SRI SANKARA ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

ENATHUR, KANCHIPURAM – 631 561.

Learning Outcome-based Curriculum Framework (LOCF)

for

M.SC. COMPUTER SCIENCE

Choice Based Credit System (CBCS)

(Effective from the academic year 2023 - 2024)

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Preamble

The curriculum of **M.Sc., Computer Science** programme offered by Department of Computer Science is prepared in accordance with UGC and Tamil Nadu State Council of Higher Education (TANSCHE). The Programme complies with the Outcome Based Education (OBE) and is designed with relevance to Choice Based Credit System (CBCS) affiliated to the University of Madras.

The curriculum and syllabi conform to the Learning Outcomes-based Curriculum Framework (LOCF) to make it student-centric, interactive and outcome-oriented education for the student's community. The Programme Outcome (PO), Programme Specific Outcome (PSO) and Course Outcome (CO) were discussed and finalized keeping the broad requirements of the programme.

Since the curriculum is intended for the post-graduate students, more emphasis is laid on inculcating research aspects through the curriculum. To cater to the needs of advanced learners, the curriculum is structured to include higher-end technologies and research-oriented software that are prevalent in the job-market. To facilitate graduates to be successful in competitive exams, the syllabi is made to focus on core-competent subjects as part of the curriculum.

A comprehensive and detailed curriculum and syllabi along with Text books and Reference books were framed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Research Organizations and Parents to capture the voice of the respective stakeholders.

The students are offered a well-rounded curriculum that are research-oriented and advanced subjects such as such as Block Chain Technology, Human Computer Interaction, Artificial Neural Network, Internet of Things, Robotic Process Automation for Business, among many other courses.

1. Introduction

The field of Computer Science has been on an evolution spree for the past three decades and the state-of-the-art technologies have often been breached day-in and day-out by the emergence of new technologies. The mutual growth of hardware and software has supplemented and complimented each other to propel the field of computer science and expanded the horizons of the field. Computers have invaded into every form of human lives giving them instant solutions for the problems that they encounter in their daily life. So, its safe to say that computers have become an integral part of humankind and inevitable to stay away from its magic.

The field of Computer science has been stretching its contours at a rapid pace so much so that even highly complex problems are being breached with consummate ease with the ever-evolving cutting-edge technologies. The latest topics that are hogging the limelight of late are Machine Learning, Artificial Intelligence, Internet of things, Image Processing, Cloud Computing, Natural Language Processing, etc.,

The M.Sc. Computer Science programme aims to instill research-oriented skillsets through introduction of theoretically complex subjects and higher-end technologies that trains the students to seek computational solutions for complex real-life and real-time problems. The curriculum is designed so as to enhance the research and problem-solving capabilities, entrepreneurship skill, and skill necessary for cracking the competitive exams such as SET and NET. In particular, the course prepares the students to be employable as Web Developer, Network Administrator, Database Administrator, Data Analyst and a Research Scholar.

The Learning Outcomes-based Curriculum Framework for M.Sc. CS is structured and developed to facilitate the students to achieve the following:

- To acquire basic core competencies in research-oriented papers and higher-end technologies such as Block Chain Technology, Human Computer Interaction, Artificial Neural Network, Internet of Things, Robotic Process Automation forBusiness.
- To develop an ability to synthesize the learned knowledge to analyze the real-world problems and to propose new self-thought solutions from the acquired knowledge.
- To learn advanced and latest technologies to meet the industry standards and challenges. The course outcomes and objectives are designed to cater to the enlisted purposes.

2. Learning Outcomes-based Curriculum Framework

2.1. Nature and Extent of the M.Sc. CS Programme

The postgraduate programme in Computer Science builds on to the fundamental knowledge gained in undergraduate programme, which infuses core-competencies in Computer Science and basic programming languages. This creates a temperament for research among technology-savvy graduates.

Curriculum and syllabi framework is intended to introduce students to the advanced computing concepts and higher-end technologies and its applications. It is highly critical in inculcating a strong research-temper in computer science so as to venture into a advanced research and equips them to solve highly complex problems in of computer science. The curriculum in computer science is reinforced with internship and main-project work to expose the graduates to the corporate standards and procedures and introduce them to hands-on problems.

3. Graduate Attributes:

Graduate Attributes (GA) are the qualities, skills and understandings that students should develop during their graduation. These qualities prove to be the characteristics and defining roles of the graduates. Graduate attribute is a key outcome that underpin curriculum planning and development. The graduate attributes are fostered through meaningful learning experiences made available through the curriculum, college experience and a process of critical and reflective thinking.

The graduate attributes can be viewed as qualities as listed subcategories:

- **Disciplinary knowledge:**

The graduate must demonstrate comprehensive and in-depth knowledge and understanding of the core concepts offered in the curriculum of Computer Science.

- **Intellectual Rigor:**

Intellectual Rigor is the commitment to excellence in all scholarly and intellectual activities, including critical judgment. This capability involves engaging constructively and methodically when exploring ideas and theories. It also relates to the ability to analyse and construct knowledge with depth, insight and intellectual maturity.

- **Life-Long Learning:**

The skill of being a lifelong learner means a graduate is open, curious, willing to investigate and consider new knowledge and ways of thinking. This flexibility of mind means they are amenable to new ideas and actively seek out new ways of learning or understanding the real-world problems.

- **Problem Solving and Design:**

Problem solving skills empower students to find methodical solutions to any real-world problems or real-time problems using computational algorithms and solutions. Problem solvers are most sought-after attributes of the graduates form the field of Computer Science. They should possess the ability to clearly understand the problem, think creatively or out-of-the-box thinking and to convert the problem into a computational model to find a scientific solution backed by the theories.

- **Self-Management:**

Graduates must have capabilities for self-organization, self-review, personal development and life-long learning.

3.1. LIST OF GRADUATE ATTRIBUTES FOR B.SC CS:

GA-1: Ability to think carefully, deeply and with rigour when faced with new knowledge and arguments.

GA-2: Ability to develop creative and effective response to intellectual, professional and social challenges.

GA-3: Ability to be responsive to change, to be inquiring and reflective in practice, through information literacy and autonomous, self-managed learning.

GA-4: Ability to understand, design and analyse precise specifications of algorithms, procedures and interaction behaviour.

GA-5: Ability to be equipped with a range of fundamental principles of Computer Science that will provide the basis for future learning and enable them to adapt to the constant rapid development of the field.

GA- 6: Ability to synthesize alternative/innovative solutions, concepts and procedures.

4. Qualification Descriptors:

Qualification Descriptors are generic statements that define the outcomes of the graduates. The Qualification descriptors are used as metric by two parties:

The first party is the designer of academic programmes who can use the qualification metrics to measure the achievement of students for the award of the qualification.

The second party is the employers of the graduates who can use the qualification descriptors to assess the quality and capabilities of the graduates holding the qualification.

4.1. Qualification Descriptors for M.Sc. with CS

On completion of M.Sc. with Computer Science, the expected learning outcomes that a student should be able to demonstrate are the following.

QD-1: Procedural knowledge that creates different types of professionals related to Computer Science, including research and development, teaching and industry, government and public service.

QD-2: Use knowledge, understanding and skills required for identifying problems and issues, collection of relevant quantitative and qualitative data drawing on a wide range of sources and their application, analysis and evaluation using methodologies as appropriate to Computer Science for formulating solutions.

QD-3: Meet one's own learning needs, drawing on a range of current research and development work and processional materials.

QD-4: Communicate the results of studies undertaken in Computer Science accurately in a range of different contexts using main concepts, constructs and techniques.

QD-5: Demonstrate subject-related and transferable skills that are relevant to industry and employment opportunities.

5. Programme Outcomes (PO)

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc., Computer Science**
Programme Code	
Duration	**PG - Two Years**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and A global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one‟s life.

Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others‟ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

	PSO3 – Research and Development Design and implement HR systems and practices grounded in researches that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

Sl.No	Level	Parameter	Description
1	K1	Knowledge / Remembering	It is the ability to remember the previously learned
2	K2	Comprehension / Understanding	The learner explains ideas or Concepts
3	K3	Application / Applying	The learner uses the information in a new way
4	K4	Analysis / Analysing	The learner distinguishes among different concepts
5	K5	Evaluation / Evaluating	The learner justifies a stand or Decision
6	K6	Synthesis / Creating	The learner creates a new product of point of view

6. SYLLABUS AND REGULATIONS:

6.1.CBCS SYSTEM :

All programmes (named after the core subject) mentioned earlier shall be run on **Choice Based Credit System (CBCS).** It is an instructional package developed to suit the needs of students to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education

6.2.ELIGIBILITY FOR ADMISSION:

Candidates with B.Sc. degree in Computer Science or Computer Science & Technology or B.C.A. degree of this University or any other degree accepted as equivalent thereto by Academic Council of the Autonomous College shall be eligible for admission to M.Sc Computer Science Degree Course.

6.3.ELIGIBILITY FOR THE AWARD OF DEGREE

A Candidate shall be eligible for the award of the Degree only if he / she has undergone the prescribed course of study in a Autonomous College for a period of not less than two academic years, passed the examinations of all the Four Semesters prescribed earning 91 credits in Parts-I, II, III, IV & V and fulfilled such conditions as have been prescribed therefore. The parent university will award degrees to the students evaluated and recommended by autonomous colleges.

6.4. DURATION

Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters respectively.

The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester exclusive of the days for the conduct of semester examinations.

In each semester, Courses are administered in 15 teaching weeks and another 5 weeks are utilized for evaluation and grading purposes. Each week has 30 working hours spread over in a 5 day week. Depending upon the content and specialization, a paper may have 1 to 6 credits. Total number of teaching hours in a semester will be 450 hrs.

6.5. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMMES

The candidates shall complete the Masters Degree Programmes within 4 years from the date of admission. The term completing the programmes means passing all the prescribed examinations of the programme to become eligible for the degree. No candidate shall be permitted to appear for the examinations after the prescribed period for completing the programme.

6.6. MEDIUM OF INSTRUCTION

The medium of instruction shall be English.

6.7. COURSE OF STUDY

A Master's programme consists of a number of courses (papers). The term Course is used to indicate logical part of a subject matter of the programme. In each of Master's programmes, there will be a prescription of (i) Part –I (Core subjects – Theory, Practicals, Project, and Field work), (ii) Part – II (Elective subjects – Inter disciplinary or Extra disciplinary subjects), (iii) Part – III: a set of papers recommended by UGC and TANSCHE (Soft skills), (iv) Part – IV: Internship, and (v) The detail of the Study for Master Degree Courses shall consist of the following:

PART – I Core Subjects – Theory, Practicals, Project / Field work PG students shall be required to take up Project / Field Work and submit the Project Report during the second year. The Head of theDepartment shall allot the Guide who in turn will suggest the Project Work to the students. Two typed copies of the Project Report shall be submitted to the Department before the due date and onecopy will be forwarded to the Controller of Examinations. For the Project Report, the maximum internal marks will be 20 percent, the maximum external marks will be 60 per cent and for the Viva-Voce 20 per cent (If in some programmes, if the project is equivalent to more than one paper, the project marks would be in proportion to the number of equivalent papers). Each student shall be required to appear for Viva-Voce Examination in defense of the Project only.

PART – II Elective Subjects – Inter-disciplinary or Extra-disciplinary or self-study elective oropen elective

PART – III Skill Based Subjects - Soft Skills

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed papers on Soft Skills. For three years PG degree Programme, a candidate must undergo a minimum of 2 papers (2 x 2 = 4 credits). Papers will be finalized in due course.

PART – IV Internship

Each PG student shall appear for intenship training during the vacation of II Semester for a minimum period of 15 days and shall submit the report to the controller of examinations. Each student is allotted 4 credits on submission of the report.

Course: Every course offered will have three components associated with the teaching learning process of the paper, namely (i) Lecture - L (ii) Tutorial - T (iii) Practicals - P, (iv) Self study - S where

L stands Lecture session. **T** stands Tutorial session consisting participatory discussion / self study / desk work / brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands Practice session and it consists of Hands on experience / Laboratory Experiments / Field Studies / Case studies that equip students to acquire the much required skill component.

