R.V.R. & J.C. COLLEGE OF ENGINEERING

(Autonomous)

Regulations (R-21)

Scheme of Instruction, Examinations and Syllabi

for

Two–year M.Tech. Degree Programme

(w.e.f. 2021-2022)

Computer Science &Engineering

R.V.R. & J.C.COLLEGE OF ENGINEERING

Accredited by NBA and NAAC with "A" Grade
Chowdavaram, Guntur- 522019

R.V.R. & J.C. COLLEGE OF ENGINEERING :: GUNTUR
(Autonomous)

CHOICE BASED CREDIT SYSTEM REGULATIONS (R-21) for

2-YEAR MASTER OF TECHNOLOGY (M.Tech.) Degree Program

(w.e.f. the batch of students admitted into First Year M.Tech. from the academic year 2021-22)

1 MINIMUM QUALIFICATIONS FOR ADMISSION

The eligibility criteria for admission into M.Tech. Programme is as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE), Amaravati.

1.1 **Category – A Seats:** The seats under this category shall be filled by the Convener, PGCET Admissions.

1.2 **Category – B Seats:** The seats under this category shall be filled by the College as per the guidelines of APSCHE.

2 COURSES OF STUDY

M.Tech. Courses are offered in the following branches of study:

Branch of Engineering	Specialization Offered
Civil Engineering	Structural Engineering
Computer Science & Engineering	Computer Science and Engineering.
Electrical & Electronics Engineering	Power Systems Engineering.
Electronics & Communication Engineering	Communication Engineering & Signal Processing
Information Technology	Computer Science & Technology
Mechanical Engineering	Machine Design

3 DURATION OF THE COURSE AND MEDIUM OF INSTRUCTION

3.1 The duration of the course is two academic years consisting of two semesters in each academic year.

3.2 The medium of instruction and examination is English.

4 MINIMUM INSTRUCTION DAYS

Each semester shall consist of a minimum number of 90 days of instruction excluding the days allotted for tests, examinations and preparation holidays.

5 REGISTERING THE COURSES OFFERED

5.1 A candidate has to register and secure 68 credits out of which 30 credits from laboratory courses including project work.

5.2 The structure of the M.Tech. Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects + 4 Labs (or) 3 Labs + 1 Seminar (or) 2 Labs + 2 Seminars, followed by two semesters of Dissertation.

5.3 A candidate has to register and secure at least minimum pass grade in Research Methodology & IPR Course in I Year II Semester, for which no credit is awarded.

5.4 MOOCS (Massive Open Online Courses) Requirements.

- Enrolment of MOOCS Course will be initiated from the date of commencement of class work for I Year I Semester.
- MOOCS course completion certificate of duration not less than 8 weeks, must be submitted on or before the last instruction day of II Year I Semester, for which 2 Credits will be awarded. The Grade is awarded based on the marks obtained in the MOOCS performance.
- List of organizations offering MOOCS course(s) will be announced by the respective Board of Studies at the time of commencement of class work for I Year I Semester.

5.5 Internship / Industrial Training / Professional Certification:

- Internship / Industrial Training / Professional Certification should be taken up during the summer holidays for a period of 4-8 weeks.
- Internship / Industrial Training / Professional Certification completion certificate must be sub- mitted along with a report and presentation during the II Year I Semester Internal evaluation.

5.6 Dissertation shall be carried out under the Supervision of a Faculty Member in the concerned department.

- A student may, however, in certain cases, be permitted to work on his/her dissertation at the place of employment, any recognized Institution / R&D Organization / Industry with the approval of the Head of the Department concerned and Head of the Organization / Industry. In such cases, the dissertation shall be jointly supervised by a member of the faculty and a person from the Organization / Industry.
- The student is eligible for submission of M.Tech., dissertation report at the end of the II Year II Semester if he/she passed all the credit courses in the previous semesters.
- In a special case, if any student unable to submit his/her dissertation report at the end of II Year II Semester due to any other reason permitted by the head of the institution, he/she will be allowed to submit at a later date and the viva-voce examination will be conducted separately.

5.7 The student has to publish (or) get acknowledgement for acceptance of publication in at least one paper in a Conference / peer reviewed Journal related to his / her work to get eligibility to submit the Dissertation.

6 EVALUATION

6.1 The performance of the student in each semester is evaluated subject wise. In each Semester, there shall be two Internal Examinations consists of a Sessional Test for 30 Marks and an Assignment for 10 Marks. The semester end examination is conducted for 60 marks. The Internal Evaluation for Theory subjects is based on the 80% (24 out of

30 marks) weightage given to the best of the performances and the remaining 20% (6 out of 30 marks) for the least performance, in the two midterm examinations one held in the middle of the semester and the other held immediately after the completion of the instruction. The internal evaluation for practical subjects is based on the day to day performance and semester end internal practical Examination.

6.2 The marks for Seminar will be awarded by internal evaluation by a panel of the department.

6.3 For taking the Semester end examination in any theory or practical subject, students shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he / she is required to repeat the subject when next offered.

6.4 For each theory subject, there is a comprehensive Semester End Examination at the end of each Semester. In addition to the regular semester end examinations held at the end of each semester, supplementary examinations will also be conducted during the academic year. Such candidates taking the Regular/ Supplementary examinations as supplementary candidates may have to take more than one examination per day.

6.5 For each Practical course the Semester End Examination is conducted by one internal and one external examiner appointed by the Principal of the College. The duration of the examination is specified in the detailed Schemes of Instruction & Examination.

6.6 Examination in Dissertation (Phase-II) is conducted by one internal examiner and one external examiner appointed by the Principal.

