b>7</b>	<a href="http://www.learning-hindi.com/post/880500641/lesson-19-numbers-11-20">http://www.learning-hindi.com/post/880500641/lesson-19-numbers-11-20</a>

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Information Security Theory and Practice	2	0	2	3
PREREQUISITES:					
Fundamentals of computer and internet					
COURSE OBJECTIVES:					
1	Learn fundamentals of cryptography and its application to network security				
2	Understand network security threats, security services, and countermeasures				
3	Understand vulnerability analysis of network security.				
4	Apply methods for authentication, access control, intrusion detection, and prevention				
5	Identify and mitigate software security vulnerabilities in existing systems.				
UNIT	TITLE				PERIODS
1	Information Security and Conventional Cryptographic Techniques				12
Attacks, Vulnerability, Security Goals, Security Services, and mechanisms Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography					
UNIT	TITLE				PERIODS
2	Symmetric and Asymmetric Cryptographic Techniques				12
DES, AES, RSA algorithms, Use of Cryptography, for authentication, Secure Hash function, Key management					
UNIT	TITLE				PERIODS
3	Authentication and Digital Signatures and security in networks				12
Nonmalicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, man-in-the-middle attack,Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity,					
TOTAL					PERIODS
LABORATORY					36
1 Implement AutoKey Cipher 2 Implement Hill Cipher. 3 Implement the Rail fence technique 4 Implement Simple Columnar Transposition technique 5 Implement the Advanced Columnar Transposition technique. 6 Implement Simple RSA Algorithm					

<b>TOTAL PERIODS:</b>	
<b>72</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1</b>	Understand and explain the risks faced by computer systems and networks
<b>CO2</b>	Identify and analyze security problems in computer systems and networks.
<b>CO3</b>	Explain how standard security mechanisms work
<b>CO4</b>	Develop security mechanisms to protect computer systems and networks.
<b>CO5</b>	Write more secure programs.
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Charles P. Pfleeger, "Security in Computing", Pearson Publications, Fourth Edition, 2006
<b>2</b>	William Stallings, "Cryptography And Network Security Principles And Practice", Pearson Publications, Fourth or Fifth Edition, 2017
<b>3</b>	Wenbo Mao, "Modern Cryptography: Theory and Practice", Prentice Hall Publications, 2004

Course Code	Course Title	Periods per week			Credits
	Data Structures and algorithm Lab	L	T	P	
		0	0	6	3
PREREQUISITES:					
Fundamentals of programing					
COURSE OBJECTIVES:					
1	Demonstrates familiarity with major algorithms, and data structures and analyzes the performance of algorithms				
2	Learn to choose the appropriate data structure and algorithm design.				
3	Identify to specify the application and determine which algorithm or data structure to use in different scenarios				
TITLE					PERIODS
LABORATORY					108
1. Write a program to demonstrate insertion, deletion, search, and displaying of an element in an array, 2. Write a program to demonstrate the sorting algorithm. (using any one of these techniques: bubble, Insertion, selection) 3. Write a program to demonstrate operations performed on the stack. 4. Program to convert infix expression to postfix and infix to postfix. 5. Write a program to demonstrate operations on the queue. 6. Write a program to demonstrate operations on a single link list. 7. Write a program to implement Stack as Linked List. 8. Write a program to implement operations on a double link list. 9. Write a program to demonstrate creation, traversing, and searching in Binary Search Tree. 10. Write a program to traverse a graph using DFS with an adjacency matrix. 11. Write a program to traverse a graph using BFS with an adjacency matrix.					
TOTAL PERIODS:					108
COURSE OUTCOMES:					
Upon completion of this course, students will be able to:					
CO1:	Implement various basic data structures and their operations.				
CO2:	Implement various graph algorithms.				
CO3:	Implement various sorting and searching algorithms.				
REFERENCE BOOKS/ COURSES:					
1	Rance D. Necaie, “Data Structures and Algorithms using Python”, Wiley, John Wiley & Sons Publications, 2011.				
2	Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishing Ltd., 2017.				

Course Code	Course Title	Periods per week			Credits
	Frontend programming Theory and Practice	L	T	P	
		2	0	4	4
PREREQUISITES:					
Fundamentals of computer and web design					
COURSE OBJECTIVES:					
1	To understand basic flask and database				
2	To learn responsive web pages design				
3	To learn dashboard design and backend connectivity				
UNIT	TITLE				PERIODS
1	Database				18
SQL database, NoSQL Database, SQL or No SQL, Database management with Flask, Relationship, Database operation, Database use in View function					
UNIT	TITLE				PERIODS
2	Database framework example python+flask				18
Integration with the python shell, Database Migrations with Flask-Migrate, Creating a Migration Script, Upgrading the Database					
TITLE					PERIODS
LABORATORY					72
Front end development with bootstrap: 1. Develop a web application to control different layouts and User Authentication, User Roles, and User profiles 2. Create a webpage with HTML describing your department using paragraph and list tags. 3. underline and two other fonts to words you find appropriate, also use header tags. 4. Develop a web application with background banner images and navigation menus. , Blog Posts, Followers, User comments, 5. Develop a web application with responsive images 6. Develop a web application using the left menu. 7. Develop settings to change the theme of the entire web Application. Python+flask backend database: 8. Creating a flask database and extracting data and adding data 9. Create a dashboard using bootstrap and connect with the database to represent the data in the dashboard					
TOTAL PERIODS:					108

<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1</b>	Use basic and advanced flask
<b>CO2</b>	Use data models and databases
<b>CO3</b>	Use the built-in support for layout, grids, fluid grids, and responsive designs.
<b>CO4</b>	Use components: Contains lots of reusable components including Icons, Dropdowns, Navbars, Breadcrumbs, Popovers, Alerts, and many more
<b>CO5</b>	Use JavaScript Plug-ins: Contains lots of custom jQuery plug-ins. You can include them all or one by one.
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Miguel Grinberg, "Flash Web development", O'REILLY Publications, 2018
<b>2</b>	Jacob D Lett, Bootstrap quick start, Bootstrap Creative Publications, 2019
<b>3</b>	Alan Forbes, The joy of Bootstrap, CreateSpace Independent Publishing Platform; 2nd edition 2015

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Mobile Application development	1	0	4	3
PREREQUISITES:					
Fundamentals of computer and design					
COURSE OBJECTIVES:					
1	To facilitate students to understand android SDK				
2	To help students to gain a basic understanding of Android application development				
3	To inculcate working knowledge of Android Studio development tool				
UNIT	TITLE				PERIODS
1	Overview of Android				18
Introducing Android, The Android Application Components, The manifest file, Downloading and Installing Android, Exploring the Development Environment, Developing and Executing the first Android Application, Using Activities, Fragments, and Intents, User Interface Using Views and ViewGroups, Data Storage Options, the internal storage, the external storage, Location Services and Maps, Graphics and Animation , Audio, Video, and Camera,Publishing and Distributing Android Application.					
TITLE					PERIODS
LABORATORY					72
1. Write an Android application for a simple arithmetic operation 2. Write an Android application to convert into different currencies, for example, Rupees to dollar 3. Write an android application to counter. 4. Write an android application to convert a ball from size of radius 2(color red) to radius 4(color blue) to radius 6 (color green). The ball must rotate in the circle for 1 minute before changing size and color. 5. Write an application to load the google maps and use the gps.					
TOTAL PERIODS:					90
Upon completion of this course, students will be able to:					
CO1:	Identify various concepts of mobile programming that make it unique from programming for other platforms.				

<b>CO2:</b>	Critique mobile applications on their design pros and cons.
<b>CO3:</b>	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
<b>CO4:</b>	Program mobile applications for the Android operating system that use basic and advanced phone features.
<b>CO5:</b>	Deploy applications to the Android marketplace for distribution.
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education Publications,second edition,2011.
<b>2</b>	Reto Meier, "Professional Android 2 Application Development", Wiley India Publications,2010.
<b>3</b>	Mark L Murphy, "Beginning Android", Wiley India Publications,2009.
<b>4</b>	Barry Burd,"Android Application Development All in one for Dummies",For Dummies Publications,2015



Course Code	Course Title	Periods per week			Credits
	Integral yoga & value embodied leadership I - Refresher	L	T	P	
		1	0	4	3
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	To understand and develop a consciousness-centered worldview				
2	To demonstrate the major conception of Integral Yoga and the triple movements				
3	To learn Radical Transformational Leadership tools to apply what I stand for (care about) in my everyday practice.				
4	To learn systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment.				
5	To learn distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential				
THEORY					
UNIT	TITLE				PERIODS
1	Consciousness-centered worldview				6
Consciousness-meaning & concepts; Broad regions of Consciousness; Evolution & Involution.					
UNIT	TITLE				PERIODS
2	Integral Yoga: An Adventure of Consciousness				6
Integrality; Physical, vital and mental consciousness; The psychic being; Mental evolution; Liberation and Transformation					
UNIT	TITLE				PERIODS
3	The Triple Movements				6
Aspiration, Rejection and Surrender					
TITLE					PERIODS
LABORATORY					72

1. Integrity (being whole and undiminished) 2. Reviewing my BTI- CSFR and Respond & Realize 3. Judgment & Discernment 4. Synergistic Operational Strategies - Part 1(understanding) 5. Synergistic Operational Strategies - Part 1 - Reviewing my BTI 6. Guilt the hidden payoff 7. Three domains of my Listening and speaking 8. Synergistic Operational Strategies - Part 2 9. Likert Emberling – Stages of leadership 10. Overload and Overwhelm 11. Conversations for action - committed requests, committed responses. 12. Principled Outrage distinguished from Destructive Anger 13. Transformational Results Chain (understanding) 14. Transformational Results Chain and My project: Individual work	
<b>TOTAL PERIODS:</b>	<b>90</b>
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Understand and develop a consciousness-centered worldview
<b>CO2:</b>	Explain the major conception of Integral Yoga and the triple movements
<b>CO3:</b>	Practice Radical Transformational Leadership tools to apply what I stand for (care about) in my everyday life.
<b>CO4:</b>	Apply systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment.
<b>CO5:</b>	Have the granularity to choose to transcend emotions and fears and work out of their full potential
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	<a href="https://www.ipi.org.in/infinity/infinityfiles/0-2-2-integrality.php">https://www.ipi.org.in/infinity/infinityfiles/0-2-2-integrality.php</a>
<b>2</b>	Sri Aurobindo," Life Divine & Synthesis of Yoga", Shri Aurobindo Ashram Publications, 1921.
<b>3</b>	Monica Sharma, "Radical Transformational Leadership: Strategic Action for Change", North Atlantic Book Publications,2017.

