ACADEMIC CURRICULUM

(REGULATIONS R22)

FOR

BACHELOR OF VOCATIONAL DEGREE

CHOICE BASED CREDIT SYSTEM

(Applicable to the students admitted from the Academic Year 2022-23 onwards)

B.Voc – SOFTWARE DEVELOPMENT AND MACHINE LEARNING

AUROVILLE INSTITUTE OF APPLIED TECHNOLOGY

(A Unit of Auroville Foundation)

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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.

1.2.   Auroville B.Voc Program

We are not here to do (only a little better) what the others do.
We are here to do what others cannot do because they do not have the idea that it can be done.
We are here to open the way of the Future to children who belong to the Future.
Anything else is not worth the trouble and not worthy of Sri Aurobindo's help
— The Mother, 6 September 1961.

While looking at the incredible advancement of science, the world continues to face an enormous crisis, especially the rural-urban divide and the disconnection of technological progress with human needs. *Auroville* is the city of the future and we are here to open the way of the future for youth who belong to the future. Our program and curriculum based on integral education address not only the **skills** needed by the youth but also the **competencies** to use these skills to create a life-enhancing culture and interrupt unhealthy social narratives (or ISMs such as casteism, sexism, consumerism, etc.) and **develop inner capacity** (responsibility, dignity, courage to create) already present in the youth. The B.Voc programs over the three years are targeted for these. The program has been developed by academia, recent neuroscience and leadership training, and industry leaders through research and application and includes recent online learning platforms.

In doing so we develop the five minds of the future as described by Daniel Goleman. Unlike most programs that only focus on the disciplined mind (learning a specific discipline) through this program we aim to develop the synthesizing mind (ability to abstract, compare, and summarize), the respectful mind (respect and dignity for all), the ethical mind (developing systems and culture with care for people and planet), and the creative mind (creativity that comes from care as distinguished from innovation which may be limited to something new).

The methodology of all the courses will be to connect learning with application to make abstract learning concrete. Further, most courses as far as possible, courses will be based on constructivism and constructionism, i.e. in mini-projects that make something tangible. Even courses

that are generally considered theoretical like Mathematics will be tied into applying it through visualization or programming. In line with this approach, the assessments will be based on applying what the students care about to creating in the first year small projects and in the following years larger projects for humanity. To encourage entrepreneurship, the youth will also be required to make it into a prototype and give a presentation about the idea and create a flyer/three-fold brochure about their product and a report indicating the technical learning, problems solved and costs of the prototype. Viva will also be conducted with these submissions to ensure that the students understand the concepts and have the confidence to present themselves.

2. 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:

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

3.   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

(a) The relevant concepts and principles in essential science and Mathematics. So that he/she can understand the different vocational subjects.

(b) The concepts and principles of different programming languages

(c) The concepts of object-oriented programming language, graphical user interface, operating system, machine learning, and data processing visualization

(d) 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.

4. 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
Level 5	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
Level 6	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
Level 7	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 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.

Medium:

The medium of instruction shall primarily be English.

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.

5. 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:

Assessment Method	Marks
Continuous Assessment	40
Semester Examination	60
Total	100

Continuous Assessment (Internal)

Continuous Assessment (Internal)	Marks
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

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

Assessment Method	Marks
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.

Assessment Method	Marks
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:

a) The duration of the examination shall be 2 hours with a maximum of 30 marks.
b) 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 (s*um 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
THEORY							
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
LABORATORY							
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
						TOTAL CREDITS	**30**

**NSQF Level 5 SEMESTER - II**
Sl. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
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THEORY							
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
LABORATORY							
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
ON-JOB-TRAINING (OJT)							
7		On the Job Training					10
						TOTAL CREDITS	**30**

**NSQF Level 6 SEMESTER - III**
Sl. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
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THEORY							
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
LABORATORY							
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
						TOTAL CREDITS	**30**

		NSQF Level 6 SEMESTER - IV					
Sl. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
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
LABORATORY							
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
ON-JOB-TRAINING							
7		On the Job Training					10
						TOTAL CREDITS	**30**