S stands Self study session consisting participatory discussion by student with the guidance of faculty. This session is not included in the weekly hour plan.

In terms of credits, every one hour session of L amounts to 1 credit per semester, a minimum oftwo hour session of T or P amounts to 1 credit per semester and no credits alloted to self studyhour, over a period of one semester of 15 weeks for teaching-learning process. The total duration ofa semester is 20 weeks inclusive of semester-end examination.

A paper shall have either or all the three components. That means a paper may have only lecture component, or only practical component or combination of any two or all the three components. The total credits earned by a student at the end of the semester upon successfully completing the paper are L + T + P + S. The credit pattern of the paper is indicated as L: T: P: S.

For example: a theory paper with a L-T-P-S schedule of 4-0-0-2 will be assigned 4 credits, and alab practical paper with a L-T-P-S schedule of 0-0-3-0 will be assigned 3 credits.

The concerned Board of Studies will choose the convenient credit pattern for every paper based on the requirement. However, generally, a paper shall be of 2 - 6 credits.

Different courses of study are labeled and defined as follows:

Core Course

A course which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main discipline / subject of study or from a sister/related discipline / subject which supports the main discipline / subject. In contrast to the phrase Soft Core, a compulsory core course is called a **Hard Core** Course**.**

Elective Course

Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline / subject of study or which provides an extended scope or which enables an exposure to some other discipline / subject / domain or nurtures the candidate‟s proficiency/ skill is called an Elective Course. Elective courses may be offered by the main discipline / subject of study or by sister / related discipline / subject of study. A Soft Core course may also be considered as an elective. An elective course chosen generally from an unrelated discipline / subject, with an intention to seek exposure is called an **open elective**. An elective course designed to acquire a special / advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher is called a **Self Study Elective**.

A core course offered in a discipline / subject may be treated as an elective by other discipline / subject and vice versa. Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing / exploring a real life situation / difficult problem. A project work up to 4 - 6 credits is called Minor Project work. A project work of 8 - 12 credits is called Major Project Work. Dissertation work can be of 8 - 12 credits. A Project / Dissertation work may be a hard core or a soft core as decided by the Board of Studies concerned.

Student Advisor

All teachers of the department shall function as student advisors. There will be more or less an equal number of students assigned to each student advisor of a department. The student advisor will help the students in choosing core and elective courses of study. The student advisor shall be responsible for registration of courses (subjects) by his students. The student advisor will offer all possible student support services.

6.8.CREDITS

The term credit is used to describe the quantum of syllabus for various programmes in terms of periods of study. It indicates differential weightage given according to the contents duration of the courses in the curriculum design. The minimum credit requirement for a two year Master‟s programme shall be **91** credits. Each subject (course) is designed variously under lectures / tutorials / laboratory work / seminar / project work etc., to meet effective teaching and learning needs and credits are assigned suitably.

One credit for each lecture / tutorial / project work period per week shall be alloted. In practical, each credit should cover minimum of six experiments. One credit is alloted for two practical hours. Thus normally, in each of the subject, credits will be assigned on the basis of the lectures / tutorials / laboratory work / project work and other forms of learning in a 15 week schedule.

6.9.SCHEME OF EXAMINATION

There shall be continuous, comprehensive evaluation of students through internal and external examination. At least 2 internal examinations (Sessional Tests) per semester and 1 semester ending examination should be conducted.

Sessional Test I will he held during sixth week for syllabi covered till then. Sessional Test I will be a combination of a variety of tools such as class test, assignment, paper presentation etc.,that would be suitable for the paper. This required an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However the tests are compulsory. Test I may be for one hour duration. The pattern of question paper will be decided by the respective board of studies.

Sessional Test I will carry 20% of marks of the entire paper.

Sessional Test II will he held during eleventh week for syllabi covered between seventh and eleventh weeks. Sessional Test I will be a combination of a variety of tools such as class test, assignment, paper presentation etc., that would be suitable for the paper. It will also have an element of openness. The students are to be informed in advance about the nature of assessmentand the procedures. However the tests are compulsory. Test II may be for one hour duration. The pattern of question paper will be decided by the respective board of studies.

Sessional Test II will carry 20% of marks of the entire paper.

There will be one End Semester examination of 2 - 3 hours duration in each paper. The End semester examination will cover all the syllabi of the paper for 60% of Marks.

A dissertation may be offered in lieu of one / two papers / practicals. It shall be evaluated by two examiners one external and one internal appointed by the Controller of Examination. Wherever there is viva-voce, it shall be conducted by the common Viva Board consisting of the Chairman and internal members of the Board of Examination in the concerned subject, internal guide and one external expert as approved by the Controller of Examinations. End semester practical examinations shall be held before the theory examinations to benefit the students to undertake examinations of other departments.

Credit Distribution for PG Programme

Semester–I	Credit	Hour	Semester-II	Credit	Hour	Semester-III	Credit	Hour	Semester–IV	Credit	Hour
1.1. Core-I	5	7	2.1. Core-IV	5	6	3.1. Core-VII	5	6	4.1. Core-X	5	6
1.2 Core-II	5	7	2.2 Core-V	5	6	3.2 Core-VIII	5	6	4.2 Core-XI	5	6
1.3 Core – III	4	6	2.3 Core – VI	4	6	3.3 Core – IX	5	6	4.3 Elective – VI (Industry / Entrepreneurship 20% Theory / 80% Practical)	3	4
1.4 Elective (Discipline Centric)- I	3	5	2.4 Elective(Discipline Centric) – III	3	4	3.4 Elective (Generic / Discipline Centric) – V	4	6	4.4 Project with Viva-V6oce	7	10
1.5 Elective (Generic)- II	3	5	2.5 Elective (Generic)-IV	3	4	3.5 Elective (Generic / Discipline Centric) – V	3	3	4.5 Skill Enhancement Course - Professional Competency Skill	2	4
			2.6 Skill Enhancement Course SEC 1	2	4	3.6 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 2	2	3	4.6 Extension Activity	1	-
						3.7 Internship/ Industrial Activity	2	-			
	20	**30**		**22**	**30**		**26**	**30**		**23**	**30**
									Total Credit Points		**91**

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	**14**	**14**	**15**	**17**	**54**
Part B **(i)Discipline– Centric/Generic Skill**	**6**	**6**	**7**	3	**18**
(ii) SoftSkill		**2**	**2**	**2**	**18**
(iii) Summer Internship / Industrial Training			**2**		
Part C				**1**	**1**
Total	**20**	**22**	**26**	**23**	**91**

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	• The lowest level of questions require student store call in formation from the course content • Knowledge questions usually require students to identify information in the text book.
Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond implore call and require students to combine data together
Application (K3)	• Students have to solve problems by using / applying a concept learned in the class room. • Students must use their knowledge to determine a exact response.
Analyze (K4)	• Analyzing the questions one that asks the students to break down something in to its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged indecision-making and problem–solving. • Evaluation questions do not have single right answers.
Create (K6)	• The question soft his category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem solving skills

PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING

PROGRAMME SPECIFIC OUTCOMES (PSO)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
PSO1	**3**	**3**	**3**	**3**	**3**
PSO2	**3**	**3**	**3**	**3**	**3**
PSO3	**3**	**3**	**3**	**3**	**3**
PSO4	**3**	**3**	**3**	**3**	**3**
PSO5	**3**	**3**	**3**	**3**	**3**

Level of Correlation between PO's and PSO's

(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)

Assign the value

1 – Low
2 – Medium
3 – High
0 – No Correlation

M.Sc. Computer Science

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
Core – I	Python Programming	5	7		25	75	100
Core – II	Object Oriented Analysis and Design & C++	5	7		25	75	100
Core – III	Algorithm And OOPS Lab	4		6	40	60	100
Elective – I	Advanced Software Engineering / Software Development Technologies / Agile Software Engineering	3	5		25	75	100
Elective – II	Analysis and Design of Algorithms / Block Chain Technology / Web Services	3	5		25	75	100
	Total	20	24	6			
SECOND SEMESTER							
Core – IV	Data Mining And Warehousing	5	6		25	75	100
Core – V	Data Mining Lab using R	4		6	40	60	100
Core – VI	Advanced Java Programming	5	6		25	75	100
Elective – III	Artificial Intelligence and Machine Learning / Artificial Neural Networks and Deep Learning / Computer Vision	3	4		25	75	100
Elective –IV	Advanced Operating Systems/ Human Computer Interaction / Embedded System	3	4		25	75	100
Skill Enhancement	Multimedia and Its Applications	2	4		25	75	100
	Total	22	24	6			

THIRD SEMESTER							
Core - VII	Digital Image Processing	5	6		25	75	100
Core – VIII	Cloud Computing	5	6		25	75	100
Core – IX	Digital Image Processing Lab using Python	4		6	40	60	100
Core – X	Network Security	5	6		25	75	100
Elective – V	Mobile Computing / IoT and its Applications / Distributed Database System	3	3		25	75	100
Skill Enhancement	Cloud Computing Lab	2	3		40	60	100
Internship / Industrial Activity		2	-		40	60	100
	Total	26	24	6			
FOURTH SEMESTER							
Core – XI	Python Programming Lab Practical	5		6	40	60	100
Core – XII	Web Application development Using PHP	5	6		25	75	100
Elective – VI (Industry/ Entrepreneurship 20% Theory 80% Practical)	Robotic Process Automation for Business / Data Science and Analytics / Parallel and Distributed Computing	3	4		25	75	100
	Project work and Viva-Voce (200marks)	7	10		40	60	100*
	Skill Enhancement Course - Professional Competency Skill – Quantitative Aptitude	2	4				
	Extension Activity	1	-				
	Total	23	24	6			100
Grand Total		91					

I – SEMESTER

Course code		PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	7			5
Pre-requisite		Basics of any OO Programming Language				

Course Objectives:

The main objectives of this course are to:

1. Presents an introduction to Python, creation of web applications, network applications and working in the clouds
2. Use functions for structuring Python programs
3. Understand different Data Structures of Python
4. Represent compound data using Python lists, tuples and dictionaries

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concepts of Python Programming	K1,K2
2	Understand File operations, Classes and Objects	K2,K3
3	Acquire Object Oriented Skills in Python	K3,K4
4	Develop web applications using Python	K5
5	Develop Client Server Networking applications	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	21 hours

Python: Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets– Comparison.

Unit:2	CODESTRUCTURES	21 hours

Code Structures: if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.

Unit:3	MODULES,PACKAGESANDCLASSES	21 hours

Modules, Packages, and Programs: Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super–Inself Defense –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition.

Unit:4	DATATYPESANDWEB	20 hours

Data Types: Text Strings–Binary Data. **Storing and Retrieving Data:** File Input / Output– Structured Text Files – Structured Binary Files - Relational Databases – No SQL Data Stores.

Web : Web Clients –Web Servers–Web Services and Automation

Unit:5	SYSTEMS AND NETWORKS	20 hours
Systems: Files–Directories–Programs and Processes–Calendars and Clocks. **Concurrency:** Queues– Processes–Threads–Green Threads and event–twisted–Radis. **Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – Zero MQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and Map Reduce – Working in the Clouds.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**105 hours**

Text Books	
1	BillLubanovic, "Introducing Python", O"Reilly, First Edition-Second Release, 2014.
2	MarkLutz, "Learning Python", O"Reilly, Fifth Edition, 2013.
ReferenceBooks	
1	David M. Beazley, "Python Essential Reference", Developer"s Library, Fourth Edition,2009.
2	Sheetal Taneja, Naveen Kumar, "Python Programming-A Modular Approach", Pearson Publications.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	S	M
CO5	S	S	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		OBJECT ORIENTED ANALYSIS AND DESIGN & C++	L	T	P	C
Core/Elective/Supportive		Core	7			5
Pre-requisite		Basics of C++ and Object Oriented Concepts				

Course Objectives:

The main objectives of this course are to:

1. Present the object model, classes and objects, object orientation, machine view and model management view.
2. Enables the students to learn the basic functions, principles and concepts of object oriented analysis and design.
3. Enable the students to understand C++ language with respect to OOAD

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of Object-Oriented development and modeling techniques	K1,K2
2	Gain knowledge about the various steps perform edduring object design	K2,K3
3	Abstract object-based views for generic softwaresystems	K3
4	Link OOAD with C++ language	K4,K5
5	Apply the basic concept of OOPs and familiarize to write C++ program	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	OBJECT MODEL	21 hours

The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects**.**

Unit:2	CLASSES AND OBJECTS	21 hours

Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects –Key Abstractions and Mechanism.