6.7 The performance of the students in each semester is evaluated subject wise. The distribution of marks between internal assessment and Semester End Examination is as follows:

Nature of the subject	Sessional Marks	Semester End Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Mini Project / Professional Certification / Dissertation (Phase-I)	100	–
Dissertation (Phase-II)	40	60

7 LABORATORY / PRACTICAL COURSES

In any semester, a minimum of 10 experiments / exercises specified in the syllabus for laboratory course shall be completed by the student and get the record certified by the concerned Head of the Department, to be eligible to appear for the Semester End Examination in that Practical course.

8 ATTENDANCE

8.1 The student shall put up a minimum of 75% attendance in each subject.

8.2 Condonation for shortage in attendance up to 10% in any subject may be condoned by the Principal of the College for reasons of ill health and the application is submitted through proper channel at the time of actual illness and is supported by a certificate from the authorized Medical Officer approved by the Principal.

8.3 If the student does not satisfy the attendance requirement in any subject, he or she shall not be permitted to appear for the Semester End examination in that subject and has to repeat that subject when next offered.

9 CONDITION(S) FOR PROMOTION

A student is eligible for promotion to next semester, if he / she satisfies the minimum requirements of attendance and sessional marks in 50% of the Theory Subjects, as stipulated in **Clauses 6 and 8**.

10 CONDITIONS FOR PASS

A student is declared to have passed in individual subject if he / she secures a minimum of 40% marks in theory and 50% marks in Laboratory / Project Work in Semester End Examination and a minimum of 50% marks in both Sessional & Semester End Examination put together.

11 AWARD OF CREDITS

Credits are awarded for each Theory / Practical / Internship / Professional Certification / Seminar / Dissertation / MOOCS. Each theory subject is awarded 3 credits and each practical / Internship / Professional Certification Seminar / MOOCS subjects are awarded 2 credits. Dissertation (Phase-I) in II Year I Semester is awarded 6 credits and Dissertation (Phase-II) at the end of II Year II Semester is awarded 14 credits.

11.1 AWARD OF GRADES

S.No.	Range of marks	Grade	Grade Points
1.	≥90%	A+	10.0
2.	>80% - <90%	A	9.0
3.	>70% - <80%	B+	8.0
4.	>60% - <70%	B	7.0
5.	>55% - <60%	C	6.0
6.	>50% - <55%	D	5.0
7.	≤49%	F	0.0
8.	The grade 'W' represents withdrawal /absent (subsequently changed into pass or C to O or F grade in the same semester)	W	0.0

11.2 A candidate securing 'F' grade in any course there by securing zero grade points has to reap- pear and secure at least 'C' grade in the subsequent examinations for that course.

11.3 After each semester, Grade sheet will be issued which will contain the following details:

•The list of courses for each semester and corresponding credits and grades obtained

•The Semester Grade Point Average (SGPA) for each Semester and

•The Cumulative Grade Point Average (CGPA) of all courses put together up to that semester. SGPA is calculated based on the following formula:

$$\frac{\sum[No.of credits \times Gradepoints]}{\sum No.of credits}$$

CGPA will be calculated in a similar manner, considering all the courses up to that semester.

11.4 A consolidated Grade Sheet shall be issued to the candidate, after completing all, indicating the CGPA of all the Two years put together.

11.5 Conversion of CGPA into equivalent Percentage of marks:

Percentage of Marks = (CGPA-0.50) x 10.

12 ELIGIBILITY FOR AWARD OF M.TECH. DEGREE

The M.Tech. Degree shall be conferred on a student who satisfies the following requirements:

12.1 The student who satisfies the conditions for pass in all the subjects including labs of all the years as stipulated in **Clauses 10**.

12.2 **Maximum Time Limit for completion of M.Tech Degree:** A candidate, who fails to fulfil
all the academic requirements for the award of the degree within four academic years from the year of admission, shall forefeit his/her seat in M.Tech. Degree.

13 AWARD OF CLASS

A student who becomes eligible for the award of M.Tech. Degree as stipulated in **Clause 11**shall be placed in one of the following Classes.

S.No	Class	CGPA
1	First Class With Distinction	7.5 or more
2	First Class	6.5 or more but less than 7.5
2	Second Class	5.5 or more but less than 6.5
3	Pass Class	5.0 or more but less than 5.5

14 AWARD OF RANK

The rank shall be awarded based on the following:

14.1 Ranks shall be awarded in each branch of study for the top ten percent of the students appearing for the Regular Semester End Examinations or the top two students whichever is minimum.

14.2 The Rank shall be awarded only to those students who completes their degree within two academic years.

14.3 For the purpose of awarding rank in each branch, only such students who passed all subjects in the first attempt shall be considered.

15 TRANSITORY REGULATIONS

15.1 A student, studied under R-17 regulations of RVR & JCCE (Autonomous) curriculum and discontinued the I Year I Semester course, shall join in I Year I Semester of R-21 regulations.

15.2 A student, studied under R-17 regulations of RVR & JCCE (Autonomous) curriculum and discontinued the I year II Semester course and also at the subsequent semesters will follow the same R-17 regulations/ curriculum and he / she has to complete the subject by appearing the examinations conducted by the college under R-17 curriculum.

16 CONDUCT AND DISCIPLINE

16.1 Candidates shall conduct themselves within and outside the premises of the institute in a manner befitting the candidates of our institution.

16.2 As per the order of Hon'ble Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

16.3 The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

a) Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.

b) Willful damage of college / individual property.

c) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallu-cinogenic drugs.

d) Mutilation or unauthorized possession of library books.

e) Noisy and unseemly behavior, disturbing studies of fellow candidates.

f) Hacking of computer systems (such as entering into other person's areas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber- crime etc.)

g) Usage of camera / cell phone in the campus

h) Plagiarism of any nature

i) Any other acts of gross indiscipline as decided by the academic council from time to time.

16.4 Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debar from examination, disallowing the use of certain facilities of the institute, rustication for a specified period or even outright expulsion from the institute or even handing over the case to appropriate law enforcement or the judiciary.