		NSQF Level 7 SEMESTER - V					
Sl. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
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
LABORATORY							
6		Machine Learning Algorithms Lab - II	VC	0	0	8	4
7		Integral yoga & value embodied leadership II - Refresher	GSH	1	0	4	3
EMPLOYABILITY/ENTREPRENEURSHIP ENHANCEMENT COURSE							
8		Project Phase- I					6
						TOTAL CREDITS	**30**

NSQF Level 7 SEMESTER - VI							
Sl. No	Course Code	Course Title	Category	L	T	P	C
THEORY							
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
LABORATORY							
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
EMPLOYABILITY/ENTREPRENEURSHIP ENHANCEMENT COURSE							
8		Project Phase- II					6
						TOTAL CREDITS	**30**

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
		TOTAL CREDITS		**61**

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
			TOTAL CREDITS	10

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			TOTAL CREDITS	68

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
		TOTAL CREDITS		**9**

EMPLOYABILITY/ENTREPRENEURSHIP ENHANCEMENT COURSES (EEC)

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

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
			TOTAL CREDITS	20

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
TOTAL CREDITS	30	30	30	30	30	30	180

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

	TOTAL PERIODS:	54

COURSE OUTCOMES:	
Upon completion of this course, students will be able to:	
CO1:	The characteristics, systematic methods, model for developing web applications.
CO2:	Understand the web development process
CO3:	Build the application using all the necessary web components
CO4:	Create the own web data for customer application
REFERENCE COURSES/BOOKS:	
1	AlokRanjan,AbhilashaSinha, Ranjit Battered, "JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript ‖", 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
		L	T	P	
	English - I	3	0	0	3

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
		L	T	P	
	Applied Mathematics	3	0	0	3

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 https://www.3blue1brown.com/topics/calculus https://www.3blue1brown.com/topics/linear-algebra

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

TOTAL PERIODS:	144

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:	Become comfortable doing small projects from scratch 3.
CO3:	Skill to develop applications with real-time application
CO4:	Ability to work in programming skills in python
CO5:	The fundamentals of how to store, retrieve, and process data efficiently.
REFERENCE COURSES/BOOKS:	
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	Challenges to learn scratch https://www.auraauro.com/learn/learn-scratch/

Course Code	Course Title	Periods per week			Credits
		L	**T**	**P**	
	Operating System (Theory and Practice)	**2**	**0**	**4**	**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.

	TOTAL PERIODS:	108

COURSE OUTCOMES:

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

CO1:	Installation Linux os and dual boot enable and operating system recovery
CO2:	Understand the basics of an operating system and its major components.
CO3:	Understand and implement shell programming.
CO4:	Purpose of the system files and usage
CO5:	Create and/or modify concurrent programs.

REFERENCE MATERIAL: BOOKS, ONLINE REFERENCES & OTHER DOCUMENTATION

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:

CO1:	Understand the macro physical phenomenon using atomic model
CO2:	Interpret and model physical phenomena using calculus

REFERENCE COURSES:	
1	Balaji Sampath,"The Aha Guide to Atoms", AhaGuru Education Technology publications,Third Edition,2015.
2	Yannis Tsividis,"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		
	TOTAL PERIODS:	**90**

COURSE OUTCOMES:

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

CO1:	Be able to explain the evolutionary steps of nature and man
CO2:	To know different systems of yoga and their significance and limitations and understand the synthesis in Integral Yoga in its essence
CO3:	To apply Radical Transformational Leadership tools and distinctions and to apply what I stand for (care about) in my everyday life.
CO4:	To use systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment with universal values.

REFERENCE COURSES/BOOKS:

1	Sri Aurobindo," The Synthesis of Yoga",Sri Aurobindo Ashram Publications ,1921.
2	Indian Psychology Institute. https://infinityinadrop.net/infinityfiles/0-4-3-evo-longterm.php
3	Indian Psychology Institute. https://infinityinadrop.net/infinityfiles/0-3-1d-cons-integral.php
4	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	
	Introduction to AI and Machine Learning	4	0	0	4

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	3

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

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," 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
		L	T	P	
	Mathematics of Machine Learning - I	3	0	0	3

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 .
CO2:	Skill to design the model to generate the data similar to the dataset given.
CO3:	Understand and estimate the statistics and probability.