Unit:3	C++INTRODUCTION	21 hours

Introduction to C++-Input and output statements in C++-Declarations-control structures– Functions in C++.

Unit:4	INHERITANCE AND OVERLOADING	20 hours

Classesand Objects–Constructors and Destructors–operators overloading–Type Conversion-Inheritance – Pointers and Arrays.

Unit:5	**POLYMORPHISM AND FILES**	**20 hours**
Memory Management Operators-Polymorphism–Virtual functions–Files–Exception Handling – String Handling -Templates.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**105 hours**

Text Books	
1	"Object Oriented Analysis and Design with Applications", Grady Booch, Second Edition, Pearson Education.
2	"Object-Oriented Programming with ANSI & Turbo C++",AshokN.Kamthane, First Indian Print -2003, Pearson Education.
Reference Books	
1	Balagurusamy "Object Oriented Programming with C++",TMH, Second Edition,2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	M	S	M	S	S
CO2	S	S	S	M	S	M	S	M	S	S
CO3	S	S	S	M	S	M	S	M	S	S
CO4	S	S	S	M	S	M	S	M	S	S
CO5	S	S	S	M	S	M	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		ALGORITHM AND OOPS LAB	L	T	P	C
Core/Elective/Supportive		Core			6	4
Pre-requisite		Basic Programming of C++ language				

Course Objectives:

The main objectives of this course are to:

1. This course covers the basic data structures like Stack, Queue, Tree, List.
2. This course enables the students to learn the applications of the data structures using various techniques
3. It also enable the students to understand C++ language with respect to OOAD concepts
4. Application of OOPS concepts.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of object oriented with respect to C++	K1,K2
2	Able to understand and implement OOPS concepts	K3,K4
3	Implementation of data structures like Stack, Queue, Tree, List using C++	K4,K5
4	Application of the data structures for Sorting, Searching using different techniques.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	90 hours

1) Write a program to solve the tower of Hanoi using recursion.
2) Write a program to traverse through binary search tree using traversals.
3) Write a program to perform various operations on stack using linked list.
4) Write a program to perform various operation in circular queue.
5) Write a program to sort an array of an elements using quick sort.
6) Write a program to solve number of elements in ascending order using heap sort.
7) Write a program to solve the knapsack problem using greedy method
8) Write a program to search for an element in a tree using divide & conquer strategy.
9) Write a program to place the 8 queen son an 8 X 8 matrix so that no two queens Attack.
10) Write a C++ program to perform Virtual Function
11) Write a C++ program to perform Parameterized constructor
12) Write a C++program to perform Friend Function
13) Write a C++ program to perform Function Overloading
14) Write a C++program to perform Single Inheritance
15) Write a C++ program to perform Employee Details using files.

Expert lectures, online seminars –webinars

Total Lecture hours	90 hours

Text Books	
1	Goodrich,"Data Structures & Algorithms in Java", Wiley 3rd edition.
2	Skiena,"The Algorithm Design Manual", Second Edition,Springer,2008
Reference Books	
1	AnanyLevith," Introduction to the Design and Analysis of algorithm", Pearson Education Asia, 2003.
2	Robert Sedgewick,PhillipeFlajolet,"An Introduction to the Analysis of Algorithms", Addison-Wesley Publishing Company,1996.
Related Online Contents[MOOC, SWAYAM, NPTEL,Websitesetc.]	
1	https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/
3	https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		**ADVANCED SOFTWARE ENGINEERING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	5			3
Pre-requisite		Basics of Software Engineering &SPM				

Course Objectives:

The main objectives of this course are to:

1. Introduce to Software Engineering, Design, Testing and Maintenance.
2. Enable the students to learn the concepts of Software Engineering.
3. Learn about Software Project Management, Software Design &Testing.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand about Software Engineering process	K1,K2
2	Understand about Software project management skills, design and quality management	K2,K3
3	Analyze on Software Requirements and Specification	K3,K4
4	Analyze on Software Testing, Maintenance and Software Re-Engineering	K4,K5
5	Design and conduct various types and levels of software quality for a software project	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create		
Unit:1	**INTRODUCTION**	**15hours**
Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.		
Unit:2	**SOFTWAREREQUIREMENTS**	**15hours**
Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management –Software Quality, Software Quality Management System, ISO 9000, SEI CMM.		
Unit:3	**PROJECT MANAGEMENT**	**15hours**
Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead‟s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.		
Unit:4	**SOFTWAREDESIGN**	**15hours**
Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.		
Unit:5	**SOFTWARETESTING**	**13hours**
Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging–Testing tools-Metrics-Reliability Estimation. Software Maintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75hours**
Text Books		
1	An Integrated Approach to Software Engineering–PankajJalote, Narosa Publishing House, Delhi, 3rd Edition.	
2	Fundamentals of Software Engineering –Rajib Mall, PHI Publication, 3rd Edition.	

Reference Books	
1	Software Engineering–K.K.Aggarwal and Yogesh Singh, New Age International Publishers, 3rd edition.
2	A Practitioners Approach- Software Engineering,-R.S.Pressman, McGraw Hill.
3	Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Mano drioli, PHI Publication.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.javatpoint.com/software-engineering-tutorial
2	https://onlinecourses.swayam2.ac.in/cec20_cs07/preview
3	https://onlinecourses.nptel.ac.in/noc19_cs69/preview

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		SOFTWARE DEVELOPMENT TECHNOLOGIES	L	T	P	C
Core/Elective/Supportive		Elective	5			3
Pre-requisite		Basics of Software Engineering &SPM				

Course Objectives:

The main objectives of this course are to:

- To learn and Implementing Micro services
- To analysing the Azure Kubernetes Service
- To learn and anlyse .NET DevOps for Azure and its applications
- To building code for .NET core applications
- To get familiarized with Azure pipelines

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To understand, apply and summarize the basic concepts of Microservices communication Microsoft Azure and DevOps for software development life cycle.	K1,K2
2	To illustrate, and implement Azure Kubernetes Service tools for software development lifecycle.	K2,K3
3	To recognize ,an alyse and summarize the functionalities of .NET DevOps for Azure applications.	K3,K4
4	Tounderstand,designandevaluatetheprinciplesandarchitectureservice Tools for software development life cycle.	K4,K5
5	To comprehend ,implement and review the functionalities of API and API gateways for cloud and Azure applications.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	Implementing Micro services	15hours

Client to micro services communication, Inter service communication, data considerations, security, monitoring, micro services hosting platform options. Azure Service Fabric: Introduction, core concepts, supported programming models, service fabric clusters, develop and deploy applications of service fabric. Monitoring Azure Service Fabric Clusters: Azure application, resource manager template, Adding Application Monitoring to a Stateless Service Using Application Insights, Cluster monitoring, Infrastructure monitoring.

Unit:2	Azure Kubernetes Service(AKS)	15hours

Introduction to kubernetes and AKS, AKS development tools, Deploy applications on AKS. Monitoring AKS: Monitoring, Azure monitor and analytics, monitoring AKS clusters, native kubernetes dashboard, Prometheus and Grafana. Securing Microservices: Authenticationin microservices,Implenting security using API gateway pattern, Creating application using Ocrlot and securing APIs with Azure AD. Database Design for Micro services: Data stores, monolithic approach, Micro services approach, harnessing cloud computing, database options on MS Azure, overcoming application development challenges. Building Microservices on AzureStack: Azurestack, Offering IaaS, PaaSon -premises simplified, SaaS on Azure stack.

Unit:3	**.NETDev Ops forAzure**	**15hours**
DevOps introduction, Problem and solution. Professional GradeDevOps Environment: The state of DevOps, professional grade DevOps vision, DevOps architecture, tools for professional DevOps environment, DevOps centered application. Tracking work: Processtemplate, Types of workitems, Customizingthe process, Workingwiththe process. Tracking code: Number of repositories, Git repository, structure, branching pattern,Azure repos configuration, Git and Azure.		
Unit:4	**Building the code**	**15hours**
Structureof build, using buildswith.NET coreand Azure pipelines, Validating the code: Strategy for defect detection, Implementing defect detection. Release candidate creation: Designing release candidate architecture, Azureartifacts work flow for release candidates, Deploying the release: Designing deployment pipeline, Implementing deployment in Azure pipelines. Operating and monitoring release: Principles, Architectures for observability, Jumpstarting observability.		
Unit:5	**Introduction to APIs**	**15 hours**
Introduction, API economy, APIs in public sector. API Strategy and Architecture: API Strategy, API value chain, API architecture, API management. API Development: Considerations, Standards, kick-start API development, team orientation. API Gateways: API Gateways in public cloud, Azure API management, AWS API gateway. API Security: Request-based security, Authentication and authorization.		
	Total Lecture hours	**75hours**

Text Books	
1	Harsh ChawlaandHemantKathuria, Building Microservices Applications on MicrosoftAzure-Designing, Developing, Deploying, and Monitoring, Apress, 2019.
2	Jeffrey Palermo ,NETDevOps for Azure A Developer‟s Guide to DevOpsArchitecturethe Right Way, Apress, 2019.
Reference Books	
1	Karl Matthias and Sean P. Kane, Docker: Up and Running, O'Reilly Publication, Second Edition 2018.
2	Len Bass, IngoWeber, Liming Zhu,”DevOps, A Software Architects Perspective”, Addison Wesley-Pearson Publication, First Ediiton 2015.
3	John Ferguson Smart,”Jenkins, The Definitive Guide”, O'Reilly Publication, First Ediiton2011

Mapping with Programme Outcomes

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

S-Strong;M-Medium;L-Low

Course code		**AGILE SOFTWARE ENGINEERING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	5			3
Pre-requisite						

Course Objectives:

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set ofsoftware technologies and APIs.
- TodoadetailedexaminationanddemonstrationofAgiledevelopmentandtesting techniques.
- To understand the benefits and pitfalls of working in an Agile team.
  To understand Agile development and testing.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Realize the importance of interacting with businesss take holdersin Determining there quirements for a software system	K1,K2
2	Performiterativesoftwaredevelopmentprocesses:howtoplanthem,howto Execute them.	K2,K3
3	Point out the impact of social aspects on software development success. develop techniques and tools for improving team collaboration and software quality.	K3,K4
4	Perform Software process improvement as an on going task for development teams.	K4,K5
5	Show how agile approaches can be scaled up to the enterprise level.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	AGILE METHODOLOGY	15 hours
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto andPrinciples –AgileProject Management – Agile Team Interactions –Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values		
Unit:2	**AGILE PROCESSES**	**15 hours**
Lean Production - SCRUM, Crystal, Feature DrivenDevelopment- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.		
Unit:3	**AGILITYANDKNOWLEDGEMANAGEMENT**	**15 hours**
AgileInformationSystems– Agile Decision Making - EarlS Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging –KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating toAgile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).		
Unit:4	**AGILITY AND REQUIREMENTS ENGINEERING**	**15hours**
Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.		
Unit:5	**AGILITYANDQUALITYASSURANCE**	**15hours**
AgileProductDevelopment –Agile Metrics – FeatureDrivenDevelopment (FDD) – Financial andProduction Metrics inFDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.		
	Total Lecture hours	**75hours**

	Text Books
1	David J. Anderson and Eli Schragenheim; Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results; Prentice Hall; 2003.
2	Hazza and Dubinsky; Agile Software Engineering, Series: Undergraduate Topics in Computer Science ; Springer; 2009
	Reference Books
1	Craig Larman, Agile and Iterative Development: A Managers Guide, Addison Wesley, 2004.
2	Kevin C. Desouza, Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007
	Related Online Contents[MOOC, SWAYAM, NPTEL, Websitesetc.]
1	https://www.youtube.com/watch?v=x90kIAFGYKE&t=8s

1. Mapping with Programme Outcomes:

CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	L	M	S	L	M	S	M	L	S	M
CO4	S	L	L	M	M	L	L	S	M	S
CO5	M	S	M	L	S	M	M	L	M	L

S-StrongM-MediumL-Low

Course code		**ANALYSIS & DESIGN OF ALGORITHMS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	5			3
Pre-requisite		Basic Data Structures& Algorithms				

Course Objectives:

The main objectives of this course are to :

1. Enable the students to learn the Elementary Data Structures and algorithms.
2. Presents an introduction to the algorithms, their analysis and design
3. Discuss various methods like Basic Traversal And Search Techniques, divide and conquer method, Dynamic programming, backtracking
4. Understood the various design and analysis of the algorithms.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Get knowledge about algorithms and determines their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique.	K1,K2
2	Gain good understanding of Greedy method and its algorithm.	K2,K3
3	Able to describe about graphs using dynamic programming technique.	K3,K4
4	Demonstrate the concept of backtracking & branch and bound technique.	K5,K6
5	Explore the traversal and searching technique and apply it for trees and graphs.	K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**INTRODUCTION**	**15hours**

Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity-Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heap sort- Graph.