16.5 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief warden, the head of the department and the principal respectively, shall have the authority to reprimand or impose fine.

16.6 Cases of adoption of unfair means and / or any malpractice in an examination shall be reported to the principal for taking appropriate action.

16.7 All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the academic council.

16.8 The institute level standing disciplinary action committee constituted by the academic council shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.

16.9 The principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the programmes committee in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved by the appropriate authority, shall be reported to the academic council for ratification.

16.10 "Grievance and Redressal Committee" (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.

17 MALPRACTICES

17.1 The Principal shall refer the cases of malpractices in internal assessment tests and semester- end examinations to a malpractice enquiry committee constituted by him / her for the purpose. Such committee shall follow the approved scales of punishment. The principal shall take necessary action, against the erring candidates basing on the recommendations of the committee.

17.2 Any action on the part of a candidate during an examination trying to get undue advantage or trying to help another, or drive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the staff, who are in-charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading in- formation) that infringe upon the course of natural justice to one and all concerned in the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

18 AMENDMENTS TO REGULATIONS

The College may, from time to time, revise, amend, or change the Regulations, Schemes of Examinations, and / or Syllabus.

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R.V.R. & J.C. COLLEGE OF ENGINEERING:: GUNTUR (Autonomous)
CHOICE BASED CREDIT SYSTEM REGULATIONS (R-21) for
2-YEAR MASTER OF TECHNOLOGY (M.Tech.) Degree Program
M.Tech., Computer Science & Engineering
(w.e.f. the batch of students of admiitted from the academic year 2021-2022)

I / II M.Tech. I Semester:

S.No.	Code. No	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	CS511	Advanced Data Structures & Algorithms	3	-	40	60	3	100
2	CS512	Principles of Cloud Computing	3	-	40	60	3	100
3	CS513	Data Analytics	3	-	40	60	3	100
4	CS514	Professional Elective-I	3	-	40	60	3	100
5	CS515	Professional Elective-II	3	-	40	60	3	100
6	CS516	Professional Elective-III	2	2	40	60	3	100
7	CS551	Advanced Data Structures & Algorithms Lab	-	4	40	60	2	100
8	CS552	Data Analytics Lab		4	40	60	2	100
Total			**17**	**10**	**320**	**480**	**22**	**800**

I / II M.Tech. II Semester:

S.No	Code. No	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	CS521	Machine Learning	3	-	40	60	3	100
2	CS522	High Performance Computing	3	-	40	60	3	100
3	CS523	Cyber Security	3	-	40	60	3	100
4	CS524	Professional Elective-IV	3	-	40	60	3	100
5	CS525	Professional Elective-V	3	-	40	60	3	100
6	CS526	Professional Elective-VI	2	2	40	60	3	100
7	CS561	Machine Learning Lab	-	4	40	60	2	100
8	CS562	Cyber Security Lab	-	4	40	60	2	100
9	MC01	Research Methodology and IPR	3	-	100	-	-	100
TOTAL			**20**	**10**	**420**	**480**	**22**	**900**

II / II M.Tech. III Semester:

S.No	Code.No	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	CS611	MOOCS	-	-	-	-	2	-
2	CS651	Internship	-	-	100	-	2	100
3	CS652	Project Phase-I	-	-	100	-	6	100
TOTAL			**-**	**-**	**200**		**10**	**200**

II / II M.Tech. IV Semester:

S.No	Code.No	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total Internal Marks
			Theory	Lab	Internal Marks	Theory	Lab	
1	CS661	Project Phase-ii	-	-	40	60	14	100
TOTAL			**-**	**-**	**40**	**60**	**14**	**100**

TOTAL MARKS: 2000
TOTAL: 68 Credits

M.Tech (Computer Science & Engineering)

List of Electives

Elective	Code	Subject Name
Elective Courses for I Semester M.Tech (CSE)		
Three Electives need to be selected	**CSEL01**	Image Processing
	CSEL02	Information Retrieval
	CSEL03	Mobile Communications
	CSEL04	Artificial Intelligence
	CSEL05	Semantic Web Technologies
	CSEL06	Information Security
	CSEL07	Software Project Management
	CSEL08	Multimedia Computing
	CSEL09	High Performance Computing **(LBD)/Multicore architecture**
	CSEL10	Web and Micro services **(LBD)**
	CSEL11	Mobile Application Development **(LBD)**
	CSEL12	Internet of Things **(LBD)**
Elective Courses for II Semester M.Tech(CSE)		
Three Electives need to be selected	**CSEL13**	Block Chain Technology
	CSEL14	GPU Programming
	CSEL15	Knowledge Graphs
	CSEL16	Natural Language Processing
	CSEL17	Search Engine Internals
	CSEL18	Social Network Analysis
	CSEL19	Software Testing and Quality Assurance
	CSEL20	Virtual Reality
	CSEL21	Concurrent Programming**(LBD)**
	CSEL22	Deep Learning **(LBD)**
	CSEL23	Full Stack Development**(LBD)**
	CSEL24	Visual Programming **(LBD)**

I/II M.Tech I Semester

CS 511	Advanced Data Structures & Algorithms	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn and implement hashing techniques.
2. To understand the concepts of data structures such as Disjoint sets, Binary Search trees, balanced search Trees.
3. To understand the working of graph algorithms like finding shortest paths and minimum spanning trees.
4. To learn greedy and dynamic programming algorithms.
5. To understand the string matching algorithms.

Course Outcomes:

1. Implement hashing techniques for solving the given problem.
2. Implement the concepts of data structures such as disjoint sets, Binary Search trees and balanced search Trees.
3. Implement graph algorithms like finding shortest paths and minimum spanning trees.
4. Implement greedy and dynamic programming algorithms.
5. Implement the string matching algorithms.

Course Content:

UNIT I **12 Periods**

Hash Tables: Direct-address tables, Hash tables, Hash functions, Open addressing, perfect hashing.