REFERENCE BOOKS/ COURSES:	
1	Deisenroth et al," Mathematics for Machine Learning", Cambridge University Publications,2020 E-book available for free at: https://mml-book.github.io/book/mml-book.pdf

2	NPTEL NOC: Introduction to Data Analytics(Course sponsored by Aricent), IIT MadrasE-book available freely at: https://drive.google.com/file/d/1Wh-b5hG5ZRE11PaiHhgjzG29QMsgiYDk/view
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
		L	T	P	
	AI and Machine Learning Lab - I	**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**	**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
		L	T	P	
	Integral yoga & value embodied leadership - I	**1**	**0**	**4**	**3**

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

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 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	Credits
	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
		L	**T**	**P**	
	Mathematics for Machine Learning - II	**3**	**0**	**0**	**3**

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
		L	**T**	**P**	
	Basic Indian Language(Hindi)	3	0	0	3

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

	TOTAL PERIODS:	54

COURSE OUTCOMES:

	Upon completion of this course, students will be able to:
CO1:	Identify the Hindi alphabet.
CO2:	Write and speak Hindi words and phrases.
CO3:	Express their basic needs and interact with others
CO4:	Speak and express their ideas in Hindi

TEXT BOOKS:	
1	Rupert Snell, "Complete Hindi"; 1st Edition, Teach Yourself, 2014.
2	Richard Delacy and Sudha Joshi,"Elementary Hindi";Tuttle Publishing,2014.

REFERENCE BOOKS/RESOURCES:	
1	https://wp.nyu.edu/virtualhindi/house/
2	http://hindistartalk.lrc.columbia.edu/lesson/rathore-family-introduction/
3	http://hindistartalk.lrc.columbia.edu/lesson/rajawat-family-introduction/ (0.00 -1.05)
4	http://www.learning-hindi.com/post/1156594856/lesson-51-possessive-pronouns-part-3-%E0%A4%95-kaa
5	http://www.learning-hindi.com/post/6324812777/lesson-115-%E0%A4%AD-bhee-too-also
6	http://hindistartalk.lrc.columbia.edu/lesson/rathore-family-our-home/
7	http://www.learning-hindi.com/post/880500641/lesson-19-numbers-11-20

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

	TOTAL PERIODS:	72

COURSE OUTCOMES:	
Upon completion of this course, students will be able to:	
CO1	Understand and explain the risks faced by computer systems and networks
CO2	Identify and analyze security problems in computer systems and networks.
CO3	Explain how standard security mechanisms work

CO4	Develop security mechanisms to protect computer systems and networks.
CO5	Write more secure programs.
REFERENCE COURSES/BOOKS:	
1	Charles P. Pfleeger,"Security in Computing",Pearson Publications,Fourth Edition,2006
2	William Stallings, "Cryptography And Network Security Principles And Practice", Pearson Publications,Fourth or Fifth Edition,2017
3	Wenbo Mao,"Modern Cryptography: Theory and Practice", Prentice Hall Publications,2004

Course Code	Course Title	Periods per week			Credits
		L	**T**	**P**	
	Data Structures and algorithm Lab	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. Necaise, "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
		L	**T**	**P**	
	Frontend programming Theory and Practice	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

COURSE OUTCOMES:

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

CO1	Use basic and advanced flask
CO2	Use data models and databases
CO3	Use the built-in support for layout, grids, fluid grids, and responsive designs.
CO4	Use components: Contains lots of reusable components including Icons, Dropdowns, Navbars, Breadcrumbs, Popovers, Alerts, and many more

CO5	Use JavaScript Plug-ins: Contains lots of custom jQuery plug-ins. You can include them all or one by one.
REFERENCE COURSES/BOOKS:	
1	Miguel Grinberg,"Flash Web development", O'REILLY Publications,2018
2	Jacob D Lett, Bootstrap quick start,Bootstrap Creative Publications,2019
3	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.
CO2:	Critique mobile applications on their design pros and cons.
CO3:	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO4:	Program mobile applications for the Android operating system that use basic and advanced phone features.