Unit:2	TRAVERSAL AND SEARCH TECHNIQUES	15hours
Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs - Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.		
		Version
Unit:3	**GREEDY METHOD**	**15hours**
The Greedy Method:-General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path.		
Unit:4	**DYNAMIC PROGRAMMING**	**15hours**
Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.		
Unit:5	**BACKTRACKING**	**13hours**
Backtracking:-General Method–8-QueensProblem–Sum Of Subsets–Graph Coloring– Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars– webinars		
	Total Lecture hours	**75hours**

Text Books	
1	Ellis Horowitz,“ComputerAlgorithms”,GalgotiaPublications.
2	AlfredV.Aho, JohnE. Hopcroft, Jeffrey D.Ullman,"DataStructures and Algorithms".
ReferenceBooks	
1	Goodrich,“ Data Structures & Algorithms in Java”,Wiley3rd edition.
2	Skiena,”The Algorithm Design Manual”,Second Edition,Springer,2008
3	AnanyLevith,” Introduction to the Design and Analysis of algorithm”,Pearson Education Asia, 2003.
4	Robert Sedge wick, PhillipeFlajolet,”An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company,1996.
Related Online Contents [MOOC, SWAYAM, NPTEL,Websitesetc.]	
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
3	https://www.javatpoint.com/daa-tutorial

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	S	L	M	L	S	M
CO2	S	S	S	S	S	M	S	M	S	M
CO3	S	S	S	S	S	M	S	M	S	M
CO4	S	S	S	S	S	M	S	M	S	M
CO5	S	S	S	S	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		**BLOCK CHAIN TECHNOLOGY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	5			3
Pre-requisite		Basics of Block Chain & Crypto Currency				

Course Objectives:

The main objectives of this course are to:

1. Understand the fundamentals of block chain and crypto currency.
2. Understand the influence and role of block chain in various other fields.
3. Learn security features and its significance.
4. Identify problems & challenges posed by Block Chain.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate block chain technology and crypto currency	K1,K2
2	Understand the mining mechanism in block chain	K2
3	Apply and identify security measures, and various types of services that allow people to trade and transact with bit coins	K3,K4
4	Apply and analyze Block chain in healthcare industry	K4,K5
5	Analyze security, privacy, and efficiency of a given Block chain system	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	**INTRODUCTION**	**15 hours**

Introduction to Block chain - The big picture of the industry – size, growth, structure, players. Bit coin versus Crypto currencies versus Block chain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Block chain platforms, regulators, application providers. The major application: currency, identity, chain of custody.

Unit:2	**NETWORK AND SECURITY**	**15 hours**

Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, and Block chain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Block chain.

Unit:3	CRYPTO CURRENCY	15 hours
Crypto currency - History, Distributed Ledger, Bit coin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Block chain		
Unit:4	**CRYPTO CURRENCY REGULATION**	**15hours**
Crypto currency Regulation-Stakeholders, Roots of Bit coin, Legal views-exchange of crypto currency-Black Market-Global Economy. Cyrpto economics–assets, supply and		
Demand, inflation and deflation – Regulation.		
Unit:5	**CHALLENGES IN BLOCK CHAIN**	**13 hours**
Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machine to machine communication –Datamanagementinindustry4.0–futureprospects.Block chain in Health 4.0 – Block chain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using block chain for healthcare data		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016).
2	Antonopoulos, “ Mastering Bitcoin: Unlocking Digital Cryptocurrencies”
ReferenceBooks	
1	Satoshi Nakamoto,“Bitcoin:APeer-to-PeerElectronicCashSystem”
2	Rodrigoda Rosa Righi,Antonio Marcos Alberti, Madhusudan Singh,“Blockchain Technology for Industry 4.0” Springer 2020.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.javatpoint.com/blockchain-tutorial
2	https://www.tutorialspoint.com/blockchain/index.htm
3	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		**WEB SERVICES**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	5			3
Pre-requisite		Basics of Distributed Computing				

Course Objectives:

The main objectives of this course are to:

1. Present the Web Services , Building real world Enterprise applications using Web Services with Technologies XML, SOAP , WSDL , UDDI
2. Get overview of Distributed Computing, XML, and its technologies
3. Update with QoS and its features
4. Develop Standards and future of Web Services

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand web services and its related technologies	K1,K2
2	Understand XML concepts	K2,K3
3	Analyze on SOAP and UDDI model	K4,K5
4	Demonstrate the road map for the standards and future of web services	K5
5	Analyze QoS enabled applications in web services	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**15 hours**

Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.

Unit:2	**XML FUNDAMENTALS**	**15 hours**

XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML.

Unit:3	**SOAP MODEL**	**15 hours**
SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure- interface definitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI- UDDI registry Specification- Core data structures-Accessing UDDI		
Unit:4	**TECHNOLOGIES AND STANDARDS**	**15 hours**
Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management-workflows and workflow management systems Security: Basics-data handling and forwarding-data storage-errors-Web services security issues.		

Unit:5	**QUALITY OF SERVICE**	**13 hours**
Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS enabled web services-QoS enabled applications. Web services management-web services standards and future trends.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	SandeepChatterjee, James Webber, "Developing Enterprise Web Services: An Architects Guide", Prentice Hall, Nov 2003.
2	Keith Ballinger, "NET Web services: Architecture and Implementation with .Net", Pearson Education, First Edition, Feb 2003.
Reference Books	
1	Ramesh Nagappan, "Developing Java Web Services: Architecting and developing secure Web Services Using Java", John Wiley and Sons, first Edition Feb 2003.
2	Eric A Marks and Mark JWerrell, "Executive Guide to Web services", John Wiley and sons, March 2003.
3	Anne Thomas Manes,"Web Services: Amanagers Guide", Addison Wesley, June 2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.tutorialspoint.com/webservices/index.htm
2	https://www.javatpoint.com/web-services-tutorial
3	https://www.btechguru.com/training--programming--xml--web-services--web-services-part-1-video-lecture--11801--24--147.html

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	M	S	M	M	M	S
CO2	S	S	S	M	M	S	M	S	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

II – SEMESTER

Course code		DATA MINING AND WAREHOUSING	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basics of RDBMS &Algorithms				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
2. Develop skills of using recent data mining software for solving practical problems.
3. Develop and apply critical thinking, problem-solving, and decision-making skills.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic data mining techniques and algorithms	K1,K2
2	Understand the Association rules, Clustering techniques and Data warehousing contents	K2,K3
3	Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining	K4,K5
4	Design data warehouse with dimensional modeling and apply OLAP operations	K5,K6
5	Identify appropriate data mining algorithms to solve real world problems	K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	BASICS AND TECHNIQUES	18 hours

Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.

Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.

Unit:2	ALGORITHMS	18 hours

Classification: Introduction –Statistical –based algorithms -distance–based algorithms-decision tree-based algorithms-neural network–based algorithms–rule-based algorithms–combining Techniques.

Unit:3	CLUSTERING AND ASSOCIATION	18 hours

Clustering: Introduction–Similarity and Distance Measures–Outliers–Hierarchical Algorithms -Partitioned Algorithms.

Association rules: Introduction - large item sets - basic algorithms – parallel & distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.

Unit:4	DATA WAREHOUSING AND MODELING	18 hours

Data warehousing: introduction- characteristics of a data warehouse–data marts–other aspects

Of data mart. Online analytical processing: introduction –OLTP & OLAP systems

Data modeling –star schema for multidimensional view –data modeling – multi factstar schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.

Unit:5	**APPLICATIONS OF DATA WAREHOUSE**	**16 hours**

Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse.

Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars

	Total Lecture hours	**90 hours**

Text Books

1	Margaret H.Dunham, "Data Mining: Introductory and Advanced Topics",Pearsoneducation,2003.
2	C.S.R. Prabhu, "Data Warehousing Concepts,Techniques, Productsand Applications", PHI, Second Edition.

Reference Books

1	ArunK.Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd., 2003.
2	Alex Berson, Stephen J.Smith, "Data Warehousing, Data Mining and OLAP ", TMCH, 2001.
3	Jiawei Han &MichelineKamber, "Data Mining Concepts &Techniques", 2001, Academic press.

Related Online Contents [MOOC , SWAYAM, NPTEL, Websitesetc.]

1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		DATA MINING LAB USING R	L	T	P	C
Core/Elective/Supportive		Core			6	4
Pre-requisite		Basics of DM Algorithms & R Programming				

Course Objectives:

The main objectives of this course are to:

1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression….
2. To understand & write programs using the DM algorithms
3. To apply statistical interpretations for the solutions
4. Able to use visualizations techniques for interpretations

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Able to write programs using R for Association rules, Clustering techniques	K1,K2
2	To implement data mining techniques like classification, prediction	K2,K3
3	Able to use different visualizations techniques using R	K4,K5
4	To apply different data mining algorithms to solve real world applications	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	90 hours

1. Implement A priori algorithm to extract association rule of data mining.
2. Implement k-means clustering technique.
3. Implement any one Hierarchal Clustering.
4. Implement Classification algorithm.
5. Implement Decision Tree.
6. Linear Regression.
7. Data Visualization.

Total Lecture hours	90 hours

Text Books

1	Margaret H.Dunham, "Data Mining: Introductory and Advanced Topics", Pearson education, 2003.
2	C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition

Reference Books

1	ArunK.Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd.,2003.
2	Alex Berson,StephenJ.Smith, " Data Warehousing, Data Mining and OLAP", TMCH, 2001.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.javatpoint.com/data-warehouse
2	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3	https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		**ADVANCED JAVA PROGRAMMING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	6			5
Pre-requisite		Basics of Java & its Usage				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the basic functions, principles and concepts of advanced java programming.
2. Provide knowledge on concepts needed for distributed Application Architecture.
3. Learn JDBC, Servlet packages, JQuery, Java Server Pages and JAR file format

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the advanced concepts of Java Programming	K1,K2
2	Understand JDBC and RMI concepts	K2,K3
3	Apply and analyze Java in Database	K3,K4
4	Handle different event in java using the delegation event model, event listener and class	K5
5	Design interactive applications using Java Servlet, JSP and JDBC	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	**BASICS OF JAVA**	**18 hours**

Java Basics Review: Components and event handling–Threading concepts–Networking features – Media techniques

Unit:2	**REMOTE METHOD INVOCATION**	**18 hours**

Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons-Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces

Unit:3	**DATABASE**	**18 hours**
Java in Databases-JDBC principles–database access-Interacting-database search–Creating multimedia databases – Database support in web applications		
Unit:4	**SERVLETS**	**18 hours**
Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet- Reading data from a client-Reading http request header-sending data to a client and writing the http response header-working with cookies Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions-Script lets-Directives-Declarations-A complete example		
Unit:5	**ADVANCEDTECHNIQUES**	**16 hours**
JAR file format creation–Internationalization–Swing Programming–Advanced java Techniques		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**90 hours**

Text Books	
1	Jamie Jaworski, "Java Unleashed", SAMS Techmedia Publications, 1999.
2	Campione, Walrath and Huml, "The Java Tutorial", Addison Wesley, 1999.
Reference Books	
1	Jim Keogh, "The Complete Reference J2EE", Tata McGraw Hill Publishing Company Ltd, 2010.
2	David Sawyer McFarland, "Java Script And J Query-The Missing Manual",Oreilly Publications, 3rd Edition,2011.
3	Deitel and Deitel, "Java How to Program", Third Edition, PHI / Pearson Education Asia.
Related Online Contents[MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.javatpoint.com/servlet-tutorial
2	https://www.tutorialspoint.com/java/index.htm
3	https://onlinecourses.nptel.ac.in/noc19_cs84/preview

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	M	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of AI & an Introduction about ML				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the basic functions of AI, Heuristic Search Techniques.
2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.
3. Introduce Machine Learning with respect Data Mining, Big Data and Cloud.
4. Study about Applications & Impact of ML.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate AI problems and techniques	K1,K2
2	Understand machine learning concepts	K2,K3
3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	K3,K4
4	Analyze the impact of machine learning on applications	K4,K5
5	Analyze and design are al world problem for implementation and understand the dynamic behavior of a system	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12 hours

Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.