Course Code	Course Title	Periods per week			Credits
	Machine Learning Algorithms - I	L	T	P	
		4	0	0	
PREREQUISITES:					
Fundamentals of computer and math					
COURSE OBJECTIVES:					
1	To Understand a wide variety of machine learning algorithms				
2	To understand supervised machine learning algorithms and their application				
3	To understand unsupervised machine learning algorithms and their application				
UNIT	TITLE				PERIODS
1	Context and Framework of Machine Learning				12
Learning problems scenarios, types of learning in ML - supervised, unsupervised, reinforcement. Standard learning tasks, the Statistical Learning Framework, Probably Approximately Correct (PAC) learning.					
UNIT	TITLE				PERIODS
2	Supervised Learning Algorithms - I				12
Regression: linear regression, cost function, feature scaling, mean normalization, regularization, learning rates, multiple linear regression, polynomial regression. Normal equation					
UNIT	TITLE				PERIODS
3	Supervised Learning Algorithms - II				16
Classification problems - binary classification, logistic Regression, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART)					
UNIT	TITLE				PERIODS
4	Unsupervised Learning - I				16
Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Self Organizing Map					
UNIT	TITLE				PERIODS
5	Unsupervised LEARNING - II				16
Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis					

TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Understand a wide variety of machine learning algorithms	
CO2:	Understand supervised machine learning algorithms and their application	
CO3:	Understand unsupervised machine learning algorithms and their application	
REFERENCE BOOKS/ COURSES:		
1	Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Publications, 2012	
2	Tom Mitchell, "Machine Learning", McGraw Hill Publications, 3rd Edition, 1997.	
3	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar " Foundations of Machine Learning", MIT Publications,2012.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	<b>Foreign Language (German)</b>	<b>3</b>	<b>0</b>	<b>0</b>	

#### PREREQUISITES:

NIL / Course Code – Course Title / Topics

#### Course Objective

<b>1</b>	Students should become familiar with the German language; the 4 language skills are: listening, speaking, reading and writing.
<b>2</b>	To empower the students to use German in daily communication.
<b>3</b>	To build up their confidence in the usage of German.
<b>4</b>	Familiarize the students with social, economic and cultural life in Germany.

#### THEORY

UNIT		PERIODS
<b>1</b>	<b>Hello And Basics</b>	<b>10</b>

Language acts: greet and say goodbye/introduce oneself and others/talk about oneself and others/name numbers up to 20, telephone number and e-mail address/spell them/talk about countries and languages. Vocabulary: numbers from 1-20/countries and languages. Grammar: question/statement/verbs and personal pronouns. Pronunciation: alphabet. Regional studies: Countries and languages. Film: Good afternoon/The telephone number/I speak. Deepening: Advantages of learning German.

UNIT	TITLE	PERIODS
<b>2</b>	<b>Friends Colleagues And Me</b>	<b>11</b>

Language acts: talk about hobbies/date/name days of the week/talk about work, professions and working hours/name numbers from 20 onwards/talk about seasons/create a profile on the internet. Vocabulary: hobbies/weekdays/numbers from 20/occupations/months and seasons. Grammar: articles/verbs and personal pronouns I/yes/no questions/plural of nouns/the verbs 'have' and 'be'. Pronunciation: sentence melody, questions and answers. Regional studies: Seasons and typical hobbies. Film: The trainee. Deepening: Principles of living together.

UNIT	TITLE	PERIODS
<b>3</b>	<b>In The City</b>	<b>11</b>

Language acts: Naming places and buildings/asking questions about places/assigning texts to a picture story/asking about things/naming means of transport/asking for directions and describing a route/understanding texts with international words/learning articles. Vocabulary: places and buildings/means of transport/directions. Grammar: definite, indefinite and negative article/imperative with 'Sie/you'. Pronunciation: long and short vowels. Regional studies: Sights, numbers, events in Hamburg. Film: Taxi ride/in the Hotel. Motivation: vision, goal setting.

UNIT	TITLE	PERIODS
4	Enjoy Your Meal	11

Language acts: talking about food/planning a purchase/conversing while shopping/conversing while eating/understanding texts with W-questions/ordering and learning words. Vocabulary: meals/food/drinks/shops. Grammar: positions in a sentence/accusative/verb with accusative case. Pronunciation: Umlauts ä, ö, ü. Regional studies: Food in D-A-CH, professions related to food. Film: Breakfast/shopping. Motivation: plan progress

UNIT	TITLE	PERIODS
5	Day By Day & Time With Friends	11

Language acts: understanding and telling the time/talking about the family/arranging an appointment/excusing oneself for being late/arranging an appointment by phone. Vocabulary: daily routine/time/family. Grammar: telling time with 'am, um, von...bis'/possessive article/modal verbs. Pronunciation: Hearing and speaking 'r'. Regional studies: Punctuality in D-A-CH. Film: You never have time! Motivation: Progress diary.

Language acts: planning something together/talking about birthdays/understanding and writing an invitation/ordering and playing at a restaurant/talking about an event/finding specific information in texts/understanding event tips on the radio. Vocabulary: leisure activities/food/drinks/properties/events. Grammar: dates 'on..'/separable verbs/prepositions for + accusative/personal pronouns in accusative. Pronunciation: ei, eu, au. Regional studies: Pubs & Co. in D-A-CH. Film: Work? In the restaurant. Surprise! Deepening: Diversity of living together. Summarize course experiences. Write a short report.

<b>TOTAL PERIODS:</b>	<b>54</b>
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#### **COURSE OUTCOMES:**

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

<b>CO1:</b>	Communicate in a simple way in German
<b>CO2:</b>	Understand and use part of the basis of German grammar
<b>CO3:</b>	Understand the social and cultural life in Germany in a rudimentary way, reflect on it comparatively also with others and exchange mails about it
<b>CO4:</b>	Orientate themselves in the country and in the public sphere
<b>CO5:</b>	Focus on own motivation and set goals

#### **TEXT BOOKS:**

1	Klett Verlag, "Netzwerk, Deutsch als Fremdsprache A1.1, A1.2, Kursbuch plus Audio CD, workbook", Intensive trainer, 2016
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#### **REFERENCE BOOKS:**

<b>1</b>	Dictionary German-English, App 2018.
<b>2</b>	Lingolia Deutsche Grammatik, App 2018.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Foreign Language (French)	3	0	0	

PREREQUISITES:					
NIL / Course Code – Course Title / Topics					
COURSE OBJECTIVES:					
1	Students should become familiar with the French language; the 4 language skills are: listening, speaking, reading and writing.				
2	To empower the students to use French in daily communication.				
3	To build up their confidence in the usage of French.				
UNIT	TITLE				PERIODS
1	'Hello' and basics				10
Language acts: greet and say goodbye/introduce oneself and others/talk about oneself and others/name numbers up to 20, spelling email or telephone numbers /talk about French speaking countries Vocabulary: numbers from 1-20/countries and languages. Grammar: personal pronouns/ verb to have and to be/ statement/ yes-no questions Pronunciation: Alphabet. Typical French sounds Regional studies: French Speaking countries. Audio-Video: meeting people, very simple dialogue Deepening: Advantages of learning French.					
UNIT	TITLE				PERIODS
2	'Family, Friends, and me'				11
Language acts: talk about season/date/time/name days of the week/talk about family and friends, work, professions and working hours/name numbers from 20 onwards/talk about seasons/create a profile on the internet. Vocabulary: Season/year/month/week/time/family and friends vocabulary, numbers from 20/ occupations/months and seasons. Grammar: definite and indefinite articles/ adjectives and gender/ singular-plural of nouns/conjugation at present 1st verb group. Pronunciation: linking words in French, intonation, practice of difficult French sounds Regional studies: Seasons and most liked sport and hobbies. Audio-Video: positioning oneself with respect to others. Simple dialogue.Deepening: Family in France					
UNIT	TITLE				PERIODS
3	'In the city'				11
Language acts: Naming places, roads, and buildings/asking questions about places/assigning texts to a picture story/asking about things/naming means of transport/asking for directions and describing a route/understanding texts with international words/learning articles. Vocabulary: places and buildings/means of transport/directions right/left. Grammar: possessive-demonstrative pronouns, making a comparison, Imperative, few very useful irregular verbs Pronunciation: Deepening of “in, un, on, an, ..” French sounds. Regional studies: French geography. Audio-Video: Finding your way/ Taxi ride/in the Hotel.					



UNIT	TITLE	PERIODS
4	‘Enjoy your meal’	11
Language acts: talking about food/planning a purchase/conversing while shopping/conversing while eating/understanding texts with W-questions/ordering and leaning words. Vocabulary: meals/food/drinks/shops. Grammar: past (passé compose and imparfait) and future conjugation of the 1st verb group, different type of propositions Pronunciation: hint on the French pronunciation in the street. Shortening words Regional studies: cuisine in France, professions related to food. Audio-Video: at restaurant, at the grocery store, recipe		
UNIT	TITLE	PERIODS
5	‘Day by day’ & ‘Time with friends’	11
Language acts: talking about friends/arranging an appointment/excusing oneself for being late/deciding with friends what to do, organizing a trip, talking about money Vocabulary: daily routine /time /friends /leisure. Grammar: modal verbs and subjunctive conjugation and finding conjugation using the Bescherelle book Pronunciation: how French spoken quick. Be able to recognize and understand in real situation Regional studies: French culture and art Audio-Video: going in vacation, to the museum, at a concert		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Communicate in a simple way in French	
CO2:	Understand and use part of the basis of French grammar	
CO3:	Understand the social and cultural life in France in a rudimentary way, reflect on it comparatively also with others and exchange mails about it	
CO4:	Orientate themselves in the country and in the public sphere	
REFERENCE COURSES/BOOKS:		
1	Myrna Bell Rochester,"Easy French Step-by-Step",McGraw Hill,2008.	
2	Annie Heminway,"Practice Makes Perfect: Complete French All-in-One", Premium Third Edition 3rd Edition,McGraw Hill,2022.	