CO5:	Deploy applications to the Android marketplace for distribution.
REFERENCE COURSES/BOOKS:	
1	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education Publications,second edition,2011.
2	Reto Meier, "Professional Android 2 Application Development", Wiley India Publications,2010.
3	Mark L Murphy, "Beginning Android", Wiley India Publications,2009.
4	Barry Burd,"Android Application Development All in one for Dummies",For Dummies Publications,2015

Course Code	Course Title	Periods per week			Credits
		L	**T**	**P**	
	Integral yoga & value embodied leadership I - Refresher	**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		
	TOTAL PERIODS:	**90**

COURSE OUTCOMES:	
Upon completion of this course, students will be able to:	
CO1:	Understand and develop a consciousness-centered worldview
CO2:	Explain the major conception of Integral Yoga and the triple movements
CO3:	Practice Radical Transformational Leadership tools to apply what I stand for (care about) in my everyday life.
CO4:	Apply systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment.
CO5:	Have the granularity to choose to transcend emotions and fears and work out of their full potential

REFERENCE COURSES/BOOKS:	
1	https://www.ipi.org.in/infinity/infinityfiles/0-2-2-integrality.php
2	Sri Aurobindo," Life Divine & Synthesis of Yoga", Shri Aurobindo Ashram Publications, 1921.
3	Monica Sharma, "Radical Transformational Leadership: Strategic Action for Change", North Atlantic Book Publications,2017.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Machine Learning Algorithms - I	4	0	0	4

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	
	Foreign Language (German)	3	0	0	3

PREREQUISITES:
NIL / Course Code – Course Title / Topics

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

THEORY		
UNIT		**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, 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**
2	**Friends Colleagues And Me**	11
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 II/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**
3	**In The City**	11
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.

	TOTAL PERIODS:	**54**

COURSE OUTCOMES:

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

CO1:	Communicate in a simple way in German
CO2:	Understand and use part of the basis of German grammar
CO3:	Understand the social and cultural life in Germany 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
CO5:	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

REFERENCE BOOKS:	
1	Dictionary German-English, App 2018.
2	Lingolia Deutsche Grammatik, App 2018.

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

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
		L	T	P	
	Discrete Mathematics	3	0	0	3

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.

	TOTAL PERIODS:	54

COURSE OUTCOMES:

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

CO1:	Know the principles of graph theory
CO2:	Know principles of Trees
CO3:	Know the principles of set theory

REFERENCE BOOKS/ COURSES:

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
		L	**T**	**P**	
	Database systems Theory and Practice	**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

	TOTAL PERIODS:	108

COURSE OUTCOMES:

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

CO1:	Basic concepts of Database Systems and Application
CO2:	Identify the SQL queries for a given scenario.
CO3:	Develop solutions using database concepts for real time requirements
CO4:	Analyze and Select storage and recovery techniques of the database system Recognize the different Internet devices and their functions

REFERENCE BOOKS/ COURSES:

1	J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Volume 1 Computer Science Press Publications, 1st Edition, 1990.
2	Silberschatz, Korth & Sudarshan, "Database System Concepts", McGraw Hill International Editions,Third Edition, Computer Science Series,1997
3	R. Elmasri and S. Navathe, "Fundamentals of Database Systems", Benjamin-Cummings Publications, 6th Edition, 2005 .
4	Ivan Bayross, "SQL/PLSQL: The Programming Language of Oracle", BPB Publications,3rd Revised Edition, 2006.

Course Code	Course Title	Periods per week			Credits
		L	**T**	**P**	
	Machine Learning Algorithms Lab - I	0	0	6	3

PREREQUISITES:	
Fundamentals of machine learning	

COURSE OBJECTIVES:	
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.

	TOTAL PERIODS:	108

COURSE OUTCOMES:	
Upon completion of this course, students will be able to:	
CO1:	Design the python programs for various learning algorithm
CO2:	Understand the implementation procedures for the machine learning algorithms
CO3:	Understand a range of machine learning algorithms along with their strengths and weaknesses
REFERENCE BOOKS/ COURSES:	

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
		L	T	P	
	Integral yoga & value embodied leadership II	1	0	4	**3**

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
		L	T	P	
	Machine Learning Algorithms - II	4	0	0	4

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

COURSE OUTCOMES:

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

CO1:	Understand large margin classifiers
CO2:	Understand and explain anomaly detection and recommender systems