Binary Search Trees: What is a binary search tree? Querying a binary search tree, Insertion and deletion, randomly built binary search trees.

UNIT II **12 Periods**

Red-Black Trees: Properties of red-black trees, Rotations, Insertion, Deletion.

B-Trees: - Definition of B-trees, Basic operations on B-trees, Deleting a key from a B-tree.

Binomial Heaps: Binomial trees and binomial heaps, Operations on binomial heaps.

UNIT III **12 Periods**

Data Structures for Disjoint Sets - Disjoint-set operations.

Elementary Graph Algorithms: Representation of graphs, Breadth-first search, Depth-first search.

Minimum Spanning Trees - Growing a minimum spanning tree, The algorithms of Kruskal and Prim.

UNIT IV **12 Periods**

Single-Source Shortest Paths - The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm - All-Pairs Shortest Paths -The Floyd-Warshall algorithm.

Dynamic Programming: Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence, Optimal binary search trees.

UNIT V **12 Periods**

Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Huffman codes, A task-scheduling problem.

String Matching: The naive string-matching algorithm, The Rabin-Karp algorithm, String matching with finite automata, The Knuth-Morris-Pratt algorithm.

Learning Resources:

Text Book:

1. Charles E. Leiserson, Clifford Stein, Ronald Rivest, and Thomas H. Cormen, Introduction to Algorithms, 3rd Edition, Prentice Hall India Learning Private Limited, 2010.

Reference Books:

1. Brad Miller and David Ranum, Problem Solving with Algorithms and Data Structures, Franklin, Beedle& Associates Inc, 2nd edition.

2. E.Horowitz and Sahani, Fundamentals of Data Structures.

CS 512	Principles Of Cloud Computing	L	T	P	C
		3	0	0	3

Course Objectives:

1. Different Cloud Deploy Models & Service Models in enterprise cloud environment.
2. Cloud Virtual Machines Migration and Cloud Architecture and Programming in Cloud.
3. Cloud Applications with Threads and Task Model.

Course Outcomes:

1. Understanding the key dimensions of the challenge of Cloud Computing.
2. Explain cloud computing, virtualization and classify services of cloud computing
3. Illustrate architecture and programming in cloud
4. Describe the platforms for development of cloud applications and List the application of cloud.
5. Implement Programming applications with threads and task model.

Course Content:

UNIT I **8 Periods**

Introduction, Cloud Computing at a Glance: Introduction ,Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka Virtualization, Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples.

Xen: Paravirtualization, VMware: Full Virtualization, Microsoft Hyper-V.

UNIT II **10 Periods**

Cloud Computing Architecture: Cloud Computing Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance Security, Trust, and Privacy Organizational Aspects

Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

UNIT III **8 Periods**

Concurrent Computing: Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, what is a Thread? Thread APIs, Techniques for Parallel Computation with Threads, Multithreading with Aneka, Introducing the Thread Programming Model, Aneka Thread vs. Common Threads, Programming Applications with Aneka Threads, Aneka Threads Application Model, Domain Decomposition: Matrix Multiplication

Functional Decomposition: Sine, Cosine, and Tangent. High-Throughput Computing: Task Programming, Task Computing, characterizing a Task, Computing Categories, Frameworks for Task Computing, Task-based Application Models, Embarrassingly Parallel Applications, Parameter Sweep Applications, MPI Applications, Workflow Applications with Task Dependencies, Aneka Task-Based Programming, Task Programming Model, Developing Applications with the Task Model, Developing Parameter Sweep Application, Managing Workflows.

UNIT IV **8 Periods**

Data Intensive Computing: Map-Reduce Programming, what is Data-Intensive Computing? Characterizing Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, Aneka Map Reduce Programming, Introducing the Map Reduce Programming Model, Example Application.

UNIT V **12 Periods**

Cloud Platforms in Industry: Cloud Platforms in Industry, Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Applications Scientific

Applications, Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Biology: Gene Expression Data Analysis for Cancer Diagnosis, Geoscience: Satellite Image Processing, Business and Consumer Applications, CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming.

Learning Resources:

Text Books:

1. RajkumarBuyya, Christian Vecchiola, and ThamaraiSelvi Mastering Cloud. Computing McGraw Hill Education

Reference Books:

1. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013.

CS 513	Data Analytics	L	T	P	C
		3	0	0	3

Course Objectives:

1. Identify the field of data analytics-background and key concepts.
2. Know the basics of statistical analytics.
3. Develop and gain an understanding of probability distributions and hypothesis testing.
4. Have the knowledge of predictive analytics.
5. Analyze components and forecast the time series data.

Course Outcomes: At the end of the course, student will be able to:

1. Interpolate the role of data analytics. [Action Verb – Interpolate, Student Achievement – Inferring, Bloom's Taxonomy Level - 2]
2. Compute statistical methods to data for inferences. [Action Verb – Compute, Student Achievement –Executing, Bloom's Taxonomy Level - 3]
3. Examine statistical models like probability distributions and hypothesis testing [Action Verb – Examine, Student Achievement –Differentiating, Bloom's Taxonomy Level - 4].
4. Perform predictive analytics over data. [Action Verb – Perform, Student Achievement – Critiquing, Bloom's Taxonomy Level - 5].
5. Diagnose and forecast the time series data. [Action Verb – Diagnose, Student Achievement – Analysing, Bloom's Taxonomy Level - 5].

Course Content:

UNIT-I **8 Periods**

Data Analytics Life Cycle:
Introduction to Big Data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

UNIT-II **12 Periods**

Statistics :
Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

UNIT-III **12 Periods**

Probability and Hypothesis Testing:
Random variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence - Test of significance, 1& 2 tailed test, uses of tdistribution, F-distribution, $\chi 2$ distribution.