Course Code	Course Title	Periods per week			Credits
	Discrete Mathematics	L	T	P	
		3	0	0	
PREREQUISITES:					
Fundamentals of mathematics					
COURSE OBJECTIVES:					
1	To learn symbolic logic				
2	To learn set theory				
3	To learn the principles of graph theory				
4	To learn the principles of Trees				
UNIT	TITLE				PERIODS
1	Symbolic Logic				10
Proposition, Logical operators, conjunction, disjunction, negation, conditional and bi-conditional operators, converse, Inverse, ContraPositive, logically equivalent, tautology and contradiction. Normal forms – Disjunctive normal forms and Conjunctive normal forms.					
UNIT	TITLE				PERIODS
2	Set Theory				11
Set operations, Venn diagram, Properties of sets, number of elements in a set, Power set- Cartesian product, relations & functions,					
UNIT	TITLE				PERIODS
3	Relations and functions				11
Equivalence relation, partially and Ordered sets, Functions: Types of Functions, Composition of Functions. Boolean Algebra and its Properties – Karnaugh Map (1, 2, 3, and 4 variables only)					
UNIT	TITLE				PERIODS
4	Graph Theory				11
Graph – Definition – Applications of Graph – Finite and Infinite Graphs – Incidence and Degree – Isolated Vertex – Pendant Vertex – Null Graph -Isomorphism –Sub graphs – Walks, paths and circuits – Connected Graphs – Disconnected Graphs and components. Euler Graphs –operations on Graphs - Hamiltonian and circuit					
UNIT	TITLE				PERIODS
5	Tree				11

Trees and Fundamentals Circuits: Trees - Some properties of Trees – Pendant Vertices in a tree – Distance and Centers in a Tree – Rooted and Binary Trees – On Counting Trees – Spanning Trees – Fundamental Circuits.	
<b>TOTAL PERIODS:</b>	
<b>54</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Know the principles of graph theory
<b>CO2:</b>	Know principles of Trees
<b>CO3:</b>	Know the principles of set theory
<b>REFERENCE BOOKS/ COURSES:</b>	
1	Narsingh Deo, "Graph Theory with Applications to Engineering & Computer Science", Dover Publications Inc., New York, 2016.
2	J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Publications, India, 1st Edition, 1997.

Course Code	Course Title	Periods per week			Credits
	Database systems Theory and Practice	L	T	P	
		2	0	4	4
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	To understand basic database system				
2	To learn Data models and normalization				
3	To learn SQL queries to handle the database				
4	To learn database transaction management and database recovery				
UNIT	TITLE				PERIODS
1	Basic Concept				8
Database, Database system, Database management system, Data independence, advantages and disadvantages, 3-level architecture and mapping DBMS vs.File System, DBA's Role, RDBMS.					
UNIT	TITLE				PERIODS
2	Data Models and Normalization				8
Relational model, Hierarchical model, Network model, comparison of these model, An overview of the E/R Model, E/R diagrams, Database design with the E/R model. Introduction to Normalization, Need of Normalization, various forms of Normalization (1NF, 2NF, 3NF, BCNF)					
UNIT	TITLE				PERIODS
3	SQL				8
Introduction, Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL) statements, Views, Sub–queries, Access Rights.					
UNIT	TITLE				PERIODS
4	SQL and transaction management				12
Introduction, Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL) statements, Views, Sub–queries, Access Rights. Introduction to Transaction Processing, Properties of Transactions, Concurrency Control, the purpose of concurrency control, Techniques for concurrency control.					
UNIT	TITLE				PERIODS
LABORATORY					72

Study of Database Concepts: Relational model – table – operations on tables – index – table space – clusters – synonym – view – schema – data dictionary – privilege – role transactions. 2. Study of SQL: Primitive Data Types – User Defined data Types – Built-in Functions – Parts of Speech of create, alter, drop, select, insert, delete, update, commit, rollback, save point, grant, revoke. 3. Study of Query Types: Queries involving Union, Intersection, Difference, Cartesian product, Divide Operations – Subqueries – Join Queries – Nested Queries – Correlated, Queries – Recursive Queries. 4. Study of Procedural Query Language: Blocks, Exception Handling, Functions, Procedures, Cursors, Triggers, Packages. 5. Application: Design and develop any two of the following: (a) Library Information System (b) Logistics Management System (c) Students' Information System (d) Ticket Reservation System (e) Hotel Management System (f) Hospital Management System (g) Inventory Control (h) Retail Shop Management (i) Employee Information System (j) Payroll System	
<b>TOTAL PERIODS:</b>	
<b>108</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Basic concepts of Database Systems and Application
<b>CO2:</b>	Identify the SQL queries for a given scenario.
<b>CO3:</b>	Develop solutions using database concepts for real time requirements
<b>CO4:</b>	Analyze and Select storage and recovery techniques of the database system Recognize the different Internet devices and their functions
<b>REFERENCE BOOKS/ COURSES:</b>	
<b>1</b>	J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Volume 1 Computer Science Press Publications, 1st Edition, 1990.
<b>2</b>	Silberschatz, Korth & Sudarshan, "Database System Concepts", McGraw Hill International Editions, Third Edition, Computer Science Series, 1997
<b>3</b>	R. Elmasri and S. Navathe, "Fundamentals of Database Systems", Benjamin-Cummings Publications, 6th Edition, 2005 .
<b>4</b>	Ivan Bayross, "SQL/PLSQL: The Programming Language of Oracle", BPB Publications, 3rd Revised Edition, 2006.

Course Code	Course Title	Periods per week			Credits
	<b>Machine Learning Algorithms Lab - I</b>	<b>L</b>	<b>T</b>	<b>P</b>	
		<b>0</b>	<b>0</b>	<b>6</b>	<b>3</b>
<b>PREREQUISITES:</b>					
Fundamentals of machine learning					
<b>COURSE OBJECTIVES:</b>					
1	To work on machine learning in a scientific working environment				
2	To implement, train and apply supervised machine learning algorithms - linear regression, and logistic regression.				
3	To implement, train and apply unsupervised machine learning algorithm - K-Means				
TITLE					PERIODS
LABORATORY					108
1. Installing - Jupyter Notebook and libraries numpy, scikit-learn 2. Loading and using Jupyter notebook by creating variables and printing them 2. Loading datasets and separating loaded datasets into training and testing 3. In Jupyter notebook review, modify, run and observe: a. Simple linear regression model with two parameters loading training and test data with NumPy and plotting it. b. Review a simple cost function and minimize the cost to provide optimal two parameters c. Reviewing gradient function and automating optimizing of parameters using gradient descent d. Using Numpy to create, index, slice, vector dot product, speed of vector vs loop. 4. Create a linear regression model to predict the financial sustainability of an organic store 5. Train a linear regression model using scikit-learn 6. Review, modify, run and observe: a. Issues with using linear regression to classify data b. Exploring sigmoid function in logistic regression c. Plotting decision boundary example d. Cost function for logistic regression 7. Create a logistic regression model to predict if it will rain tomorrow based on the last 10 year's rainfall data. 8. Train a logistic regression model using scikit-learn. 9. Implement the k-means clustering algorithm and use it for image compression.					

<b>TOTAL PERIODS:</b>	
<b>108</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Design the python programs for various learning algorithm
<b>CO2:</b>	Understand the implementation procedures for the machine learning algorithms
<b>CO3:</b>	Understand a range of machine learning algorithms along with their strengths and weaknesses
<b>REFERENCE BOOKS/ COURSES:</b>	
1	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press Publications, 2nd Edition, 2018.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer Publications, 2nd Edition, 2009.
3	Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Publications, 2020
4	Tom M. Mitchell, "Machine Learning", Mc Graw Hill Publications, Indian Edition, 2017

Course Code	Course Title	Periods per week			Credits
	Integral yoga & value embodied leadership II	L	T	P	
		1	0	4	
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	To incorporate aspects of integral yoga into life with meditation and reflection				
2	To incorporate aspects of integral yoga into life with Surya namaskar				
3	To integrate Radical Transformational Leadership tools in everyday practice.				
4	To design projects for system and cultural shift from universal values				
5	To learn distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential				
THEORY					
UNIT	TITLE				PERIODS
1	Review of the triple movement				9
Aspiration, Rejection and Surrender					
UNIT	TITLE				PERIODS
2	RTL (Radical Transformational Leadership) Book Reading				9
Understanding the praxis around the world around RTL					
LABORATORY					
UNIT	TITLE				PERIODS
1	Meditation				14
To learn and incorporate daily meditation					
UNIT	TITLE				PERIODS
2	Suryanamaskar				14
To learn and incorporate Surya namaskar					
UNIT	TITLE				PERIODS
3	Reflection				10
To reflect weekly on the progress made physically and mentally					
UNIT	TITLE				PERIODS
4	Refresher and triad practice				18



Reflection on the tools applied in day to day life. Conversations for clarity and refreshers.		
UNIT	TITLE	PERIODS
5	Design and implementation of breakthrough initiative	16
Refresher on design templates and design and refining the breakthrough initiative at college.		
TOTAL PERIODS		90
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
1	Develop in meditation and reflection	
2	Develop physically through suryanamaskar	
3	Use Radical Transformational Leadership tools in everyday practice.	
4	Design projects for system and cultural shift from universal values	
5	Notice distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential	
REFERENCE COURSES/BOOKS:		
1	Daniel Goleman and Richard Davidson,"Altered Traits: Science Reveals How Meditation Changes Your Mind, Brain, and Body",Avery Publications, 2017	
2	Monica Sharma," Radical Transformational Leadership: Strategic Action for Change", North Atlantic books Publications, Berkeley, California,2017.	