CO3:	Understand optimizations needed for large data algorithms
CO4:	Apply these ideas to a real life example
REFERENCE BOOKS/ COURSES:	
1	Oliver Theobald,"Machine Learning For Absolute Beginners: A Plain English Introduction",ScatterPlot Publications,Second Edition,2017
2	Dustin Boswell,"Introduction to Support Vector Machines",Semantic scholar publications,2002

Course Code	Course Title	Periods per week			Credits
		L	**T**	**P**	
	Computer Networks	4	0	0	4

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	
	Soft Skill Development – I	3	0	0	3

PREREQUISITES:

English,Mathematics

COURSE OBJECTIVES:

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

UNIT	TITLE	PERIODS
1	**Report, Proposal, and Project**	11

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
2	**Communication Skills**	10

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
3	**Strategies for Recruitment**	11

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

UNIT	TITLE	PERIODS
4	**Numbers and Arithmetic Basic**	11

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
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
		L	**T**	**P**	
	Machine Learning Algorithms Lab - II	0	0	8	4

PREREQUISITES:	
Machine Learning	

COURSE OBJECTIVES:	
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.

TITLE	PERIODS
LABORATORY	**144**

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.

	TOTAL PERIODS:	144

COURSE OUTCOMES:	
Upon completion of this course, students will be able to:	
CO1:	Understand large margin classifiers(SVM).
CO2:	Understand anomaly detection and recommender systems.
CO3:	Understand a large data algorithm.
CO4:	Apply algorithms to a real-life problem.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Integral yoga & value embodied leadership II - Refresher	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		
	TOTAL PERIODS:	**90**

COURSE OUTCOMES:

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

CO1:	apply Radical Transformational Leadership tools in what I stand for (care about) in my everyday practice.
CO2:	develop systems thinking and design projects for cultural and systemic shifts and technical solutions in alignment.
CO3:	learn distinctions that give students granularity to choose to transcend emotions and fears and work out of their full potential

REFERENCE BOOKS/ COURSES:

1	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:

CO1:	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.
CO2:	Examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arriving at a consensus.
CO3:	Identity, 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.
CO4:	Relate, choose, conclude and determine the usage of the right vocabulary

REFERENCE COURSES/BOOKS:

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

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Cloud computing Theory and Practice	**2**	**0**	**4**	**4**

PREREQUISITES:
Fundamentals of computer and Internet

COURSE OBJECTIVES:	
1	To provide an overview of an exciting field of Cloud Computing
2	To introduce tools requires building, deploying, running and managing applications on a cloud platform.
3	To develop the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry, and DevOps services
4	To enable students to have skills that will help them to solve complex real-world problems in decision support.

UNIT	TITLE	PERIODS
1	**Introduction to Cloud Computing**	**18**

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

UNIT	TITLE	PERIODS
2	**Cloud Enabling Technologies**	**18**

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.

TITLE	PERIODS
LABORATORY	**72**

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.

	TOTAL PERIODS:	108

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

CO1:	Understand the vision of Cloud Computing from a global context.
CO2:	To understand various compute options on IBM Cloud from the market perspective of Cloud Computing.
CO3:	Identity, 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.
CO4:	Relate, choose, conclude and determine the usage of the right vocabulary

REFERENCE COURSES/BOOKS:

1	Anthony T. Velte,Tony Velte,Robert Elsenpeter, "Cloud Computing, A Practical Approach ",McGraw Hill Publications,2017
2	Anubhav Hanjura,"Cloud Application Development",Packt Publications,2014
3	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
		L	T	P	
	Deep Learning Lab	0	0	8	4

PREREQUISITES:

Python Programming

COURSE OBJECTIVES:

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.