Unit:2	SEARCH TECHNIQUES	12 hours

Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

Unit:3	PREDICATE LOGIC	12 hours

Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming -Forward Vs Backward reasoning -Matching-Control knowledge.

Unit:4	MACHINE LEARNING	12 hours
Understanding Machine Learning: What Is Machine Learning?- Defining Big Data-Big Data in Context with Machine Learning-The Importance of the Hybrid Cloud-Leveraging the Power of Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.		
Unit:5	**APPLICATIONS OF MACHINE LEARNING**	**10hours**
Looking Inside Machine Learning: The Impact of Machine Learning on Applications-Data Preparation-The Machine Learning Cycle.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

	Text Books
1	Elaine Richand Kevin Knight," Artificial Intelligence",Tata McGraw Hill Publishers company Pvt Ltd, Second Edition, 1991.
2	George FLuger, "Artificial Intelligence", 4th Edition, Pearson EducationPubl, 2002.
	Reference Books
1	Machine Learning For Dummies ®, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch.
	Related Online Contents[MOOC, SWAYAM, NPTEL,Websitesetc.]
1	https://www.ibm.com/downloads/cas/GB8ZMQZ3
2	https://www.javatpoint.com/artificial-intelligence-tutorial
3	https://nptel.ac.in/courses/106/105/106105077/

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite						

Course Objectives:

- To understand the theoretical foundations, algorithms and methodologies of Neural Network
- To design and develop an application using specific deeplearning models
- Toprovidepracticalknowledgeinhandlingandanalyzingrealworldapplications.
- To recognize the characteristics of deep learning models that are useful to solve real-world problems.
- To introduce Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1.	Understand different methodologies to create applications using deep nets.	K1,K2
2.	Identify and apply appropriate deep learning algorithms for analyzing the Data for a variety of problems.	K2,K3
3.	Implement different deep learning algorithms	K3,K4
4.	Design the test procedures to assess the efficacy of the developed model.	K4,K5
5.	Combine several models into gain better results	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	Basics of artificial neural networks(ANN)	12 hours

Basics of artificial neural networks(ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks Feedforwardneuralnetworks:Patternclassificationusingperceptron,Multilayerfeedforwardneural networks (MLFFNNs), Back propagation learning, Empirical risk minimization, Regularization, Auto encoders

Unit:2	Deep neural networks (DNNs)	12 hours

Deep neural networks (DNNs): Difficulty of training DNNs, Greedy layer wise training, Optimization for training DNNs, Newer optimization methods for neural networks (Ada Grad, RMS Prop, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization)

Unit:3	Convolution neural networks (CNNs)	12 hours

Convolution neural networks (CNNs): Introduction to CNNs – convolution, pooling,Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, training a CNNs: weights initialization, batch normalization, hyper parameter optimization, Understanding and visualizing CNNs.

Unit:4	Recurrent neural networks (RNNs)	12 hours
Recurrent neural networks (RNNs): Sequence modeling using RNNs, Backpropagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture-Generative models: Restricted Boltzmann Machines (RBMs), Stacking RBMs, Belief nets.		
Unit:5	**Auto Encoders and Decoders**	**10 hours**
Learning sigmoid belief nets, Deep belief nets Under complete - Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders. Applications: Applications in vision, speech and natural language processing		
	Total Lecture hours	**60 hours**

	Text Books
1	S. Haykin, Neural Networks and Learning Machines, Prentice Hall of India,201
2	Ian Goodfellow, Yoshua Bengio and Aaron Courville, " Deep Learning", MIT Press, 2017
	Reference Books
1	Francois Chollet "Deep Learning with Python", Manning Publications, 2017.
2	Satish Kumar, Neural Networks-A Class Room
3	B.Yegnanarayana, Artificial Neural Networks,Prentice-HallofIndia,1999
4	Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
5	Antonio Gulli,SujitPal"DeepLearningwithKeras",PacktPublishers,2017.
	Related Online Contents[MOOC, SWAYAM, NPTEL,Websitesetc.]
1	https://www.youtube.com/watch?v=aPfkYu_qiF4&list=PLEAYkSg4uSQ1r2XrJ_GBzzS6I-f8yfRU

Mapping with Programming Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	S	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	L	S	L	M	L	M	M	L

*S-Strong; M-Medium; L-Low

Course code		COMPUTER VISION	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite						

Course Objectives:

- Understanding the Basics of Computer Vision.
- Acquiring skills to develop computer vision-based applications. To introduce students the fundamentals of image formation
- To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition
- To develop an appreciation for various issues in the design of computer vision and object recognition systems
- To provide the student with programming experience from implementing computer vision and object recognition applications

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1.	Ability to understand the computer vision pipeline. Ability to build solutions Using computer vision algorithms.	K1,K2
2.	Identify basic concepts, terminology, theories, models and methods in the Field of computer vision	K2,K3
3.	Describe known principles of human visual system	K4
4.	Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, Motion and object recognition	K4,K5
5.	Suggest a design of a computer vision system for a specific problem	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1 **12 hours**

Cameras-Pinhole Cameras- Cameras with Lenses-The Human Eye-Sensing Geometric Camera Models-Elements of Analytical Euclidean Geometry-Camera Parameters & Perspective projection - Affine Cameras and Affine Projection equations

Unit:2 **12 hours**

.GeometricCameraCalibration-Leastsquaresparameterestimation-ALinear Approach to Camera Calibration - Taking Radial Distortion into Account - Analytical Photogrammetry - Radiometry - Light in Space - Light at Surfaces

Unit:3 **10hours**

Sources, Shadows and shading - Qualitative Radiometry - Sources and Their Effects - Local Shading Model - Color- The Physics of Color - Human Color Perception - Representing Color - Surface Color from Image Color

Unit:4		12 hours
Linear filters - Convolution - Shift Invariant Linear Systems - Spatial Frequency and Fourier Transforms- Sampling and Aliasing - Scale and Image Pyramids		
Unit:5		**12 hours**
Edge detection- Noise- Detecting Edges - Texture- Representing Texture- Analysis (and Synthesis) Using Oriented Pyramids - Synthesizing Textures for Rendering- Shape from Texture for Planes		
	Total Lecture hours	**60 hours**

Text Books	
1	D.Forsyth and J.Ponce; Computer Vision-Amodern approach;Pearson India;2015
ReferenceBooks	
1	Richard Szeliksy "Computer Vision: Algorithms and Applications" (http://szeliski.org/Book/)
2	Haralick &Shapiro,"Computer and Robot Vision",VolI
3	G_erardMedioni and Sing Bing Kang "Emerging topics in computer vision"
4	Emanuele Trucco and Allessandro Verri "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
5	Olivier Faugeras, "Three-Dimensional Computer Vision", The MITPress,1993
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.youtube.com/watch?v=3LaVxEX3F0o&list=PLwdnzlV3ogoVsma 5G mBSsgJM6gHv1QoAo

Mapping with Programme Outcomes:

CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	L	M	S	L	M	S	M	L	S	M
CO4	S	L	L	M	M	L	L	S	M	S
CO5	M	S	M	L	S	M	M	L	M	L

S-Strong M-Medium L-Low

Course code		ADVANCED OPERATING SYSTEMS	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of OS & its functioning				

Course Objectives:

The main objectives of this course are to:

1. Enable the students to learn the different types of operating systems and their functioning.
2. Gain knowledge on Distributed Operating Systems
3. Gain insight into the components and management aspects of real time and mobile operating systems.
4. Learn case studies in Linux Operating Systems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the design issues associated with operating systems	K1,K2
2	Master various process management concepts including scheduling, deadlocks and distributed file systems	K3,K4
3	Prepare Real Time Task Scheduling	K4,K5
4	Analyze Operating Systems for Hand held Systems	K5
5	Analyze Operating Systems like LINUX and iOS	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	BASICS OF OPERATING SYSTEMS	12 hours

Basics of Operating Systems: What is an Operating System? – Main frame Systems –Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery.

Unit:2	DISTRIBUTED OPERATING SYSTEMS	12 hours

Distributed Operating Systems: Issues – Communication Primitives – Lamport‟s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.

Unit:3	REAL TIME OPERATING SYSTEM	10hours

Real-time Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling

Unit:4	**HANDHELD SYSTEM**	**12 hours**
Operating Systems for Hand held Systems: Requirements–Technology Overview–Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android–		
Securing handheld systems		
Unit:5	**CASE STUDIES**	**12 hours**
Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars–webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Abraham Silberschatz; Peter Baer Galvin;Greg Gagne,“ Operating System Concepts”, Seventh Edition, John Wiley & Sons, 2004.
2	Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.
Reference Books	
1	RajibMall,“Real-Time Systems: Theory and Practice”, Pearson Education India,2006.
2	Pramod Chandra P.Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.
3	Daniel.P.Bovet& Marco Cesati, “Under standing the Linux kernel”,3rd edition,O“Reilly,2005
4	Neil Smyth,“iPhonei OS4 Development Essentials–Xcode”,Fourth Edition, Payload media, 2011.
Related Online Contents[MOOC, SWAYAM, NPTEL,Websitesetc.]	
1	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2	https://www.udacity.com/course/advanced-operating-systems--ud189
3	https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	M	S	S	S	S	S	M	S	M
CO3	S	M	S	S	S	S	S	M	S	M
CO4	S	M	S	S	S	S	S	M	S	M
CO5	S	M	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		HUMAN COMPUTER INTERACTION	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite						

Course Objectives:

To learn the foundations of Human Computer Interaction.
To become familiar with the design technologies for individuals and persons with disabilities.
To be aware of mobile HCI.
To learn the guide lines for user interface.
To encourage to design certain tools for blind or differently abled people

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1.	Design effective dialog for HCI	K1,K2
2.	Design effective HCI for individuals and persons with disabilities.	K2,K3
3.	Assess the importance of user feedback.	K4,K5
4.	Explain the HCI implications for designing multimedia/ecommerce/e-Learning Websites.	K5,K6
5.	Develop a meaningful user interface.	K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1		12 hours

FOUNDATIONSOFHCI TheHuman: I/Ochannels –Memory –Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity Paradigms. - Case Studies

Unit:2		12 hours

DESIGN & SOFTWARE PROCESS Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle–usabilityengineering –Prototypinginpractice–designrationale.Designrules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

Unit:3		12hours

MODELS AND THEORIES HCI Models: Cognitive models: Socio Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

Unit:4		12 hours

MOBILE HCI Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

Unit:5		**12 hours**
WEB INTERFACE DESIGN Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies		