Course Code	Course Title	Periods per week			Credits
	Machine Learning Algorithms - II	L	T	P	
		4	0	0	
PREREQUISITES:					
Machine Learning					
COURSE OBJECTIVES:					
1	To know large margin classifiers(SVM)				
2	To understand anomaly detection and recommender systems				
3	To understand large data algorithms				
4	To apply these ideas on a real life example				
UNIT	TITLE				PERIODS
1	SVM (Support Vector Machines)				14
Large margin classification, outliers, non-linear decision boundaries, kernel, SVM parameters and usage					
UNIT	TITLE				PERIODS
2	Anomaly Detection				14
Applications of anomaly detection, Probability Density functions, density estimation, density transformation, algorithms, anomaly detection vs supervised learning, multivariate gaussian distribution					
UNIT	TITLE				PERIODS
3	Recommender systems				14
Applications of recommender systems, selecting features, collaborative filtering, content based filtering					
UNIT	TITLE				PERIODS
4	Optimization and parallelism				16
Stochastic gradient descent, mini-batch gradient descent, checking convergence of stochastic gradient descent, map-reduce and data parallelism					
UNIT	TITLE				PERIODS
5	Application Example				14
Photo OCR (Optical Character Recognition), sliding window - step size, artificial data synthesis.					
TOTAL PERIODS:					72

<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Understand large margin classifiers
<b>CO2:</b>	Understand and explain anomaly detection and recommender systems
<b>CO3:</b>	Understand optimizations needed for large data algorithms
<b>CO4:</b>	Apply these ideas to a real life example
<b>REFERENCE BOOKS/ COURSES:</b>	
<b>1</b>	Oliver Theobald,"Machine Learning For Absolute Beginners: A Plain English Introduction",ScatterPlot Publications,Second Edition,2017
<b>2</b>	Dustin Boswell,"Introduction to Support Vector Machines",Semantic scholar publications,2002

Course Code	Course Title	Periods per week			Credits
	Computer Networks	L	T	P	
		4	0	0	
PREREQUISITES:					
Fundamentals of computer and internet					
COURSE OBJECTIVES:					
1	The course introduces the main concepts of networking.				
2	To introduce the types of layers in computer networks.				
3	To educate the functions of various OSI layers				
UNIT	TITLE				PERIODS
1	Introduction to Computer network				14
Uses of Computer Networks: Business Applications, Home Applications, Mobile Users, Social Issues, Network Hardware: LANs, MANs, WANs.					
Network Software: Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services, Service Primitives, The Relationship of Services to Protocols. Reference Models: The OSI Reference Model, The TCP/IP Reference Model. Example Networks: The Internet, Connection-Oriented Networks (X.25, Frame Relay & ATM), Ethernet.					
Network Layer: Network Layer Design Issues: Store-and-Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection-Oriented Service, Comparison of Virtual-Circuit & Datagram Subnets.					
UNIT	TITLE				PERIODS
2	Network Layer				14
Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding, Jitter Control.					
Quality of Service: Requirements, Techniques for Achieving Good Quality of Service, Integrated Services, Differentiated Services.					
Internetworking: Networks Differences, Connecting Networks, Concatenated Virtual Circuits, Connectionless Internetworking, Tunneling, Internetwork Routing, Fragmentation.					
Network Layer in the Internet: The IP Protocol, IP Addresses, Internet Control Protocols, OSPF-The Interior Gateway Routing Protocol, BGP-The Exterior Gateway Routing Protocol, Internet Multicasting, Mobile IP, IPv6.					

UNIT	TITLE	PERIODS
3	TCP and UDP	16
Transport Layer: The Transport Service: Services Provided to the Upper Layers, Transport Service Primitives, Berkeley Sockets. Elements of Transport Protocols: Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Crash Recovery, Simple Transport Protocol.		
User Datagram Protocol (UDP): Introduction to UDP, Remote Procedure Call, The Real-Time Transport Protocol.		
Internet Transport Protocols (TCP): Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, Modeling TCP Connection Management, TCP Transmission Policy, TCP Congestion Control, TCP Timer Management, Wireless TCP & UDP Transactional TCP.		
UNIT	TITLE	PERIODS
4	Application Layer	14
Application Layer: The Domain Name System(DNS): The DNS Name Space, Resource Records, Name Servers. Electronic Mail: Architecture & Services, The User-Agent, Message Formats, Message Transfer, Final Delivery.		
UNIT	TITLE	PERIODS
5	World Wide Web	14
Architectural Overview, Static Web Documents, Dynamic Web Documents, HTTP – HyperText Transfer Protocol, Performance Enhancements. Multimedia: Introduction to Digital Audio, Audio Compression, Streaming Audio, Internet Radio, Voice over IP, Introduction to Video, Video Compression, Video on Demand, The MBone – The Multicast Backbone.		
TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Knowledge of OSI Layers in Computer Network.	
CO2:	Ability to identify transmission media, types, and topologies of the network.	
CO4:	Familiarization with the techniques of error detection and congestion control	
REFERENCE COURSES/BOOKS:		
1	Andrew S Tanenbaum and David J Wetherall, “Computer Networks” Fifth Edition, Pearson Publications, 2012.	
2	William Stallings, “Data and Computer Communications”, Pearson Education Publications,Eighth Edition, 2007.	
3	Behrouz A. Forouzan and Sophia Chung Fegan, “Data Communications and networking,McGraw-Hill Higher Education, 2004.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	<b>Soft Skill Development – I</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

#### PREREQUISITES:

English, Mathematics

#### COURSE OBJECTIVES:

<b>1</b>	To prepare the students to write their project report
<b>2</b>	Get ready to write proposals implementing their ideas
<b>3</b>	To prepare them to speak in Public
<b>4</b>	To make them prepare effective Presentations and Enable students in Aptitude building
<b>5</b>	Enable students to use their Aptitude Knowledge effectively in decision making

UNIT	TITLE	PERIODS
<b>1</b>	<b>Report, Proposal, and Project</b>	<b>11</b>

Report Writing, Types, Structure, Style, and Writing of Reports (on different topics), Characteristics of Report, Categories and Types of Report, Types of Proposal, Nature, and Significance, Structure of formal Proposal, Sample Proposal, Writing Proposals on different topics, Difference between Report and Proposal, Project Writing: Essential Features, Structure, Choosing the Subject, and Writing the Project on the related subject - Using CFSR

UNIT	TITLE	PERIODS
<b>2</b>	<b>Communication Skills</b>	<b>10</b>

Activities related to Skills required for Engineers (Managerial Skills, Leadership Skills, and Organizational Skills). Recruitments and Interviews, Stages in Job Interview, Desirable Qualities, Reviewing the common Question Types of Interviews.

UNIT	TITLE	PERIODS
<b>3</b>	<b>Strategies for Recruitment</b>	<b>11</b>

Recruitments and Interviews, Stages in Job Interview, Desirable Qualities, Reviewing the Common Question Types of Interviews.

UNIT	TITLE	PERIODS
<b>4</b>	<b>Numbers and Arithmetic Basic</b>	<b>11</b>

Classification of Numbers, Divisibility rules –LCM/HCF, Remainders – Base System, Surds, Indices, Logarithms, Percentage, Profit and Loss, Ratio and Proportion, Approximations, Vedic Maths, Intro to DI, Comprehensive Practice Test on the Number system, Percentage and Calculation

UNIT	TITLE	PERIODS
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5	Logic Puzzles	11
Code-decoding, Analogies, Direction Test, Blood relations, Reading Comprehension Practice test-1 and test-2		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
CO1:	Students are trained to write the proposals and assigned projects	
CO2:	Students write Presentations on different Industrial topics	
CO3:	Improve arithmetic aptitude	
CO4:	Learn tricks to solve Aptitude questions faster thereby saving time during competitive exams	
REFERENCE COURSES/BOOKS:		
1	Sanjay Kumar, Pushp Lata, "Communication Skills", Oxford University Press ,2012	
2	Raymond Murphy "Essential English Grammar", Cambridge University Press, 1998	
3	R. K. Narayan, "Malgudi Days: A Collection of Short Stories", Penguin Publications, 2006	
4	Meenakshi Raman, Prakash, "Business Communication", Oxford University Press, 2011	
5	Aggarwal R.S , "Quantitative Aptitude for Competitive Examinations", S.Chand Publications, 2021.	
6	Meenakshi Raman, Sangeeta Sharma "Technical Communication Principles and Practice", Oxford University Press, 2012.	

Course Code	Course Title	Periods per week			Credits
	<b>Machine Learning Algorithms Lab - II</b>	<b>L</b>	<b>T</b>	<b>P</b>	
		<b>0</b>	<b>0</b>	<b>8</b>	<b>4</b>
<b>PREREQUISITES:</b>					
Machine Learning					
<b>COURSE OBJECTIVES:</b>					
1	To implement large margin classifiers(SVM).				
2	To implement anomaly detection and recommender systems.				
3	To implement a large data algorithm.				
4	To apply algorithms to a real-life problem.				
<b>TITLE</b>					<b>PERIODS</b>
<b>LABORATORY</b>					<b>144</b>
1. Downloading iris datasets 2. Implement SVM and use it for classification using iris datasets. 3. Gathering data for computer networks to detect anomalies. 4. Implement the anomaly detection algorithm and apply it to monitor computer servers failing. 5. Gathering data for collaborative filtering recommender systems 6. Implement a content-based collaborative filtering recommender system for movies. 7. Implement stochastic gradient descent and check for convergence. 8. Implement OCR (Optical Character Recognition) with two ML algorithms.					
<b>TOTAL PERIODS:</b>					<b>144</b>
<b>COURSE OUTCOMES:</b>					
Upon completion of this course, students will be able to:					
<b>CO1:</b>	Understand large margin classifiers(SVM).				
<b>CO2:</b>	Understand anomaly detection and recommender systems.				
<b>CO3:</b>	Understand a large data algorithm.				
<b>CO4:</b>	Apply algorithms to a real-life problem.				