UNIT-IV **12 Periods**

Predictive Analytics:
Predictive modelling and Analyisis - Regression Analyisis, Multicollinearity, Correlation analysis, Rank correlation coefficient, Multiplecorrelation, least square, Curve fitting and good ness of fit.

UNIT-V **12 Periods**

Time Series Forecasting and Design of Experiments
Forecasting Models for Time series: MA, SES, TS with trend, season - Design of Experiments, one-way classification, two-way classification, ANOVA, Latin square, Factorial Design.

Learning Resources:

Text Books:

1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., "Understanding Big Data", McGrawHill, 2012.
2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014.
3. Eric Siegel, Thomas H. Davenport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013.
4. James R Evans, "Business Analytics – Methods, Models and Decisions", Pearson 2013.
5. R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics", Wiley, 2015.
6. S M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Foundation, 2011.
7. David Hand, HeikiMannila, Padhria Smyth, "Principles of Data Mining", PHI 2013.
8. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, "Forecasting methods and applications", Wiley2013(Reprint).
9. David Hand, HeikkiMannila, Padhraic Smyth, "Principles of Data mining", PHI 2013.
10. http://cran.r-project.org/doc/manuals/R-intro.html.
11. W.N. Venables, D.M Smith, "An introduction to R",
12. R in Nutshell, O Reilly.

CS 551	Advanced Data Structures & Algorithms Lab	L	T	P	C
		0	0	4	2

Course Objectives:

1. To learn and implement hashing techniques.
2. To understand the concepts of data structures such as Disjoint sets, Binary Search trees, balanced search Trees.
3. To understand the working of graph algorithms like finding shortest paths and minimum spanning trees.
4. To learn greedy and dynamic programming algorithms.
5. To understand the string matching algorithms.

Course Outcomes:

1. Implement hashing techniques for solving the given problem.
2. Implement the concepts of data structures such as disjoint sets, Binary Search trees and balanced search Trees.
3. Implement graph algorithms like finding shortest paths and minimum spanning trees.
4. Implement greedy and dynamic programming algorithms.
5. Implement the string matching algorithms.

List of Experiments:

1. Write a C program to implement hashing techniques
    a. Separate chaining.
    b. Open addressing.

2. Write a C program to implement the following operations on a binary search tree
    a. Insert a node.
    b. Delete a node.
    c. Find a node.
    d. Traverse the tree.

3. Write a C program to implement the following
a. Disjoint sets operations.
b. Breadth First Search and Depth First Search using adjacency list.

4. Write a C program to implement insertion and deletion operations on a B-tree.

5. Write a C program to find minimum spanning tree of a given graph using Kruskal'salgorithm.

6. Write a C program to find minimum spanning tree of a given graph using Prim's algorithm.

7. Write a C program to find the lengths of the shortest paths from a source in the given weighted graph using Bellman-Ford algorithm.

8. Write a C program to find the length of the shortest path in the given weighted graph using Dijkstra'salgorithm.

9. Write a C program to solve all pairs shortest path problem using Floyd-Warshall algorithm.

10. Write a C program to implement the string matching algorithms:
    a. Naïve.
    b. Robin-Karp.
    c. KMP.

CS 551	Data Analytics Lab	L	T	P	C
		0	0	4	2

List of Experiments(write in short form)

1. Introduction to R: Installing R in windows, R Console (R window to edit and execute R Commands), Commands and Syntax (R commands and R syntax), Packages and Libraries (Install and load a package in R), Help In R, Workspace in R.
2. Familiarity of Data Structures in R: Introduction to Data Types (Why Data Structures?, Types of Data Structures in R), Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data.
3. Graphical Analysis: Creating a simple graph (Using plot () command), Modifying the points and lines of a graph (Using type, pch, font, cex, lty, lwd, col arguments in plot () command), Modifying Title and Subtitle of graph (Using main, sub, col. main, col.sub, cex. main, cex. Sub, font. Main, font.sub arguments in plot () command).
4. Graphical Analysis: Modifying Axes of a Graph (Using xlab, ylab, col.lab, cex. Lab, font. Lab, xlim, ylim, col. axis, cex. Axis, font. Axis arguments and axis () command), Adding Additional Elements to a Graph (Using points (), text (), abline (), curve () commands), Adding Legend on a Graph (Using legend () command), Special Graphs (Using pie (), bar plot (), hist() commands), Multiple Plots (Using mfrow or mfcol arguments in par() command and layout command).
5. Descriptive Statistics: Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution).
6. Comparing Population: Test of Hypothesis (Concept of Hypothesis testing, Null Hypothesis and Alternative Hypothesis), Cross Tabulations (Contigency table and their use, Chi-Square test, Fisher's exact test),
7. One Sample t test (Concept, Assumptions, Hypothesis, Verification of assumptions, Performing the test and interpretation of results),
8. Independent Samples t test (Concept, Type, Assumptions, Hypothesis, Verification of assumptions, Performing the test and interpretation of results), Paired Samples t test (Concept, Assumptions, Hypothesis, Verification of assumptions, Performing the testand interpretation of results).
9. One way ANOVA (Concept, Assumptions, Hypothesis, Verification of assumptions, Model fit, Hypothesis testing, Post hoc tests: Fisher's LSD, Tukey's HSD).
10. Perform Time series analysis on the given data set and identify the pattern in it for forecasting.

I/II M.Tech II Semester

CS 521	Machine Learning	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To develop skills of using recent machine learning strategies for solving practical problems.

Course Outcomes: By the end of the course, students should be able to:

1. Explain fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Implement machine learning techniques and computing environment that are suitable for the applications.
3. Evaluate learning models generated from data.
4. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
5. Analyze existing learning algorithms, including well-studied methods for classification, regression, structured prediction, clustering, and representation learning

Course Content:

UNIT-I **12 Periods**

Introduction: Why Machine Learning?,Why Python?, scikit-learn, Essential Libraries and Tools, A First Application: Classifying Iris Species.