	Total Lecture hours	**60 hours**

Text Books	
1	Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale; Human Computer Interaction; Pearson Education; 3rd Edition; 2004
2	BrianFling;MobileDesignandDevelopment;FirstEdition;O,,ReillyMediaInc.;2009
3	Bill Scottand Theresa Neil; Designing Web Interfaces; First Edition;O,,Reilly,2009.
Reference Books	
1	Designing the userinter face.3rd Edition Ben Shneidermann, Pearson Education Asia.
2	Interaction Design Prece, Rogers, Sharps.Wiley Dreamtech.
3	User Interface Design, Soren Lauesen, Pearson Education
4	Human–Computer Interaction, D.R. Olsen, Cengage Learning.
5	Human–Computer Interaction, Smith-Atakan, Cengage Learning.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.youtube.com/watch?v=q81KXc54Ozs&list=PLxtKZf9nLWO3d2a6M8l2BU8WTJKzHC4HJ

MappingwithProgrammeOutcomes:

CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	L	M	S	L	M	S	M	L	S	M
CO4	S	L	L	M	M	L	L	S	M	S
CO5	M	S	M	L	S	M	M	L	M	L

S-StrongM-MediumL-Low

Course code		EMBEDDED SYSTEMS	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of Micro Controller				

Course Objectives:

The main objectives of this course are to:

1. Present the introduction to 8051 Microcontroller Instruction Set, concepts on RTOS & Software tools.
2. Gain the knowledge about the embedded software development.
3. Learn about Microcontroller and software tools in the embedded systems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of 8051 microcontroller	K1,K2
2	Understand the Instruction Set and Programming	K2,K3
3	Analyze the concepts of RTOS	K3,K4
4	Analyze and design various real time embedded systems using RTOS	K5
5	Debug the malfunctioning system using various debugging techniques	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**– Create

Unit:1	8051 MICRO CONTROLLER	12 hours

8051 Microcontroller : Introduction-8051 Architecture-Input / Output Pins, Port s and Circuits-External Memory - Counters / Timers - Serial Data Input / Output –Interrupts

Unit:2	PROGRAMMING BASICS	12 hours

Instruction Set and Programming Moving Data-Addressing Modes-Logical operations-Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts.

Unit:3	CONCEPTS ON RTOS	12 hours

CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment.

Unit:4	DESIGN USING RTOS	10Hours

Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL &QNX.

Unit:5	SOFTWARE TOOLS	12 hours
SOFTWARE TOOLS : Embedded software Development Tools: Hostsand Target Machines- Linker/Locators for Embedded software-getting Embedded software into the Target systems. Debugging Techniques: Testing on your Host machine -Instruction set simulators- The assert macro- using laboratory tools.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	David E. Simon, " An Embedded Software primer" Pearson Education Asia, 2003.
2	Kenneth J Ayala, "The 8051 Microcontroller and Architecture programming and application", Second Edition, Penram International.
Reference Books	
1	Raj Kamal, " Embedded Systems –Architecture, programming and design", Tata McGraw–Hill, 2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://onlinecourses.nptel.ac.in/noc20_cs14/preview
2	https://www.javatpoint.com/embedded-system-tutorial
3	https://www.tutorialspoint.com/embedded_systems/index.htm

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	S	M	S	S	M	M	S
CO2	M	M	S	S	M	S	M	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		MULTIMEDIA AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Skill Enhacement	4			2
Pre-requisite		Basics of Multimedia				

Course Objectives:

The main objectives of this course are to:

1. To introduce the students the concepts of Multimedia, Images &Animation.
2. To introduce Multimedia authoring tools
3. To understand the role of Multimedia in Internet
4. To know about High Definition Television and Desktop Computing–Knowledge based Multimedia systems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concepts of Multimedia	K1,K2
2	Demonstrate Multimedia authoring tools	K2,K3
3	Analyze the concepts of Sound,Images,Video&Animation	K4
4	Apply and Analyze the role of Multimedia in Internet and real time applications	K4,K5
5	Analyze multimedia applications using HDTV	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12 hours

What is Multimedia?–Introduction to making Multimedia–Macintosh and Windows Production platforms – Basic Software tools.

Unit:2	MULTIMEDIA TOOLS	12 hours

Making Instant Multimedia–Multimedia authoring tools–Multimedia building blocks–Text– Sound.

Unit:3	ANIMATION	12 hours

Images–Animation–Video.

Unit:4	INTERNET	12 hours

Multimedia and the Internet–The Internet and how it works–Tools for World Wide Web–Designing for the World Wide Web.

Unit:5	MULTIMEDIA SYSTEMS	10 hours

High Definition Television and Desktop Computing –Knowledge based Multimedia systems.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Tay Vaughan, "Multimedia making it work", Fifth Edition, Tata McGraw Hill.
2	John F.Koegel Bufford, "Multimedia Systems", Pearson Education.
ReferenceBooks	
1	Judith Jeffloate, "Multimedia in Practice (Technology and Applications)",PHI,2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.tutorialspoint.com/multimedia/index.htm
2	https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm
3	https://nptel.ac.in/courses/117/105/117105083/

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	M	M	M	S
CO2	S	S	S	S	M	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

III SEMESTER

Course code		DIGITAL IMAGE PROCESSING	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basics of Image Processing				

Course Objectives:

The main objectives of this course are to:

1. Learn basic image processing techniques for solving real problems.
2. Gain knowledge in image transformation and Image enhancement techniques.
3. Learn Image compression and Segmentation procedures.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the fundamentals of Digital Image Processing	K1,K2
2	Understand the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement	K2,K3
3	Apply, Design and Implement and get solutions for digital image processing problems	K3,K4
4	Apply the concepts of filtering and segmentation for digital image retrieval	K4,K5
5	Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	18 hours

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.

Unit:2	IMAGE ENHANCEMENT	18 hours

Image Enhancement in the spatial domain:- Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.

Unit:3	IMAGE RESTORATION	18 hours

Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.

Unit:4	**IMAGE COMPRESSION**	**18 hours**
Image Compression: Fundamentals–Image compression models–Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards.		
Unit:5	**IMAGE SEGMENTATION**	**16 hours**
Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**90 hours**

Text Books	
1	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Second Edition, PHI / Pearson Education.
2	B.Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2003.
Reference Books	
1	Nick Efford, "Digital Image Processing a practical introducing using Java", Pearson Education, 2004.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	M	S	M	M	S
CO2	S	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		CLOUD COMPUTING	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basics of Cloud & its Applications				

Course Objectives:

The main objectives of this course are to:

1. Gain knowledge on cloud computing, cloud services, architectures and applications.
2. Enable the students to learn the basics of cloud computing with real time usage
3. How to store and share, in and from cloud?

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of Cloud and its services	K1,K2
2	Collaborate Cloud for Event & Project Management	K3,K4
3	Analyzeon cloud in –Word Processing, Spread Sheets, Mail, Calendar, Database	K4,K5
4	Analyze cloud in social networks	K5,K6
5	Explore cloud storage and sharing	K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	18 hours

INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

Unit:2	CLOUD COMPUTING	18 hours

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

Unit:3	CLOUD SERVICES	18 hours

USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

Unit:4	OUTSIDE THE CLOUD	18 hours

OUT SIDE THE CLOUD Evaluating webmail services, Evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating online

Groupware, collaborating viablogs and wikis.

Unit:5	**STORING AND SHARING**	**16 hours**
STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**90 hours**

Text Books

1	Michael Miller, "Cloud Computing", Pearson Education, New Delhi, 2009.

Reference Books

1	Anthony T. Velte, "Cloud Computing: A Practical Approach", 1st Edition, Tata McGraw Hill Education Private Limited, 2009.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]

1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	M	S	M	S	M	M	M	S
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		DIGITAL IMAGE PROCESSING USING PYTHON LAB	L	T	P	C
Core/Elective/Supportive		CORE			6	4
Pre-requisite		Basic Programming of Image Processing & an intro to Python				

Course Objectives:

The main objectives of this course are to:

1. To understand the basics of Digital Image Processing fundamentals, image enhancement and image restoration techniques
2. To enable the students to learn the fundamentals of image compression and segmentation
3. To understand Image Restoration & Filtering Techniques
4. Implementation of the above using Python

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To write programs in Python for image processing using the techniques	K1,K2
2	To able to implement Image Enhancements & Restoration techniques	K2,K3
3	Capable of using Compression techniques in an Image	K3,K4
4	Must be able to manipulate the image and Segment it	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

LISTOF PROGRAMS	90 hours

1. Implement Image enhancement Technique.
2. Histogram Equalization
3. Image Restoration.
4. Implement Image Filtering.
5. Edge detection using Operators (Roberts, Prewitts and Sobels operators)
6. Implement image compression.
7. Image Subtraction
8. Boundary Extraction using morphology.
9. Image Segmentation

Total Lecture hours	90 hours

Text Books	
1	Rafael C.Gonzalez, Richard E.Woods,"Digital Image Processing",Second Edition,
	PHI / Pearson Education.
2	B.Chanda, D. Dutta Majumder," Digital Image Processing and Analysis",PHI, 2003.
Reference Books	
1	Nick Efford,"Digital Image Processing a practical introducing using Java",Pearson Education, 2004.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://nptel.ac.in/courses/117/105/117105135/
2	https://www.tutorialspoint.com/dip/index.htm
3	https://www.javatpoint.com/digital-image-processing-tutorial

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		Network Security	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		-				

Course Objectives:

- Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography.
- To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory.
- To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
- To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the process of the cryptographic algorithms	K1,K2
2	Compare and apply different encryption and decryption techniques to solve Problems related to confidentiality and authentication	K2,K3
3	Apply and analyze appropriate security techniques to solve network security problem	K3,K4
4	Explore suitable cryptographic algorithms	K4,K5
5	Analyze different digital signature algorithms to achieve authentication and design secure applications	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1		**18 hours**

Introductionto Cryptography –Security Attacks – Security Services –Security Algorithm-Stream cipher and Block cipher – Symmetric and Asymmetric-key Cryptosystem SymmetricKeyAlgorithms:Introduction–DES–TripleDES–AES–IDEA–Blowfish– RC5.

Unit:2		**18 hours**

Public – key Cryptosystem: Introduction to Number Theory – RSA Algorithm– Key Management- Diffie–Hellman Key exchange– Elliptic Curve Cryptography Message Authentication and Hash functions–HashandMac Algorithm – Digital Signatures and Authentication Protocol.

Unit:3		**18 hours**

Network Security Practice: Authentication Applications–Kerberos–X.509Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME –IP Security.

Unit:4		18 hours
WebSecurity–SecureSocketLayer–SecureElectronicTransaction.SystemSecurity -IntrudersandViruses–Firewalls–PasswordSecurity.		
Unit:5		**18 hours**
Case Study: Implementation of Cryptographic Algorithms–RSA–DSA–ECC (C/JAVA Programming).Network Forensic – Security Audit – Other Security Mechanism: Introduction to: Stenography –Quantum Cryptography – Water Marking – DNA Cryptography		
	Total Lecture hours	**90 hours**

	Text Books
1	WilliamStallings,"CryptographyandNetworkSecurity",PHI/PearsonEducation.
2	BruceSchneir,"AppliedCryptography",CRCPress.
	Reference Books
1	Amenezes,PvanOorschotandS.Vanstone,"HandBookofAppliedCryptography", CRC Press, 1997
2	AnkitFadia,"NetworkSecurity",MacMillan.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]
1	https://nptel.ac.in/courses/106/105/106105031/
2	http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3	https://www.tutorialspoint.com/cryptography/index.htm

Mapping with Programming Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	S	M	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong;M-Medium;L-Low

Course code		MOBILE COMPUTING	L	T	P	C
Core/Elective/Supportive		Elective	3			3
Pre-requisite		Basics of Mobile Communication				

Course Objectives:

The main objectives of this course are to:

1. Present the overview of Mobile computing, Applications and Architectures.
2. Describe the futuristic computing challenges.
3. Enable the students to learn the concept of mobile computing.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the need and requirements of mobile communication	K1,K2
2	Focus on mobile computing applications and techniques	K2,K3
3	Demonstrate satellite communication in mobile computing	K4
4	Analyze a bout wireless local loop architecture	K5,K6
5	Analyze various mobile communication technologies	K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12 hours

Introduction: Advantages of Digital Information - Introduction to Telephone Systems –Mobile communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication.