Course Code	Course Title	Periods per week			Credits
	Integral yoga & value embodied leadership II - Refresher	L	T	P	
		1	0	4	3
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	Understanding the potentialities of man				
2	Understanding the synthesis in Integral Yoga of various systems of yoga				
3	To learn Radical Transformational Leadership tools to apply what I stand for (care about) in my everyday practice.				
4	To learn systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment.				
5	To learn distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential				
UNIT	TITLE				PERIODS
1	Triple birth: The Threefold of Life				6
Threefold potentialities of man- material man, mental man & spiritual man; Material and spiritual life in India; Collective perfection					
UNIT	TITLE				PERIODS
2	The Systems of Yoga				6
Three consenting parties & Omnipresent Trinity; Hata yoga, raja yoga, bhakti yoga, jnana yoga, karma yoga					
UNIT	TITLE				PERIODS
3	The Synthesis of Systems				6
Meaning of synthesis; Synthesis in Integral Yoga and Aim of Integral Yoga					
TITLE					PERIODS
LABORATORY					72

1. Intersession 2: learning about self for social transformation 2. Stages of Leadership 3. Integrity Lens 4. Three domains of Listening & Speaking 5. Story of Solutions – Creating Criteria 6. Reviewing my BTI- CSFR and Respond & Realize; Synergistic Operational Strategies & Transformational Results Chain 7. Creating transformational spaces in routine activities: meetings 8. Interrupting disempowering ISMs 9. Aligning projects for Synergy based on my BTI 10. Emotional reactions distinguished from courageous heart response 11. Strategic Action & Results at Scale 12. Fruition Time for Results 13. Synergistic Partnerships for Results- using Likert Emberling Framework 14. Transformational Listening and speaking: My Project, & what I will do to break disempowering ISMS- Groups of 6	
<b>TOTAL PERIODS:</b>	
<b>90</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	apply Radical Transformational Leadership tools in what I stand for (care about) in my everyday practice.
<b>CO2:</b>	develop systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment.
<b>CO3:</b>	learn distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential
<b>REFERENCE BOOKS/ COURSES:</b>	
<b>1</b>	Monica Sharma,"Radical Transformational Leadership: Strategic Action for Change", North Atlantic Books Publications,Berkeley, California,2017

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Deep Learning	4	0	0	4
PREREQUISITES:					
Fundamentals of computer					
COURSE OBJECTIVES:					
1	To understand complexity of Deep Learning algorithms and their limitations				
2	To learn modern notions in data analysis oriented computing				
3	Be capable of performing distributed computations				
4	Be capable of performing experiments in Deep Learning using real-world data				
UNIT	TITLE				PERIODS
1	Introduction to Neural Networks				14
Computational Graph, Key highlights, Creating a Graph, Perceptron, XOR Gate, Visualizing using TensorBoard, Modularity Sharing Variables Keras					
UNIT	TITLE				PERIODS
2	Activation Functions and Artificial Neural Networks				14
Activation Functions:Sigmoid,ReLU, Hyperbolic Fns,Softmax. Artificial Neural Networks :Introduction, Perceptron Training Rule, Gradient Descent Rule					
UNIT	TITLE				PERIODS
3	Gradient Descent and Backpropagation				16
Gradient Descent and Backpropagation:Gradient Descent, Stochastic Gradient Descent,Backpropagation, Some problems in ANN Optimization and Regularization :Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters					
UNIT	TITLE				PERIODS
4	Introduction to Convolutional Neural Networks				14
Introduction to Convolutional Neural Networks: Introduction to CNNs, Kernel filter,Principles behind CNNs, Multiple Filters, CNN applications Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs,Seq2Seq RNNs, LSTM, RNN applications					
UNIT	TITLE				PERIODS
5	Deep Learning applications:				14
Image Processing, Natural Language Processing, Speech Recognition, Video Analytics					

TOTAL PERIODS:		72
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Understand the language and fundamental concepts of artificial neural networks	
CO2:	Implement deep learning algorithms, understand neural networks and traverse the layers of data abstraction which will empower the student to understand data more precisely.	
CO3:	Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces	
CO4:	Applying deep learning to real world applications using - TensorFlow	
REFERENCE BOOKS/ COURSES:		
1	Bishop.C.M," Pattern Recognition and Machine Learning", Springer Publications, 2006.	
2	Yegnanarayana.B," Artificial Neural Networks", PHI Learning Publications, 2009.	
3	Golub.G.H, Van Loan.C.F," Matrix Computations", JHU Publications, 2013.	
4	Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education, Publications,2004.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Soft Skill Development – II	1	2	0	3
PREREQUISITES:					
English and Mathmetics					
COURSE OBJECTIVES:					
1	To prepare the students, think critically.				
2	To prepare the get ready for aptitude exams				
3	To Improve communication skills.				
4	Develop a synthesizing mind.				
UNIT	TITLE				PERIODS
1	Group discussions				10
Advantages of group discussion, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.					
UNIT	TITLE				PERIODS
2	Reading comprehension advanced				8
A course on how to approach middle-level reading comprehension passages.					
UNIT	TITLE				PERIODS
3	Problem solving				11
Money-related problems; Mixtures; Symbol-based problems; Clocks and calendars; Simple, linear, quadratic, and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics, Time speed and distance, work time problems.					
UNIT	TITLE				PERIODS
4	Professional grooming and practices				11
Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behavior, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation, concluding the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.					
UNIT	TITLE				PERIODS
5	Non-verbal reasoning, simple engineering aptitude, and Spatial aptitude				14

Mirror image, Water image, Paper folding, Paper cutting, Grouping of figures, Figure formation and analysis, Completion of incomplete pattern, Figure matrix, Miscellaneous, Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems, etc., related problems.

**TOTAL PERIODS:** **54**

**COURSE OUTCOMES:**

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

<b>CO1:</b>	Communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their interpersonal and leadership skills.
<b>CO2:</b>	Examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arriving at a consensus.
<b>CO3:</b>	Identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability, and combinatorics.
<b>CO4:</b>	Relate, choose, conclude and determine the usage of the right vocabulary

**REFERENCE COURSES/BOOKS:**

<b>1</b>	R. S. Aggarwal, S. Chand, Abijith Guha, TMH, Arun Sharma, "Quantitative Aptitude ", S.Chand Publications, 2001
<b>2</b>	Geoffrey Leech, Jan Svartvik, "A Communicative Grammar of English", Longman Publications, London, 2003.

Course Code	Course Title	Periods per week			Credits
	<b>Cloud computing Theory and Practice</b>	L	T	P	
		<b>2</b>	<b>0</b>	<b>4</b>	<b>4</b>
<b>PREREQUISITES:</b>					
Fundamentals of computer and Internet					
<b>COURSE OBJECTIVES:</b>					
<b>1</b>	To provide an overview of an exciting field of Cloud Computing				
<b>2</b>	To introduce tools requires building, deploying, running and managing applications on a cloud platform.				
<b>3</b>	To develop the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry, and DevOps services				
<b>4</b>	To enable students to have skills that will help them to solve complex real-world problems in decision support.				
<b>UNIT</b>	<b>TITLE</b>				<b>PERIODS</b>
<b>1</b>	<b>Introduction to Cloud Computing</b>				<b>18</b>
Definition with Real Time Examples, Introduction to cloud computing and its characteristics, Benefits of cloud, Models of Cloud, IBM Cloud resources, REST architecture, Cloud Foundry concepts					
<b>UNIT</b>	<b>TITLE</b>				<b>PERIODS</b>
<b>2</b>	<b>Cloud Enabling Technologies</b>				<b>18</b>
Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices – Virtualization Support and Disaster Recovery.					
<b>TITLE</b>					<b>PERIODS</b>
<b>LABORATORY</b>					<b>72</b>
1. Configuring IBM Cloud account and creating an application using Cloud Foundry Service on IBM Cloud. 2. Mention all commands used in IBM CLI to push an application from the local system to the IBM cloud environment. 3. Configuring secure web application with single sign-on (APP ID) on IBM cloud. 4. Configuring Cloud and managing the datasets on IBM Cloud. 5. Configuring Visual Recognition Service with IBM Watson. 6. Configuring IAM (identity access management) service on IBM cloud. 7. Configuring a server to fetch files from a local file system using Nodejs. 8. Implementation of containerization using Docker. 9. Implementation of container orchestration using Kubernetes. 10. Creating a Nodejs application using Express Framework.					
<b>TOTAL PERIODS:</b>					<b>108</b>

<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Understand the vision of Cloud Computing from a global context.
<b>CO2:</b>	To understand various compute options on IBM Cloud from the market perspective of Cloud Computing.
<b>CO3:</b>	Identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability, and combinatorics.
<b>CO4:</b>	Relate, choose, conclude and determine the usage of the right vocabulary
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Anthony T. Velte, Tony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw Hill Publications, 2017
<b>2</b>	Anubhav Hanjura, "Cloud Application Development", Packt Publications, 2014
<b>3</b>	Scott Adkins, John Belamaric, Vincent Giersch, Denys Makogon, Jason Robinson, "OpenStack Cloud Application Development", Wiley Publications, 2016



Course Code	Course Title	Periods per week			Credits
	Deep Learning Lab	L	T	P	
		0	0	8	4
<b>PREREQUISITES:</b>					
Python Programming					
<b>COURSE OBJECTIVES:</b>					
1	To learn scientific libraries for implementing deep learning algorithms.				
2	To implement neural networks for binary,multi-class classification.				
3	To implement decision Trees with neural networks.				
4	To evaluate and improve neural network models.				
<b>TITLE</b>					<b>PERIODS</b>
<b>LABORATORY</b>					<b>144</b>
1. Installing Tensorflow library in Python 2. Review, modify, run and observe examples of neurons and layers 3. Implement simple neural network in numpy 4. Implement simple neural network in tensorflow 5. Neural networks for binary classification 6. Review, modify, run and observe: a. RelU activation function b. Softmax c. MultiClass 7. Implement neural network for multi-class 8. Evaluate and improve neural network models					
<b>TOTAL PERIODS:</b>					<b>144</b>
<b>COURSE OUTCOMES:</b>					
Upon completion of this course, students will be able to:					
<b>CO1:</b>	Understand scientific libraries for implementing deep learning algorithms.				
<b>CO2:</b>	Implementation of neural networks for binary,multi-class classification.				
<b>CO3:</b>	Implement Neural network models.				