Supervised Learning: Classification and Regression, Generalization, Overfitting, and Under fitting, Supervised Machine Learning Algorithms, Uncertainty Estimates from Classifiers,

UNIT-II **12 Periods**

Unsupervised Learning and Preprocessing: Types of Unsupervised Learning, Challenges in Unsupervised Learning, Preprocessing and Scaling, Dimensionality Reduction, Feature Extraction, and Manifold Learning, Clustering,

Representing Data and Engineering Features: Categorical Variables, OneHotEncoder and ColumnTransformer,ConvenientColumnTransformer creation with make columntransformer, Binning, Discretization, Linear Models, and Trees, Interactions and Polynomials, Univariate Nonlinear Transformations, Automatic Feature Selection, Utilizing Expert Knowledge.

UNIT-III **12 Periods**

Model Evaluation and Improvement: Cross-Validation, Grid Search, Evaluation Metrics and Scoring.

Algorithm Chains and Pipelines: Parameter Selection with Preprocessing, Building Pipelines, Using Pipelines in Grid Searches, Interface, Grid, Grid-Searching Which Model To Use.

UNIT-IV **12 Periods**

Working with Text Data: Types of Data Represented as Strings, Example Application: Sentiment Analysis of Movie Reviews, Representing Text Data as a Bag of Words,Stopwords, Rescaling the Data with tf–idf,Investigating Model Coefficients, Bag-of-Words with More Than One

Word (n-Grams), Advanced Tokenization, Stemming, and Lemmatization, Topic Modeling and Document Clustering.

LearningResources:

TextBook:

1. Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media.

ReferenceBooks:

1. Christopher.M. Bishop,PatternRecognitionandMachineLearning, SpringerPublications,October 2007.
2. EthenAlpaydin,IntroductiontoMachineLearning,SecondEdition,MITPublishers,2010.

CS 523	Cyber Security	L	T	P	C
		3	0	0	3

Course Objectives: The objectives are

1. To introduce the security posture and incident response process.
2. To impart the cyber security kill chain process and reconnaissance techniques.
3. Describe various methods of system compromising techniques.
4. Discuss the security polices, user awareness, policy enforcement and compliance techniques.
5. Explain the vulnerability management strategy and log analysis.

Course Outcomes:

1. Create an incident response process by analysing the organizational information security threats.
2. Implement external and internal reconnaissance techniques.
3. Describe the attacks against computers, servers, and websites.
4. Review and enforce security policy of an entire organization.
5. Apply log analysis techniques and vulnerability management tools.

Course Content:

UNIT-I **11 Periods**

Security Posture: The current threat landscape - The credentials – authentication and authorization -Apps -Data Cyber Security challenges - Old techniques and broader results - The shift in the threat landscape, enhancing your security posture, The Red and Blue Team -Assume breach.

Incident Response Process: Reasons to have an IR process in place -Creating an incident response process -Incident response team -Incident life cycle, handling an incident -Best practices to optimize incident handling -Post-incident activity -Real-world scenario -Lessons learned, Incident response in the cloud - Updating your IR process to include cloud.

UNIT-II **11 Periods**

Understanding the Cyber Security Kill Chain: Scanning, NMap -Metasploit - John the Ripper - THC Hydra -Wireshark -Aircrack-ng - Nikto – Kismet- Cain and Abel, Access and privilege escalation- Vertical privilege escalation, Horizontal privilege escalation, Threat life cycle management.

External reconnaissance -Dumpster diving -Social media -Social engineering -Pretexting - Diversion theft - Phishing - Phone phishing (vishing) - Spear phishing - Water holing - Baiting - Quid pro quo – Tailgating.

Internal reconnaissance -Sniffing and scanning -Prismdump -tcpdump -NMap -Wireshark - Scanrand -Cain and Abel -Nessus -Metasploit -Aircrack-ng –Wardriving

UNIT-III **10 Periods**

Compromising the System:
Analyzing current trends -Extortion attacks -Data manipulation attacks -IoT device attacks - Backdoors -Mobile device attacks -Hacking everyday devices -Hacking the cloud ,Phishing -

Exploiting a vulnerability, Zero-day -Fuzzing -Source code analysis -Types of zero-day exploits -Buffer overflows -Structured exception handler overwrites.

Performing the steps to compromise a system -Deploying payloads-Installing and using a vulnerability scanner-Using Metasploit-Compromising web-based systems-SQL injection -Cross-site scripting-Broken authentication-DDoS attacks

UNIT-IV **10 Periods**

Security Policy: Reviewing your security policy, Educating the end user -Social media security guidelines for users -Security awareness training, Policy enforcement -Application whitelisting -Hardening ,Monitoring for compliance,Investigating an Incident, Scoping the issue -Key artifacts, Investigating a compromised system on-premises,Investigating a compromised system in a hybrid cloud -Search and you shall find it, Lessons learned.

UNIT-V **10 Periods**

Vulnerability Management

Creating a vulnerability management strategy -Asset inventory -Information management -Risk assessment -Scope -Collecting data -Analysis of policies and procedures -Vulnerability analysis -Threat analysis -Analysis of acceptable risks -Vulnerability assessment -Reporting and remediation tracking -Response planning -Vulnerability management tools -Asset inventory tools -Peregrine tools –LAN Desk Management Suite –Still Secure –Foundstone's Enterprise -Information management tools -Risk assessment tools -Vulnerability assessment tools -Reporting and remediation tracking tools -Response planning tools.

Log Analysis: Datacorrelation,Operating system logs -Windows logs -Linux logs,Firewall logs, Web server logs'

Learning Resources:

Text Book:

1.Cyber Security – Attack and Defense Strategies by Yuri Diogenes and ErdalOzkaya.

Reference Books:

1. MarttiLehto, PekkaNeittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
2. NASSCOM Handbook Study Material
3. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press.