Unit:2	MOBILE COMMUNICATION	12 hours

Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems.

Unit:3	MOBILE COMPUTING	12 hours
Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication – Interferences in Cellular Mobile Communication.		
Unit:4	**MOBILE COMMUNICATION SYSTEM**	**12hours**
Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol.		
Unit:5	**COMMUNICATION TECHNOLOGY**	**10 hours**
WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars–webinars		
	Total Lecture hours	**60 hours**

	Text Books
1	T.G.Palanivelu, R.Nakkeeran,"Wireless and Mobile Communication",PHI Limited, 2009.
2	Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2007.
	Reference Books
1	Asoke K Talukder, Hasan Ahmed, RoopaYavagal,"Mobile Computing", TMH, 2010.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]
1	https://www.tutorialspoint.com/mobile_computing/index.htm
2	https://www.javatpoint.com/mobile-computing
3	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	M	L	L	M	S	M	M	M	M
CO2	S	S	S	M	M	S	M	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		IOT AND ITS APPLICATIONS	L	T	P	C
Core/Elective/Supportive		Elective	3			3
Pre-requisite		Basics of Sensors & its Applications				

Course Objectives:

The main objectives of this course are to:

1. About Internet of Things where various communicating entities are controlled and managed for decision making in the application domain.
2. Enable students to learn the Architecture of IoT and IoT Technologies
3. Developing IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand about IoT, its Architecture and its Applications	K1,K2
2	Understand basic electronics used in IoT& its role	K2,K3
3	Develop applications with Cusing Arduino IDE	K4
4	Analyze about sensors and actuators	K5,K6
5	Design IoT in real time applications using today‟s internet & wireless technologies	K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	9 hours

Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT

Unit:2	BASIC ELECTRONICS FOR IoT	9 hours

Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.

Unit:3	PROGRAMMING USING ARDUINO	9 hours

Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.

Unit:4	SENSORS AND ACTUATORS	9 hours

Sensor sand Actuators: Analog and Digital Sensors–Interfacing temperature sensor, ultrasound

Sensor and infrared (IR) sensor with Arduino– Interfacing LED and Buzzer with Arduino.

Unit:5	**SENSOR DATA IN INTERNET**	**7 hours**
Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU Wi-Fi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (Thing Speak).		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45 hours**

Text Books	
1	Arshdeep Bahga,Vijay Madisetti, "Internet of Things :A Hands-On Approach",2014. ISBN: 978-0996025515
2	Boris Adryan, Dominik Obermaier, Paul Fremantle, "The Technical Foundations of IoT", Artech Houser Publishers, 2017.
ReferenceBooks	
1	Michael Margolis,"Arduino Cook book",O"Reilly,2011
2	Marco Schwartz, "Internet of Things with ESP8266", Packt Publishing, 2016.
3	DhivyaBala, " ESP 8266 : Step by Step Tutorial for ESP 8266 IoT, Arduino NO DEMCU Dev. Kit", 2018.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2	https://www.javatpoint.com/iot-internet-of-things
3	https://www.tutorialspoint.com/internet_of_things/index.htm

Mapping with Programming Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	M	M	S	M
CO2	M	S	M	S	M	S	M	S	S	S
CO3	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Distributed Database Systems	L	T	P	C
Core/Elective/Supportive		Elective	3			3
Pre-requisite						

Course Objectives:

To introduction students to Distributed DBMS and associated problems.
To make students understand various algorithms and techniques for managing distributed database.
To understand theoretical and practical aspects of distributed database systems.
To study and identify various issues related to the development of distributed database system.
To make students understand Transaction Management & Compare various approaches to concurrency control in Distributed database

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Apply various fragmentation techniques given a problem	K1
2	Analyse and calculate the cos to fen forcing semantic integrity control	K2,K3
3	Use the steps of query processing	K4
4	Apply optimization techniques are applies to Distributed Database	K4,K5
5	Apply effectively Query Optimization Algorithms	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1 **9 hours**

Introduction: Distributed Data Processing, Distributed Database Systems, Promises of DDBSs, Complicating factors, Problem areas Overview of RDBMS: Concepts, Integrity, Normalization - Distributed DBMS Architecture: Autonomy, Distribution, Heterogeneity DDBMS Architecture – Client/Server, Peer to peer, MDBS

Unit:2 **9 hours**

Data Distribution Alternatives: Design Alternatives – localized data, distributed data Fragmentation–Vertical,Horizontal(primary&derived),hybrid,generalguidelines, correctness rules Distribution transparency – location, fragmentation, replication Impact of distribution on user queries – No Global Data Dictionary (GDD), GDD containing location information Example on Fragmentation

Unit:3 **9 hours**

Semantic Data Control: View Management, Authentication – database authentication, OS authentication, Access Rights, Semantic Integrity Control –Centralized &Distributed, Cost ofenforcingsemanticintegrity-:QueryProcessing:QueryProcessingProblem,Layersof Query Processing Query Processing in Centralized Systems – Parsing & Translation, Optimization, Code generation, Example Query Processing in Distributed Systems – Mapping global query to local, Optimization,

Unit:4		9 hours
Optimization of Distributed Queries: Query Optimization, Centralized Query Optimization, Join Ordering Distributed Query Optimization Algorithms – Distributed Transaction Management & Concurrency Control: Transaction concept, ACID property, Objectives of transaction management, Types of transactions, Objectives of Distributed Concurrency Control, Concurrency Control anomalies, Methods of concurrency control, Serializability and recoverability, Distributed Serializability, Enhanced lockbased and timestamp based protocols, Multiple granularity, Multi version schemes, Optimistic Concurrency Control techniques		
Unit:5		**9 hours**
Distributed Deadlock & Recovery: Deadlock concept, Deadlock in Centralized systems, Deadlock in Distributed Systems – Detection, Prevention, Avoidance, Wait-Die Algorithm, Wound-Wait algorithm Recovery in DBMS - Types of Failure, Methods to control failure, Different techniques of recoverability, Write- Ahead logging Protocol, Advanced recovery techniques- ShadowPaging, Fuzzy checkpoint, ARIES, RAIDlevels, TwoPhaseand Three Phase commit protocols		
	Total Lecture hours	**45 hours**

Text Books	
1	Ozsu;PrinciplesofDistributedDatabaseSystems;Springer;4thedition;2020
Reference Books	
1	Rahimi & Haug; Distributed Database Management Systems;Wiley;2010
2	Distributed Database Systems, Chanda Ray, Pearson Publication
3	SachinDeshpande;DistributedDatabases;Dreamtech;2014
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.youtube.com/watch?v=dlBVWMdGhqw&list=PLUJ7JmcrTifBROW

MappingwithProgrammeOutcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	S	M	L	M	L	S
CO2	S	M	S	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	S	L

S-StrongM-MediumL-Low

Course code		PRACTICAL VI:CLOUD COMPUTING LAB	L	T	P	C
Core/Elective/Supportive		Skill Enhancement			3	2
Pre-requisite		Basic Programming using Cloud				

Course Objectives:

The main objectives of this course are to:

1. This course covers the basic data structures like Stack, Queue, Tree, and List.
2. This course enables the students to learn the applications of the data structures using various techniques
3. It also enable the students to understand C++ language with respect to OOAD concepts
4. Application of OOPS concepts

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of object oriented with respect to C++	K1,K2
2	Able to understand and implement OOPS concepts	K3,K4
3	Implementation of data structures like Stack, Queue, Tree, List using C++	K4,K5
4	Application of the data structures for Sorting, Searching using different techniques.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

LIST OF PROGRAMS	45 hours

1. Working with Google Drive to make spreadsheet and notes.
2. Launch a Linux Virtual Machine.
3. To host a static website
4. Exploring Google cloud for the following a)Storage b)Sharing of data c)manage your calendar, to-do lists, d) a document editing tool
5. Working and installation of Google App Engine
6. Working and installation of Microsoft Azure
7. To Connect Amazon Red shift with S3 bucket
8. To Create and Query a No SQL Table

Expert lectures, online seminars–webinars

Total Lecture hours	45 hours

Text Books	
1	Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.
Reference Books	
1	Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGraw Hill Education Private Limited, 2009.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Semester -IV

Course code		PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/Supportive		Core			6	5
Pre-requisite		Basics of any OO Programming Language				

Course Objectives:

The main objectives of this course are to:

1. This course presents an overview of elementary data items, lists, dictionaries, sets and tuples
2. To understand and write simple Python programs
3. To Understand the OOPS concepts of Python
4. To develop web applications using Python

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Able to write programs in Python using OOPS concepts	K1,K2
2	To understand the concepts of File operations and Modules in Python	K2,K3
3	Implementation of lists, dictionaries, sets and tuples as programs	K3,K4
4	To develop web applications using Python	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

LISTOF PROGRAMS	90 hours

Implement the following in Python:

1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive web pages using forms.

Total Lecture hours	90 hours

Text Books	
1	BillLubanovic, “Introducing Python”, O‟Reilly, First Edition-Second Release, 2014.
2	MarkLutz, “Learning Python”, O‟Reilly, Fifth Edition, 2013.
Reference Books	
1	David M. Beazley, “Python Essential Reference”, Developer‟s Library, Fourth Edition, 2009.
2	SheetalTaneja, Naveen Kumar, ”Python Programming-A Modular Approach”,Pearson Publications.
Related Online Contents[MOOC, SWAYAM, NPTEL,Websitesetc.]	
1	https://www.programiz.com/python-programming/
2	https://www.tutorialspoint.com/python/index.htm
3	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview

Mapping with Programming Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		WEB APPLICATION DEVELOPMENT USING PHP	L	T	P	C
Core/Elective/Supportive		Core	6			5
Pre-requisite		Basic Programming using HTML tags				

Course Objectives:

The main objectives of this course are to:

1. Apply the procedures and processes necessary for the construction of high-quality web applications
2. Compare and contrast a variety of front end and back end web application frameworks
3. Evaluate the contribution of underpinning web technologies to the process of web application development

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Develop program using control statements in PHP	K1,K2
2	To create interactive applications using PHP	K2,K3
3	Create simple web applications in one tier, two tier and three tier architectures	K4,K5
4	Able to write dynamic web applications in PHP & HTML tags using XAMPP.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	Introduction to PHP	18 hours

PHP features. - XAMPP & WAMP. - Installation of XAMPP. - Basic PHP Syntax. - Output Statements – print, echo. - Adding comments in PHP

Unit:2	Control Statements and Functions in PHP	18 hours

Declaring Variables. - Operators in PHP – If Statement - Switch Statement - For, Foreach, While, do while Statements -User defined functions. - Function with Default Arguments. - Passing Argument by Reference, Value. - Variable Scope. - Built In functions

Unit:3	Strings, Arrays and Object Oriented Programming in PHP	18 hours

Strings in PHP - String functions in PHP Types of arrays in PHP. - Creation of arrays. - Array functions. Classes and objects. - Constructor & Destructor. - Inheritance. - Polymorphism. - Abstract Class. - Interface.

Unit:4	PHP Form Handling and Sessions	18 hours

Input Form Creation. - GET and POST Methods. - include() and require() - Starting a PHP Session. - Storing and Accessing Session Data. - Destroying Session Data.