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Indian Culture and Universal Values	1	0	4	
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	To understand culture and learn how to know the core of a culture				
2	To analyze one's relationship with region and rituals celebrated in India				
3	To familiarize with Indian Mythology and learn to embody a universal value in it				
4	To introduce Indian architecture through temples, its essence and its appreciation				
THEORY					
UNIT	TITLE				PERIODS
1	Indian Culture through the exploration of Tamil Culture				5
People, food, clothes; Art, music, literature, architecture, sculpture, philosophy, religion and science; Customs, traditions, and festivals					
UNIT	TITLE				PERIODS
2	Religions in India: Exploration through Godheads & Festivals				5
Origin and meaning behind Indian festivals and rituals; Worshipping the Godheads; Essence of different religions and the purpose of all religions;					
UNIT	TITLE				PERIODS
3	Indian Cultural Symbols: Clothing & Attire				4
Origin; Diversity of Indian clothing and significance; Conscious clothing					
UNIT	TITLE				PERIODS
4	Indian Cultural Symbols: Food & Well-being				4
Conception of food and eating and cooking in India; healthy and unhealthy food and food habits; Cultural practices for well-being					
TITLE					PERIODS
LABORATORY					72

1.Enacting Stories from Mahabharatha and Ramayana; 2.Embodying Values: a project 3. Visit an ancient architecturally rich temple; 4. IKS (Indic Knowledge Systems) Science and art behind temples; 5.Demonstration of Indian art and architecture-appreciation of art 6. Create projects about food and eating and cooking in India; 7. Create projects on healthy and unhealthy food and food habits; 8. Understanding cultural practices for well-being 9. Create projects about the origin and meaning behind Indian festivals and rituals; 10.Projects About Worshiping the Godheads and their significance; 11.Play on the essence of different religions and the purpose of all religions	
<b>TOTAL PERIODS:</b>	
<b>90</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Relate to Indian culture and its core principles
<b>CO2:</b>	Explain the root of religions and rituals and rebuild one's religious personality
<b>CO3:</b>	Practice universal values inspired by Indian mythology
<b>CO4:</b>	Appreciate Indian genius in architecture and essence of Indian art and architecture
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Sri Aurobindo," National Value of Art ", Sri Aurobindo Ashram Publications,1922.
<b>2</b>	Sri Aurobindo," Foundations of Indian Culture",Sri Aurobindo Ashram Publications,1953.
<b>3</b>	Devdutt Pattanaik,"Indian Culture, Art and Heritage", Pearson Publications,1996.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Innovative and Design Thinking	1	0	4	
PREREQUISITES:					
NIL / Course Code – Course Title / Topics					
COURSE OBJECTIVES:					
1	To Learn how to develop an innovative design model.				
2	To Identify, understand and discuss current, real-world issues.				
3	To learn the best design solution among the potential solutions with its functional position probability, and combinatorics.				
4	To learn how to utilize the technical resources and to work in actual working environments.				
5	To understand how to write technical documents and give oral presentations related to the work completed.				
Students are advised to create or innovate a software development with the following objective: Instead of creating new software and then "selling" it to the public, innovative design is a process of identifying, pinpointing, and understanding the needs of the user or audience. What we need are new choices - new products that balance the needs of individuals and society as a whole; new ideas and new strategies that tackle the global challenges of health, poverty, and education. Each student has to identify the need for a product, synthesize, analyze, design, modify and select the best design. Project Identification - Specification Development,specification,SRS,design,development and testing.Conduct Functional Decomposition, Brainstorming of possible solutions, The student will make an oral presentation followed by a brief question and answer session. The innovative design (presentation and report) will be evaluated by an internal assessment committee. The presentation will take place during the weekly class session. Students have to make oral presentations periodically and finally submit a technical project report.					
TOTAL PERIODS:					90
COURSE OUTCOMES:					
Upon completion of this course, students will be able to:					
CO1:	Develop an innovative design model				
CO2:	Identity, understand and discuss current, real-world issues.				
CO3:	Select the best design solution among the potential solutions with its functional position probability and combinatorics.				
CO4:	Utilize the technical resources and work in an actual working environment				
CO5:	Write technical documents and give oral presentations related to the work completed.				

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	<b>Intelligent Database Systems</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**PREREQUISITES:**

Fundamentals of database system

**COURSE OBJECTIVES:**

<b>1</b>	To Understand the concepts of Intelligent database
<b>2</b>	To Understand the concepts of knowledge-based systems and apply with AI
<b>3</b>	To Design and create the small applications,

UNIT	TITLE	PERIODS
<b>1</b>	<b>Introduction To IDBS</b>	<b>10</b>

The informal definition of the domain - General characteristics of IDBSs - Data models and the relational data model - A taxonomy of intelligent database systems - Guidelines for using intelligent database systems.

UNIT	TITLE	PERIODS
<b>2</b>	<b>Semantic Data Models</b>	<b>11</b>

Nested and semantic data models – Introduction - The nested relational model - Semantic models - Hyper semantic data models - Object-oriented approaches to semantic data modeling - Object-oriented database systems - Basic concepts of a core object-oriented data model - Comparison with other data models Query languages and query processing - Operational aspects – Systems - The ODMG standard. The object-relational data model - Java and databases – Conclusions - Active database systems. Basic concepts – Issues – Architectures - Research relational prototypes—the Starburst Rule System - Commercial relational approaches.

UNIT	TITLE	PERIODS
<b>3</b>	<b>Knowledge-Based Systems- AI Context</b>	<b>11</b>

Characteristics and classification of the knowledge-based systems – Introduction - The resolution principle Inference by inheritance – Conclusion - Deductive database systems - Basic concepts - DATALOG language - Deductive database systems and logic programming systems—differences - Architectural approaches - Research prototypes - Updates in deductive databases - Integration of deductive database and object database technologies - Constraint databases - Conclusions.

UNIT	TITLE	PERIODS
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4	Advanced Knowledge-Based Systems	11
Introduction - Architectural solutions - The 'general bridge' solution - Extending a KBS with components proper to a DBMS - The 'tight coupling' approach – Conclusion - Advanced Solutions: Introduction A 'knowledge level' approach to the interaction with an IAS- TELOS - a language for implementing very large 'integral approach' systems-The CYC project -Other projects based on 'conceptual representation' approach - Lexical approaches to the construction of large KBs.		
UNIT	TITLE	PERIODS
5	Application In IDBS	11
Introduction - Temporal databases - Basic concepts - Temporal data models - Temporal query languages –Ontologies -Ontology theoretical foundations - Environments for building ontologies - Structured, semi-structured and unstructured data - Multimedia database - Semi-structured data - Mediators – Motivation Architecture - Application of mediators to heterogeneous systems – Proposals - Multi-Agents systems Main issues in designing a multi-agent system - Open problems. Internet indexing and retrieval - Basic indexing methods - Search engines or meta-searchers - Internet spiders - Data mining -Data mining taskData mining tools - Medical and legal information systems - Medical information systems - Legal information systems – Conclusions.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Understand the concepts of Intelligent database.	
CO2:	Make study of the Database installation then create the database with user and apply SQL	
	Understand the concepts of knowledge-based systems and apply with AI	
CO3:	Understand the intermediary between users and the computer system and provide a level of abstraction due to which complicated details can be kept hidden from the user.	
REFERENCE BOOKS/ COURSES:		
1	Ngoc ThanhNguyen,Radoslaw Katarzynski,and Shyi-MingChen (Eds.),"Advances inIntelligent Information andDatabase Systems ", Springer Publications, 2010.	
2	Elisa Bertino, Barbara Catania, GianPieroZarri, “Intelligent Database systems”, Collection ACM Publications,2001.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	IoT Cloud And Data Analytics	3	0	0	3
PREREQUISITES:					
Internet and Machine learning					
COURSE OBJECTIVES:					
1	To Understand the concepts of internet of things				
2	To Understand the concepts of many connectivity options and cloud				
3	To understand the security of the iot edge device				
UNIT	TITLE				PERIODS
1	Introduction to IOT				10
Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT data vs big data IoT Analytics lifecycle and Techniques-IoT complete Technology chain- Applications of IoT Opportunities and challenges in IoT.					
UNIT	TITLE				PERIODS
2	IoT and Cloud				11
Cloud computing – Cloud service models – Cloud Deployment models – Need of cloud computing for IoT-Fog computing Vs Cloud Computing for IoT-IoT Cloud Platforms –Microsoft Azure IoT-Amazon Web Services IoT-IBM WATSON IoT-Google's cloud IoT.					
UNIT	TITLE				PERIODS
3	IoT and Machine Learning				11
Principles and foundation of Artificial intelligence and IoT – Machine Learning Paradigms for IoT – Supervised learning for IoT-Linear regression-Logistic regression-SVM – Decision Tree -Naïve's bayes Deep Learning for IoT-Neural Network.					
UNIT	TITLE				PERIODS
4	Data Analytics for IoT				11
Defining IoT Analytics - IoT Analytics challenges – IoT analytics for the cloud-Microsoft Azure overview–Designing data processing for analytics – Designing visual analysis for IoT data-Data science for IoT-Feature engineering with IoT data.					
UNIT	TITLE				PERIODS
5	IoT Security				11

Overview of IoT Security- security Threats in IoT- APIs in IoT-Authentication in IoT-Strategies for securing IoT-Public Key Cryptography.	
<b>TOTAL PERIODS:</b>	
<b>54</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Identify the need of cloud computing for IoT
<b>CO2:</b>	Predict and visualize output using Data Analytic tools
<b>CO3:</b>	Identify the Vulnerability in connected networks
<b>REFERENCE BOOKS/ COURSES:</b>	
<b>1</b>	John Soldatos, "Building Blocks for IoT Analytics", River Publications,2016.
<b>2</b>	Amita Kapoor, "Hands on Artificial intelligence for IoT", 1 st Edition, Packt Publications, 2019
<b>3</b>	John E. Rossman, "The Amazon way on IoT", John E. Rossman publication,Volume 2, 2016.