Web references:

1. https://www.cvedetails.com/browse-by-date.php
2. https://cybermagazine.com/
3. https://thehackernews.com/

CS 561 **Machine Learning Lab** **L T P C**

List of Experiments

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.
2. Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
4. Build an Artificial Neural Network by implementing the Back-propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Write a program to implement k-Nearest Neighbour algorithm to classify the given data set.
7. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.
8. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
9. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points.

CS 562	Cyber Security Lab	L	T	P	C
		0	0	4	2

Course Objectives:

1. To implement cryptanalysis techniques.
2. To learn and use tools used for security.
3. To study and analyze different vulnerabilities & attacks.

Course Outcomes:

After successful completion of the course, students are able to

1. Implement cryptanalysis of private key and public key encryption techniques.
2. Hack user credentials using tools like Wireshark, Burp suite etc.
3. Implement steganography technique.
4. Implement phishing attack in kali Linux using SE toolkit.
5. Demonstrate attacks using OWASP and DVWA tools.

Lab Programs

1. Hack user credentials of any insecure website using Wireshark tool.
2. Implement steganography technique using Hex Editor tool.
3. Implement phishing attack using SE toolkit with web templates in kali Linux.
4. Implement phishing attack using SE toolkit with site cloner in kali Linux.
5. Perform SQL injection using DVWA (DAMN Vulnerable Web Application tool.
6. Spoof the physical MAC address using MAC changer in Kali Linux.
7. Crack user credentials using John the Ripper tool.
8. Hack user password using Burp suite tool.
9. Implement Caesar- Cipher Brute force attack.
10. Demonstration of attacks using OWASP Tool.
11. Implement One Time Pad using Web application.
12. Demonstration of cryptographic algorithms using JCrypt Tool.

MC01	Research Methodology and IPR	L	T	P	C
		3	0	0	0

Course objectives:

1. Knowledge of the principles of research methodology and the techniques involved in defining a research problem
2. Study the approaches to conduct the literature review in research.
3. Understand the art of interpretation and the art of writing research reports
4. To acquire knowledge on research designs and their characteristics.

Course Outcomes: At the end of the course, student will be able to:

1. Investigate the research problem and formulate a solution to a selected research problem
2. Explain the details of sampling designs, measurement, scaling techniques and also different methods of data collections.
3. Apply the several parametric tests of hypotheses and Chi-square test.
4. Analyze literature search, developing, conceptual frameworks, theoretical concepts and write a review.
5. Explore the types of intellectual property, its relevance, and business impact in the changing global business environment.
6. Acquire knowledge on International Instruments concerning Intellectual Property Rights.

Course Content:

UNIT-I **12 Periods**

Meaning of research problem, Sources of the research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of the research problem.

Approaches of investigation of solutions for the research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II **12 Periods**

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

UNIT-III **10 Periods**

Statistical Methods of Analysis Descriptive Statistics: Mean, Median, Mode, Range, Standard Deviation, regression and correlation analysis. Inferential Statistics: Estimation of parameters, Hypothesis, Types of Hypothesis, Testing of Hypothesis, Test of Normality,

Introduction to Parametric and Non Parametric tests. Test of significance: t-test, chi-square test, ANOVA (1-way, 2-way), Repeated Measures ANOVA, ANCOVA, α-correction

UNIT-IV **12 Periods**

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

UNIT-V **12 Periods**

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

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

Learning Resources:

Text Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice-Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Elective Courses for I Semester

CSEL01 **Image Processing**

Course objectives:

1. To create basic understanding of fundamental concepts in digital image processing and enhancement in the spatial domain.
2. To demonstrate the approaches used in enhancement in the frequency domain and image segmentation.
3. To teach image restoration and image compression techniques.
4. To analyse morphological transformations, and image representation of real world objects

Course outcomes:

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

1. Define image processing systems and develop algorithms for image enhancement techniques in the spatial domain.
2. Implement enhancement techniques in the frequency domain and image segmentation
3. Develop image restoration, and image compression techniques.
4. Analyse morphological transformation algorithms, and select various descriptors for image representation.

Course Content:

UNIT I **12 Periods**

Introduction: Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals:Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels.

Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters.

UNIT II **12 Periods**

Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing frequency domain Filters, Sharpening frequency-domain Filters, Holomorphic Filtering, Implementation.

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.

UNIT III **12 Periods**

Image Restoration: A Model of the Image Degradation/Restoration Process, Linear, Position-Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.
Image Compression: Image Compression Models, Error-free Compression, Lossy Compression, Image Compression Standards.

UNIT IV **12 Periods**

Morphological Image Processing: Dilation and Erosion, The Hit-or-Miss Transformation, Some basic Morphological Algorithms, Extension to Gray-Scale Images.

Representation and Description: Representation, Boundary Descriptors, Regional Descriptors.

Learning Resources:
Text Book(s):

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing' Addison Wesley Pubs (Second Edition).

Reference Book(s):

1. "Image Processing. Analysis, and Machine Vision ", Milan Sonka, Vaclav Hlavac, Roger Boyle (Second Edition).
2. A.K.Jain, 'Fundamentals of Digital Image Processing' PHI.

CSEL02	Information Retrieval	L	T	P	C
		3	0	0	3

Course Objectives

At the end of the course the students will understand

Course Outcomes:
At the end of the course the students will be able to

Course Content:

UNIT I **15 Periods**

Boolean retrieval: An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, References and further reading.

The term vocabulary and postings lists: Document delineation and character sequence decoding, Determining the vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings and phrase queries.

Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction, Phonetic correction.

UNIT II **15 Periods**

Index construction: Hardware basics, blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes.
Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression.
Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, Variant tf-idf functions.

UNIT III **15 Periods**

Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction.

Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, A broader perspective: System quality and user utility, Results snippets.