Unit:5	Database Programming PHP & MySQL	16 hours

Database creation. - CREATE, ALTER, DELETE, DROP tables. - INSERT, UPDATE, DELETE table data. - WHERE clause - AND, OR, IN, LIKE, DISTINCT, ORDER BY, GROUP BY - One-tier architecture - Two-tier architecture - Three-tier architecture - Using AJAX and JQuery in PHP.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**90 hours**

Text Books	
1	Ivan Bay ross,"Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP", BPB Publications, 4th Revised Edition, 2010.
2	PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide by Ullman
ReferenceBooks	
1	Web Development using PHP, Rajinder Kumar
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.tutorialspoint.com/xml/index.htm
2	https://www.tutorialspoint.com/internet_technologies/websites_development.htm
3	https://www.youtube.com/watch?v=PlxWf493en4

Mapping with Programming Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		ROBOTIC PROCESS AUTOMATION FOR BUSINESS	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of Robots & its Applications				

Course Objectives:

The main objectives of this course are to:

1. Learn the concepts of RPA, its benefits, types and models.
2. Gain the knowledge in application of RPA in Business Scenarios.
3. Identify measures and skills required for RPA

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the benefits and ethics of RPA	K1,K2
2	Understand the Automation cycle and its techniques	K2
3	Draw inferences and information processing of RPA	K3,K4
4	Implement & Apply RPA in Business Scenarios	K5
5	Analyze on Robots & leverage in automation	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12 hours

Introduction to RPA –Overview of RPA –Benefits of RPA in a business environment -Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA –Centre of Excellence –Types and their applications –Building an RPA team -Approach for implementing RPA initiatives.

Unit:2	AUTOMATION	12 hours

Role of a Business Manager in Automation initiatives-Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.

Unit:3	AUTOMATION IMPLEMENTATION	12 hours

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.

Unit:4	ROBOT	12 hours

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

Unit:5	**ROBOT SKILL**	**10 hours**
Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books

1	Alok Mani Tripathi ” Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool” Packt Publishing Limited March 2018.
2	Tom Taulli“ The Robotic Process Automation Handbook”A press, February 2020.

ReferenceBooks

1	Steve Kaelble ”Robotic Process Automation” John Wiley &Sons,Ltd., 2018

Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]

1	https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2	https://www.javatpoint.com/rpa
3	https://onlinecourses.nptel.ac.in/noc19_me74/preview

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		DATA SCIENCE AND ANALYTICS	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		Basics of Data Science & its Applications				

Course Objectives:

The main objectives of this course are to:

1. Introduce the students to data science, big data & its eco system.
2. Learn data analytics &its life cycle.
3. To explore the programming language R, with respect to the data mining algorithms.
4. Relate the relationship between artificial intelligence, machine learning and data science.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concept of data science and its techniques	K1,K2
2	Review data analytics	K2,K3
3	Apply and determine appropriate Data Mining techniques using R to real time applications	K3,K4
4	Analyze on clustering algorithms	K4,K5
5	Analyze on regression methods in AI	K6

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5** -Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12 hours

Introduction of Data Science: data science and big data–facets of data-data science process-Ecosystem- The Data Science process – six steps- Machine Learning.

Unit:2	BASICS OF DATA ANALYTICS	12 hours

Data Analytics life cycle-review of data analytics-Advanced data Analytics-technology and tools.

Unit:3	DATA ANALYTICS USING R	12 hours

Basic Data Analytics using R : R Graphical User Interfaces – Data Import and Export – Attribute and Data Types –Descriptive Statistics – Exploratory Data Analysis –Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables – Data Exploration Versus Presentation.

Unit:4	CLUSTERING	12 hours

Overview of Clustering : K-means – Use Cases – Overview of the Method – Perform a K-means Analysis using R –Classification – Decision Trees – Overview of a Decision Tree – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Tree in R – Bayes‟ Theorem – Naïve Bayes Classifier – Smoothing – Naïve Bayes in R.

Unit:5	**ARTIFICIAL INTELLIGENCE**	**10 hours**
Artificial intelligence: Machine Learning and deep learning in data science-Clustering, association rules. Linear regression-logistic regression-Additional regression methods.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools-2016. Pdf
2	Data science in big data analytics-Wiley 2015 John Wiley &Sons
Reference Books	
1	A simple introduction to Data Science – Lars Nielson 2015
2	Introducing Data Science Davy Cielen, Arno D.B.Meysman, Mohamed Ali 2016 Manning Publication
3	R Programming for Data Science-Roger D.Peng 2015 Lean Publication
4	Data Science & Big Data Analytics : Discovering, Analyzing,Visualizing and Presenting Data
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.tutorialspoint.com/python_data_science/index.htm
2	https://www.javatpoint.com/data-science
3	https://nptel.ac.in/courses/106/106/106106179/

Mapping with Programming Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		Parallel and Distributed Computing	L	T	P	C
Core/Elective/Supportive		Elective	4			3
Pre-requisite		-				

Course Objectives:

To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.
To learn and apply knowledge of parallel and distributed computing techniques and methodologies
To learn the architecture and parallel programming in graphics processing units (GPUs).
To understand the memory hierarchy and cost-performance tradeoffs.
To gain experience in the design, development, and performance analysis of parallel and distributed applications

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Develop and apply knowledge of parallel and distributed computing Techniques and methodologies.	K1,K2
2	Apply design, development, and performance analysis of parallel and Distributed applications.	K2,K3
3	Use the application off undamental Computer Science methods and algorithms in the development of parallel applications.	K4,K5
4	Explain the design, testing, and performance analysis of a software system, And to be able to communicate that design to others.	K5
5	Understand the requirements for programming parallel systems and how they can be used to facilitate the programming of concurrent systems.	K5,K6

K1-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1		12 hours

Introduction to Parallel Computing: The Idea of Parallelism, Power and potential of parallelism, examining sequential and parallel programs, Scope and issues of parallel and distributed computing, Goals of parallelism, Parallelism and concurrency using multiple instruction streams.

Unit:2		12 hours

Parallel Architecture: Pipeline architecture, Array processor, Multi-processor architecture, Systolic architecture, Dataflow architecture, Architectural classification schemes, Memory access classification, Memory Issues: Sharedvs. distributed, Symmetric multiprocessing (SMP), SIMD, Vector processing, GPU co-processing, Flynn‟s Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).

Unit:3		12 hours
Parallel Algorithm Design Principles and Programming: Need for communication and coordination/synchronization, Scheduling and contention, Independence and partitioning, Task-BasedDecomposition,DataParallelDecomposition,Characteristicsoftaskandinteraction, Load balancing, Data Management, parallel algorithm models, Sources of overhead in parallel programs, Performance metrics for parallel algorithm implementations, Parallel algorithmic patterns like divide and conquer, Map and Reduce, Specific algorithms like parallel Merge Sort, Parallel graph Algorithms.		
Unit:4		**12 hours**
Architectures Of Distributed Systems - Architectural Styles – System Architectures - Architectures Versus Middleware - Self-Management In Distributed Systems - Processes -Threads - Virtualization - Clients -Servers - Communication -Remote Procedure Call - Message- Oriented Communication - Stream-Oriented Communication - Multicast Communication		
Unit:5		**12 hours**
Distributed Object Based Systems - Architecture - Processes - Communication -Naming - Synchronization - Fault Tolerance - Security - Distributed System Examples - File Systems And Web Based Systems		
	Total Lecture hours	**60 hours**

Text Books	
1	Ananth Grama, Anshul Gupta, and George Karypis, Vipin Kumar; Introduction to Parallel Computing; Addition Wesley; 2nd Edition;2003
2	A.S. Tanenbaum; Distributed Operating Systems; Create Space Independent Publishing Platform; 3rd edition;2017
Reference Books	
1	Introduction To Parallel Programming, Steven Brawer, Academic Press
2	Introduction To Parallel Processing, M. Sasikumar, Dinesh Shikhare and P. Ravi Prakash,PHI
3	RandyChow,T.Johnson,DistributedOperatingSystemsandAlgorithms,Addison Wesley
4	Ian Foster: Designing and Building Parallel Programs–Concepts and tools forParallel Software Engineering, Pearson Publisher, 1st Edition, 2019.
5	Parallel Programming in C with MPI and Open MP Michael J.Quinn, McGraw Hill Higher Education
Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]	
1	https://www.youtube.com/watch?v=qbQCQ0U6H0o&list=PLbMVogVj5nJQRvzENlvMKA9q70ScSRZBQ

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	S	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	M	L

S-Strong M-Medium L-Low

9. Teaching – Learning Process:

The Teaching-Learning process for the B.Sc. Computer Science programme has been in alignment with the course objectives and outcomes put forth for the programme. It has been ensured that the process is in compliance with the Programme Specific Outcomes and Course Outcomes envisaged for the programme. To enable effective and efficient teaching process various teaching aids have been used including online classes through Google Meet. To facilitate better learning process for the students the Institution has offered online repository such as Google Classroom for online sharing of reading resources and contents to the students.

To meet the set objectives of the course and enable students achieve the expected outcomes of the course the following teaching processes are utilized:

Class Room Teaching:

Time tested regular Class room teaching and face-to-face teaching using chalk and talk method is used to imbibe the theoretical foundations to the students. Using Live Classroom teaching provides teachers with a handle to monitor the mindset of the students and grasp of the teaching. LCD/Projectors can be used in classroom for providing simulated/animated explanations of the concepts of the curriculum.

Laboratory Teaching:

Laboratory Teaching provides hands-on practical sessions for the students to have deep understanding of the theoretical concepts that they learn in classrooms. Laboratory is furnished with state-of-the-art technologies and higher-end software to help students to solve the problems practically.

Forums:

Student forum in the name of ITALERT Forum is organized every week where Industry experts are invited to provide Guest Lectures for the students to learn the latest trends and technologies prevalent in the industry. Forums are also used for peer-to-peer learning as students take seminars, involve themselves in group discussions on technical topics.

MOOCS:

Students are advised to take up MOOC course such as NPTEL and other industry endorsed online courses to provide blended learning to cater to the needs of the ever-evolving field of Computer Science.

Project:

Students are subjected to carryout Project-based assignments for every core subject. Students are a given a real-time problem. They are to apply the theoretical concepts to the problems, analyse the technical details of the problem, evaluate the possible solutions to the problem and have to propose a computational solution for the given problem.

Final year students in their final semester are mandated to complete a real-time mini-project for the successful completion of the degree.

Assignments:

Home assignments are regularly given to students that comprises of

6 Data collection from real-world to prepare themselves to gain insights to the data by comparing the data from various sources and preparing a report for the collected data.

7 Solve theoretical problems using practical approaches to provide exposure to real-world problems and industry practices.

10. Assessment Methods:

Assessment methods play a pivotal role in evaluation of student's progress. More importantly the Assessments methods employed are structured in such a way that students can themselves introspect as to what is expected of them by the Institution and by the Industry. Assessment methods provide students with window to know where they lack as a learner and more importantly how to improve upon themselves from the inputs of the curriculum. In bachelors programme of Computer Science, the assessment and evaluation method focus on testing the intuitive understanding of the fundamental concepts of software and hardware along with programming skills in various languages and more importantly the ability to apply the knowledge to real-life applications. The assessment methods try to validate and enhance the well-rounded

skillsets of the students such as employable skills, entrepreneurship skills, research-relevance skills and programming-conscious skills.

10.1 Continuous Assessment:

The Continuous assessment occurs on a regular and continuous basis, it is an ongoing formative and summative process, involving the monitoring of students. This assessment is inherently integrated with teaching and involves of series of process like systematic collection of marks or grades that gradually flow into the final score. The assessment marks or grades collected through various stages of the semester eventually contribute to the final grade of the students.

The continuous Assessment process tests the students on various grounds and aspects such as:

- Continuous Internal Assessment – I
- Continuous Internal Assessment – II
- Continuous Internal Assessment – III
- Attendance
- Class Participation or seminars
- Assignments

The student is subjected to three internal assessment written exams in a semester. The student's regular class attendance proves to be an important factor in the evaluation of the student's credentials. The assessment also takes cognizance of the student's active participation in the class room discussions in the form of seminars and group discussions. The prompt submission of home assignments is monitored for assessing the student's final evaluation of their credentials. The overall marks secured in the Continuous Assessment Process contributes for 25% of the total marks secured in the end-semester examinations.

11. Keywords:

Learning Outcome, Graduate Descriptor, Qualification Descriptor, Skill Enhancement, Core Compulsory Courses, Discipline Specific Elective, Continuous Assessment, Assessment methods, CO, PSO, Teaching-Learning process