Course Code	Course Title	Periods per week			Credits
	Social Network Analytics	L	T	P	
		3	0	0	
PREREQUISITES:					
Computer network					
COURSE OBJECTIVES:					
1	To Understand a social network analysis				
2	To Understand the Web data and semantics in social network applications				
3	Model and aggregate the social network data				
UNIT	TITLE				PERIODS
1	Social Network Analysis.				10
Network analysis- Development of Social network analysis- Key concepts and measures in network analysis -The global structure of networks - The macro-structure of social networks - Personal networks.					
UNIT	TITLE				PERIODS
2	Web Semantics In Social Network Applications				11
Electronic sources for network analysis - Electronic discussion networks - Blogs and online communities Web-based networks -Knowledge Representation on the Semantic Web -Ontologies and their role in the Semantic Web Ontology languages for the Semantic Web - The Resource Description Framework (RDF) and RDF Schema - The Web Ontology Language (OWL) - Comparison to the Unified Modelling Language (UML) - Comparison to the Entity/Relationship (E/R) model and the relational model - Comparison to the Extensible Markup Language (XML) and XML Schema.					
UNIT	TITLE				PERIODS
3	Modelling And Aggregating Social Network Data				11
State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data Representing identity - On the notion of equality - Determining equality - Reasoning with instance equality - Evaluating smushing					
UNIT	TITLE				PERIODS
4	Developing Social-Semantic Applications				11

Building Semantic Web applications with social network features - The generic architecture of Semantic Web applications -Sesame – Elmo – GraphUtil - The features of Flink - System design – open academia: distributed, semantic-based publication management - The features of open academia - System design.		
UNIT	TITLE	PERIODS
5	Evaluation Of Social Network Analysis	11
Evaluation of web-based social network extraction - Data collection - Preparing the data - Optimizing the goodness of fit - Comparison across methods and networks - Predicting the goodness of fit Evaluation through analysis - Semantic-based Social Network Analysis in the sciences - Data acquisition - Representation, storage and reasoning- Visualization and Analysis – Results - Descriptive analysis - Structural and cognitive effects on scientific performance.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Understand a social network analysis	
CO2:	Understand the Web data and semantics in social network applications	
CO3:	Model and aggregate the social network data	
CO4:	Develop social–semantic applications	
REFERENCE BOOKS/ COURSES:		
1	Peter Mika , Social Networks and the Semantics Web”,Springer Publications, 2007	
2	Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer Publications,1st Edition,2010.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Software Testing	3	0	0	3
PREREQUISITES:					
Basic programming					
COURSE OBJECTIVES:					
1	Understand how to detect, classify, prevent and remove defects				
2	Understand the effective strategies of testing, the methods, and technologies of software testing				
3	Understand the concepts of milestone for controlling and monitoring				
UNIT	TITLE				PERIODS
1	Software Testing				10
The Role process in Software Quality- Testing as a process- Overview of testing maturity model, software testing definition- Software Testing Principles –Origin of defects, Defect classes, the defect Repository and Test Design					
UNIT	TITLE				PERIODS
2	Testing Strategies				11
Testing design strategies, Test case design strategies, Black box testing, Random Testing, Equivalence partitioning, Boundary value analysis , Cause-and- Effect, State transition, Error Guessing, COTS,White box testing techniques - Statement coverage - Branch Coverage - Condition coverage -Decision/Condition coverage - Multiple condition coverage - Dataflow coverage - Mutation testing					
UNIT	TITLE				PERIODS
3	The Need For Levels Of Testing				11
Unit test, Planning, Designing the unit tests, Integration test, Integration Strategies for Procedure and Functions, Integration strategies for Classes, Integration test planning, System Test: Functional Testing,Performance Testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing, Regression testing, Alpha, Beta and Acceptance Tests.					
UNIT	TITLE				PERIODS
4	Test Object Oriented Software				11
Unit Testing in OO Context, Integration Testing in OO Context, OO testing methods, Class level testing, the interclass test case design, testing for real-time system					

UNIT	TITLE	PERIODS
5	Controlling And Monitoring	11
Status, Productivity, Cost, Error, fault and Failures, Effectiveness, Criteria for Test Completion, Reviews as testing Activity: Inspection Walkthrough, Components of review plan, testing for web application, Component level testing, and Clean room tests.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Understand how to conduct formal inspections, record and evaluate results of inspections	
CO2:	To implement different testing strategies	
CO3:	Describe controlling and monitoring	
REFERENCE BOOKS/ COURSES:		
1	Ali Behforooz, Frederick J Hudson, "Software Engineering Fundamentals", Oxford University Press, New York, 2003.	
2	Roger S Pressman, "Software Engineering – A Practitioner's Approach", McGraw Hill Publications, Sixth Edition, 2006.	
3	William Perry, "Effective Methods for Software Testing", John Wiley & Sons Publications, Second edition, USA, 2000.	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	<b>Programming For Problem Solving</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PREREQUISITES:</b>					
Basic Programming					
<b>COURSE OBJECTIVES:</b>					
<b>1</b>	To introduce the basics of computers and information technology				
<b>2</b>	To educate problem solving techniques				
<b>3</b>	To educate problem solving techniques				
<b>4</b>	To practice structured programming to solve real life problems				
<b>5</b>	To understand File Operations concepts				
UNIT	TITLE				PERIODS
<b>1</b>	<b>Introduction</b>				<b>10</b>
History of Computers – Block diagram of a Computer – Components of a Computer system – Classification of computers - Hardware – Software – Categories of Software –Operating System – Applications of Computers – Network Structure– Internet and its services – Intranet –Study of word processor – Preparation of worksheets - Algorithm –Pseudocode – FlowChart.					
UNIT	TITLE				PERIODS
<b>2</b>	<b>C Programming Basics</b>				<b>11</b>
Problem formulation – Problem Solving – Introduction to ‘ C’ programming –fundamentals – structure of a ‘C’ program – compilation and linking processes – Constants,Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations –Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.					
UNIT	TITLE				PERIODS
<b>3</b>	<b>Array, String, And Functions</b>				<b>11</b>
Arrays – Initialization – Declaration – One-dimensional and Two-dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching –matrix operations- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion.					
UNIT	TITLE				PERIODS
<b>4</b>	<b>Structure And Unions</b>				<b>11</b>

Pointers – Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems. Structures – need for structure data type – structure definition – Structure declaration – Structure within a structure – Union – Programs using structures and Unions – Storage classes.		
UNIT	TITLE	PERIODS
5	Files	11
operations on a file – Random access to files – command line arguments Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Apply problem-solving techniques like algorithms, flowchart and pseudo code on real-life problems; summarize 7 phases of the program development cycle, basic tokens of the C program, its structure, I/O functions	
CO2:	Familiar on usage of structures, pointers and its manipulation	
REFERENCE BOOKS/ COURSES:		
1	Ashok N Kamthane,” Computer Programming”, Pearson Education Publications, 2nd impression, 2008.	
2	Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill Publications, 6th Edition, 2012.	
3	Vikas Verma, “A book on C”, Language learning Publications, 2nd edition 2012.	

Course Code	Course Title	Periods per week			Credits
	High-Performance Computing	L	T	P	
		3	0	0	
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	Students will be enabled to understand Stored-program computer architecture and Cache.				
2	Students will be enabled to understand Multicore processors.				
3	Students will be enabled to understand Multithreaded processors and Vector processors.				
UNIT	TITLE				PERIODS
1	Modern processor				10
Stored-program computer architecture -General-purpose cache-based microprocessor architecture - Performance metrics and benchmarks -Transistors galore: Moore’s Law - Pipelining -Superscalar - SIMD					
UNIT	TITLE				PERIODS
2	Memory hierarchies and Vector processors				11
Cache -Cache mapping- Prefetch-Design principles - Maximum performance estimates- Programming for vector architectures -					
UNIT	TITLE				PERIODS
3	Basic optimization techniques for serial code				11
Scalar profiling-Common sense optimizations-Simple measures, the large impact-The role of compilers- optimizations					
UNIT	TITLE				PERIODS
4	Data access optimization				11
Balance analysis and lightspeed estimates-Storage order- Case study: The Jacobi algorithm-Case study: Dense matrix transpose- Algorithm classification and access optimizations.					
UNIT	TITLE				PERIODS
5	Parallel computers				11
Taxonomy of parallel computing paradigms-Shared-memory computers-Distributed-memory computers-Hierarchical (hybrid) systems-Networks					

<b>TOTAL PERIODS:</b>	
<b>54</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	Understand the need and importance of Modern processors
<b>CO2:</b>	Understand the need and importance of Memory hierarchies and Multicore processors and Multithreaded processors
<b>CO3:</b>	Understand the need and importance of the role of compilers and C++ optimizations
<b>CO4:</b>	Understand the need and importance of the role of Data access optimization and Storage order.
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Georg Hager, Gerhard Wellein,"Introduction to High-Performance Computing for Scientists and Engineer",CRC Publications, 2010
<b>2</b>	Georg Hager, Gerhard Wellein,Introduction-to-High-Performance-Computing-for-scientists and engineers, CRC Press Publications,2011



Course Code	Course Title	Periods per week			Credits
	Communication Network	L	T	P	
		3	0	0	
PREREQUISITES:					
Fundamentals of computer					
COURSE OBJECTIVES:					
1	Students will be enabled to understand data communications and networking.				
2	Students will be enabled to understand networks and define protocols.				
3	Students will be enabled to understand data flow and computer networks.				
UNIT	TITLE				PERIODS
1	Networking Fundamentals				10
Introduction-Data & Information-Data Communication-Data Representation-Data Flow-Computer Network-Protocol-Standards In Networking					
UNIT	TITLE				PERIODS
2	Signals				11
Introduction-Data & Signals-Analog Signal-Relation between Frequency & Period-Wavelength-Time & Frequency Domain Representation of a signal-Composite Signal -Digital Signal-Transmission of Digital signal					
UNIT	TITLE				PERIODS
3	Bandwidth				11
Introduction-Fourier Analysis- Bandwidth of a signal-Bandwidth of a channel-The Maximum Data Rate of a Channel.					
UNIT	TITLE				PERIODS
4	Network Models				11
Introduction-Concept of Layered task-OSIRM-Introduction to OSI Model & its layers-Layered Architecture of OSI Model-Communication & Interfaces-Encapsulation of data-Description of Layers in the OSI Model					
UNIT	TITLE				PERIODS
5	Tcp/Ip Model, Addressing In Tcp/Ip – Ipv4				11
Introduction-TCP/IP Model-Addressing In TCP/IP-IPv4-IP addresses-Address Space-Notations used to express Address-Classfull Addressing-Subnetting-CIDR-NAT-IPv4 Header Format.					