TITLE	PERIODS
LABORATORY	**144**

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

	TOTAL PERIODS:	144

COURSE OUTCOMES:

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

CO1:	Understand scientific libraries for implementing deep learning algorithms.
CO2:	Implementation of neural networks for binary,multi-class classification.
CO3:	Implement Neural network models.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Indian Culture and Universal Values	1	0	4	3

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

	TOTAL PERIODS:	90

COURSE OUTCOMES:	
Upon completion of this course, students will be able to:	
CO1:	Relate to Indian culture and its core principles
CO2:	Explain the root of religions and rituals and rebuild one's religious personality
CO3:	Practice universal values inspired by Indian mythology
CO4:	Appreciate Indian genius in architecture and essence of Indian art and architecture
REFERENCE COURSES/BOOKS:	
1	Sri Aurobindo," National Value of Art ", Sri Aurobindo Ashram Publications,1922.
2	Sri Aurobindo," Foundations of Indian Culture",Sri Aurobindo Ashram Publications,1953.
3	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	3

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	
	Intelligent Database Systems	**3**	**0**	**0**	**3**

PREREQUISITES:
Fundamentals of database system

COURSE OBJECTIVES:	
1	To Understand the concepts of Intelligent database
2	To Understand the concepts of knowledge-based systems and apply with AI
3	To Design and create the small applications,

UNIT	TITLE	PERIODS
1	**Introduction To IDBS**	**10**

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
2	**Semantic Data Models**	**11**

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
3	**Knowledge-Based Systems- AI Context**	**11**

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
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.		
	TOTAL PERIODS:	**54**

COURSE OUTCOMES:

Upon completion of this course, students will be able to:	
CO1:	Identify the need of cloud computing for IoT
CO2:	Predict and visualize output using Data Analytic tools
CO3:	Identify the Vulnerability in connected networks
REFERENCE BOOKS/ COURSES:	
1	John Soldatos, "Building Blocks for IoT Analytics", River Publications,2016.
2	Amita Kapoor, "Hands on Artificial intelligence for IoT", 1 st Edition, Packt Publications, 2019
3	John E. Rossman, "The Amazon way on IoT", John E. Rossman publication,Volume 2, 2016.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Social Network Analytics	3	0	0	3

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	
	Programming For Problem Solving	3	0	0	3

PREREQUISITES:
Basic Programming

COURSE OBJECTIVES:	
1	To introduce the basics of computers and information technology
2	To educate problem solving techniques
3	To educate problem solving techniques
4	To practice structured programming to solve real life problems
5	To understand File Operations concepts

UNIT	TITLE	PERIODS
1	**Introduction**	10

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
2	**C Programming Basics**	11

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
3	**Array, String, And Functions**	11

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
4	**Structure And Unions**	11

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
		L	T	P	
	High-Performance Computing	**3**	**0**	**0**	**3**

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

	TOTAL PERIODS:	54

COURSE OUTCOMES:

Upon completion of this course, students will be able to:	
CO1:	Understand the need and importance of Modern processors
CO2:	Understand the need and importance of Memory hierarchies and Multicore processors and Multithreaded processors
CO3:	Understand the need and importance of the role of compilers and C++ optimizations
CO4:	Understand the need and importance of the role of Data access optimization and Storage order.
REFERENCE COURSES/BOOKS:	
1	Georg Hager, Gerhard Wellein,"Introduction to High-Performance Computing for Scientists and Engineer",CRC Publications, 2010
2	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
		L	T	P	
	Communication Network	3	0	0	3

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.

	TOTAL PERIODS:	54

COURSE OUTCOMES:

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

CO1:	On successful completion of the course, the student will be having the basic knowledge of data sharing transmission media and their protocols.
CO2:	Students will have a basic knowledge of computer networks.
CO3:	Students will have a basic knowledge of computer networks. and IPV4
CO4:	Students will be having the basic knowledge of data sharing, transmission media, and their protocols.

REFERENCE COURSES/BOOKS:	
1	Oludipe O., Yekini N.A., & Adelokun P.A. ,"Data Communication & Network. Published In Nigeria Has-Fem (Nig) Publications,2012
2	Spurgeon, Charles E," Ethernet: The Definitive Guide", O'Reilly Media,2014
3	Kurose, J.F,K.W. Ross,"Computer Networking: A Top Down Approach Featuring the Internet", Addison Wesley Publications,2003
4	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 Communications‖", PHI Publications, Second Edition, 2003.
2	Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing‖", 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 Computing‖", Springer Publications, 2003.

Course Code	Course Title	Periods per week			Credits
		L	T	P	
	Image and Video Processing	3	0	0	3

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.