<b>TOTAL PERIODS:</b>	
<b>54</b>	
<b>COURSE OUTCOMES:</b>	
Upon completion of this course, students will be able to:	
<b>CO1:</b>	On successful completion of the course, the student will be having the basic knowledge of data sharing transmission media and their protocols.
<b>CO2:</b>	Students will have a basic knowledge of computer networks.
<b>CO3:</b>	Students will have a basic knowledge of computer networks. and IPV4
<b>CO4:</b>	Students will be having the basic knowledge of data sharing, transmission media, and their protocols.
<b>REFERENCE COURSES/BOOKS:</b>	
<b>1</b>	Oludipe O., Yekini N.A., & Adelokun P.A. , "Data Communication & Network. Published In Nigeria Has-Fem (Nig) Publications,2012
<b>2</b>	Spurgeon, Charles E," Ethernet: The Definitive Guide", O'Reilly Media,2014
<b>3</b>	Kurose, J.F,K.W. Ross,"Computer Networking: A Top Down Approach Featuring the Internet", Addison Wesley Publications,2003
<b>4</b>	Goleniewski L, "Telecommunications Essentials", Addison Wesley Publications,2006

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Mobile Computing	3	0	0	3
PREREQUISITES:					
Computer network					
COURSE OBJECTIVES:					
1	To understand the basic concepts of mobile computing.				
2	To learn the basics of mobile telecommunication systems.				
3	To be familiar with the network layer protocols and Ad-Hoc networks.				
4	To know the basis of transport and application layer protocols.				
5	To gain knowledge about different mobile platforms and application development.				
UNIT	TITLE				PERIODS
1	Introduction to Mobile Computing				10
Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA.					
UNIT	TITLE				PERIODS
2	Mobile Telecommunication System				11
Introduction to Cellular Systems - GSM – Services & Architecture – Protocols– Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover - Security					
UNIT	TITLE				PERIODS
3	Mobile Network Layer				11
Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols– DSR, AODV Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc Networks ( VANET) –MANET Vs VANET – Security.					
UNIT	TITLE				PERIODS
4	Mobile Transport And Application Layer				11
Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture– WML.					
UNIT	TITLE				PERIODS

5	Mobile Platforms And Applications	11
Mobile Device Operating Systems – Special Constraints & Requirements –Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, – eCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Explain the basics of mobile telecommunication systems.	
CO2:	Illustrate the generations of telecommunication systems in wireless networks	
CO3:	Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network	
CO4:	Explain the functionality of Transport and Application layers	
CO5:	Develop a mobile application using android/blackberry/ios/Windows SDK	
REFERENCE COURSES/BOOKS:		
1	Jochen Schiller,"Mobile CommunicationsII", PHI Publications, Second Edition, 2003.	
2	Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile ComputingII", PHI Publications,2012	
3	Dharma Prakash Agarwal, Qing, and An Zeng, "Introduction to Wireless and Mobile systems", Thomson AsiaPublications, 2005.	
4	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile ComputingII", Springer Publications, 2003.	

Course Code	Course Title	Periods per week			Credits
	Image and Video Processing	L	T	P	
		3	0	0	
PREREQUISITES:					
NIL					
COURSE OBJECTIVES:					
1	Addresses the problems of acquisition, storage, retrieval.				
2	Processing of images, videos, and high dimensional signals				
3	Extraction and analysis of useful information for human users, robots, and autonomous systems.				
UNIT	TITLE				PERIODS
1	Introduction And Image Enhancement				10
Digital image fundamentals, Concept of pixels and gray levels, Applications of image processing, Introduction to image enhancement, spatial domain methods: point processing - intensity transformations, histogram processing, image averaging, image subtraction, Spatial filtering-smoothing filters, sharpening filters, Frequency domain methods : low pass filtering, high pass, filtering, Homomorphic filtering.					
UNIT	TITLE				PERIODS
2	Image Restoration				11
Introduction to Image restoration, Degradation model, Restoration in the presence of Noise only- Spatial Filtering, Periodic Noise reduction by Frequency Domain Filtering, Algebraic approaches- Inverse filtering, Wiener filtering, Constrained Least squares restoration.					
UNIT	TITLE				PERIODS
3	Image Compression				11
Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images-image compression scheme, Classification of image compression schemes, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standards, Wavelet-based image compression.					
UNIT	TITLE				PERIODS
4	Image Segmentation				11

Introduction to image segmentation, Detection of discontinuities - point, line, and edge and combined detection; Edge linking and boundary description - local and global processing using Hough transform, Thresholding, Regionoriented segmentation - basic formulation, region growing by pixel aggregation, region splitting, and merging.		
UNIT	TITLE	PERIODS
5	Digital Video & Coding	11
Basics of Video, Time-varying Image formation Models, SpatioTemporal Sampling, Optical flow, General methodologies, Overview of coding systems, Video Compression Standards.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Comprehend the image processing fundamentals and enhancement techniques in spatial and frequency domains.	
CO2:	Describe the color image fundamentals, models, and various restoration techniques.	
CO3:	Design and Analyze the image compression systems.	
CO4:	Outline the various image segmentation and morphology operations.	
CO5:	Comprehend the basics of video processing and video coding.	
REFERENCE COURSES/BOOKS:		
1	JR.Gonzalez, R.E.Woods, “Digital Image Processing”, Pearson Education Publications, 3rd Edition, 2009.	
2	M. Tekalp, “Digital Video Processing”, Prentice-Hall Publications,1995.	
3	Rafael C. Gonzalez, Richard E Woods and Steven L. Eddins, “Digital Image Processing using MAT LAB” , Pearson Publications, 2004.	
4	Bovik, “Handbook of Image & Video Processing”, Academic Press, 2000	

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Wireless Computing	3	0	0	3
PREREQUISITES:					
computer network					
COURSE OBJECTIVES:					
1	To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios				
2	To study the various protocols at various layers and its differences with traditional protocols				
3	To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network				
4	To create a model in wireless computing				
UNIT	TITLE				PERIODS
1	Introduction				10
Wireless networking- Physical layer- OFDM and 802.11 (WiFi) PHY - Multi- antenna systems and MIMO- Overview of 802.11n/ac PHY including beamforming- MAC layer -					
CSMA/CA and WiFi MAC overview - Wide bandwidth channel access techniques (802.11n/ac)- Energy efficiency and rate control.					
UNIT	TITLE				PERIODS
2	Mobile and wearable sensing				11
Overview of smartphone/wearable sensors -Accelerometer, gyroscope, magnetometer, etc. - Smartphone orientation and heading detection. Activity recognition and healthcare - Identifying human activities and context through sensors - Health monitoring and fitness tracking Wearables overview- Wrist-worn wearables.					
UNIT	TITLE				PERIODS
3	Multi-gigabit wireless networks				11
Millimeter wave networking - Directionality and beam forming - Mobility and signal blockage - IEEE 802.11ad (60 GHz WLAN) MAC and PHY overview-Visible light communication - High-speed networking using LED - IEEE 802.15.7 PHY and MAC overview-Sensing through visible light- Visible light indoor localization and positioning.					
UNIT	TITLE				PERIODS
4	Routing Protocols				11

The Case for Optimization in Fog Computing- Formal Modeling- Framework for Fog Computing Metrics -Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle - Toward a Taxonomy of Optimization ,Problems in Fog Computing -optimization Techniques.		
UNIT	TITLE	PERIODS
5	QoS and Energy Management	11
Smart Surveillance Video Stream Processing at the Edge for Real-Time -Smart Transportation Applications-Intelligent Traffic Lights Management (ITLM) System -Fog Orchestration Challenges and Future Directions.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	How to build a WSN network	
CO2:	Analysis of various critical parameters in deploying a WSN	
CO3:	Classify different types of mobile telecommunication systems	
CO4:	Demonstrate the Adhoc networks concepts and its routing protocols	
CO5:	Make use of mobile operating systems in developing mobile applications	
REFERENCE COURSES/BOOKS:		
1	Theodore S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall Publications, 2010.	
2	Matthew Gast, "802.11n: A Survival Guide", O'Reilly Media Publications, 2012.	



Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Software Project Management	3	0	0	3
PREREQUISITES:					
Programming , English					
COURSE OBJECTIVES:					
1	Introducing the primary important concepts of project management related to managing software development projects				
2	They will also get familiar with the different activities involved in Software Project Management				
3	Further, they will also come to know how to successfully plan and implement a software project management activity, and to complete a specific project in time with the available budget				
4	To study about project management, planning and software development process				
UNIT	TITLE				PERIODS
1	Software Process				10
Process Maturity – Capability Maturity Model (CMM) – KPA Project Management, Variations in CMM - Productivity improvement process					
UNIT	TITLE				PERIODS
2	People Management				11
Organization structure – Difficulties in people management - Effective team building – Role of Project manager - Team structures – Comparison of different team structures Software Metrics: Role of Metrics In Software Development - Project Metrics – Process Metrics – Data Gathering - Analysis Of Data For Measuring Correctness, Integrity, Reliability And Maintainability Of Software Products.					
UNIT	TITLE				PERIODS
3	Project Management and Planning				11
Project initiation – standard process, Process Tailoring - Feasibility study - Planning – Estimation - Resource allocation - the Project Plan – Software Development Process – Defects – Finding Defects – Code Review Checklist – Projecting Defects Inspection And Review: Need- Process of Inspection- SRS- Design Document Inspection					
UNIT	TITLE				PERIODS
4	Project Scheduling and Tracking				11
Scheduling - Critical path – Tracking - Timeline chart – Earned value chart. Software Configuration Management: Baselines - Software configuration items -The SCM process - Version control - Change control - Configuration audit - SCM standards					
UNIT	TITLE				PERIODS

5	Working Capital Policy	11
Importance of Working Capital Management – Risk- Risk analysis and management – Types of Risk involved - RMM plan- Return Tradeoff for Current Asset Investments – Financing Current Assets – The Costs and Risks of Alternative Debt Maturities. Quality Planning: Quality process - Quality control –Defect prevention process- Total Quality Management.		
TOTAL PERIODS:		54
COURSE OUTCOMES:		
Upon completion of this course, students will be able to:		
CO1:	Identify the different project contexts and suggest an appropriate management strategy	
CO2:	Practice the role of professional ethics in successful software development	
CO3:	Identify and describe the key phases of project management	
CO4:	Determine an appropriate project management approach through an evaluation of the business context and scope of the project	
CO5:	Describe project scheduling and project tracking	
REFERENCE COURSES/BOOKS:		
1	Pankaj Jalote, “Software Project Management in Practice”, Pearson Education publications,2002.	
2	Krish Rangarajan and Anil Misra, “Working Capital Management”, Excel Book publications, 2005	
3	Watts Humphrey, “Managing the Software Process”, Pearson publications, 2005.	
4	Roger S Pressman, “Software Engineering – A Practitioner’s Approach”, McGraw Hill Publications, International Edition, Sixth Edition, 2007.	
5	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Publications,2008.	
6	Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication, 2004.	