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

UNIT IV **15 Periods**

XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval: Review of basic probability theory, The Probability Ranking Principle, The Binary Independence Model, An appraisal and some extensions.

Matrix decompositions and latent semantic indexing: Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

Learning Resources:

Text Book:

Reference Books:

CSEL03	Mobile communications	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study about Simplified Reference model, MAC Control and applications in Mobile Communications.
2. To know about the predominant communication systems in wireless domain.
3. To understand wireless LAN technologies.
4. To learn about the protocols used in Wireless Networks.

Course Outcomes:

1. Understand the basics of Wireless Transmission Technology and media access technologies.
2. Know about Wireless communication system GSM.
3. Know about satellite and digital broadcast systems and acquire knowledge of wireless LAN technologies.
4. Be aware of mobile IP, the extension of IP Protocol for mobile users.
5. Know the Architecture of WAP, the wireless application protocol used for wireless and mobile access using different transport systems.

Course Content:

UNIT-I **12 Periods**

Introduction: Applications,A short History of wireless communication, A market for mobile communications, A simplified reference model.

Wireless transmission: Frequencies for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum.

Medium access control: Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, Comparison of S/T/F/CDMA.

UNIT-II **12 Periods**

Telecommunication System: GSM**-** Radio Interface of GSM, Protocols of GSM, Localization and Calling, Handover, Security, New data Services- General packet radio service, High-speed circuit switched data.

Mobile Network layer: Mobile IP- IP Packet delivery, Agent Discovery, Registration, Tunnelling and encapsulation, Optimizations, Dynamic host configuration protocol.

UNIT-III **12 Periods**

Mobile Transport Layer: Classical TCP improvements**-** Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction-oriented TCP, TCP over 2.5G/3G mobile networks.

Database and Mobile Computing: Data Organization, Database Transactional Models-ACID Rules, Query Processing, Data Recovery process, Database hoarding Techniques, Data caching, Client-Server Computing for Mobile Computing and Adaptation, Adaptation Software for Mobile Computing, Power-aware Mobile Computing, Context-aware Mobile Computing.

UNIT-IV **12 Periods**

Data Dissemination and Systems for Broadcasting: Communication Asymmetry, Classification of data-delivery mechanisms, Data Dissemination broadcast models, Selective tuning and Indexing techniques, Digital Audio broadcasting(DAB), Digital video broadcasting.

Data Synchronization in Mobile Computing Systems: Synchronization, Synchronization software for Mobile devices, Synchronization protocols, SyncML-Synchronization language for mobile computing, Sync4J (Funambol), Synchronized Multimedia Markup language (SMIL).

UNIT-V **12 Periods**

Mobile Devices: Mobile Agent, Application framework, Application server, Gateways, Service discovery, Device management, Mobile file systems, Security.

Mobile Wireless Short-range Networks and Mobile Internet: Wireless LAN 802.11 Architecture and protocol layers, Wireless application protocol(WAP), Wireless application protocol-WAP 2.0, Bluetooth-enabled devices network, Layers in Bluetooth protocol, Security in Bluetooth protocol, IrDA protocols, ZigBee.

Learning Resources:

Text Books:

1. Jochen Schiller, "Mobile Communications ", 2nd ed., Pearson Education, 2003.
2. Raj Kamal, Mobile Computing, Oxford University Press.

Reference Books:

1. William Stallings, Wireless Communication Networks.
2. UWE Hansmann, LotherMerk, Martin S.Nicklous, Thomas Stober, Principles of Mobile Computing, 2nd Edition.
3. Yu-KwongR.Kwok and Vincent K.N.Lau, Wireless internet and Mobile computing, John Wiley & sons, 2007.
4. Asoke K Talukder, et al, Mobile Computing, Tata McGraw Hill, 2008.

CSEL04 **Artificial Intelligence**

L	T	P	C
4	0	0	4

Course objectives:

1. To apply a given AI technique to a given concrete problem.
2. To Implement non-trivial AI techniques in a relatively large systems.
3. To understand uncertainty and Problem solving techniques.
4. To understand various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.
5. To understand different logical systems for inference over formal domain representations, and trace how a particular inference algorithm works on a given problem specification.
6. To understand various learning techniques and agent technology.

Course Outcomes:

1. Design intelligent agents for problem solving, reasoning, planning, and decision making, and learning. Specific design and performance constraints, and when needed, design variants of existing algorithms.
2. Apply AI technique on current applications.
3. Problem solving, knowledge representation, reasoning, and learning.
4. Demonstrating how to write a programs for Artificial Intelligence
5. Analyzing and Solving Artificial Intelligence programs by using Backtracking methods

Course Content:

UNIT-I **12 Periods**

Artificial Intelligence: The AI Problems, The Underlying assumption, What is an AI Technique?, The Level of the model, Criteria for success, some general references, One final word and beyond.

Problems, problem spaces, and search: Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional Problems.

Intelligent Agents: Agents and Environments, The nature of environments, The structure of agents.

UNIT-II **12 Periods**

Heuristic search techniques: Generate-and-test, Hill climbing, best-first search, Problem reduction, Constraint satisfaction, Mean-ends analysis.
Knowledge representation issues: Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The frame problem.

Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution, Natural Deduction.
Logical Agents: Knowledge –based agents, the Wumpus world, Logic-Propositional logic,

Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic.

UNIT-III **12 Periods**

Symbolic Reasoning Under Uncertainty: Introduction to non-monotonic reasoning, Logic for non-monotonic reasoning, Implementation Issues, Augmenting a problem-solver, Implementation: Depth-first search, Implementation: Breadth-first search.

Statistical Reasoning: Probability and bayes Theorem, Certainty factors and rule-based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy logic.

Quantifying Uncertainty: Acting under uncertainty, Basic probability notation, Inference using full joint distributions, Independence, Bayes' rule and its use, The Wumpus world revisited.

UNIT-IV **12 Periods**

Weak Slot-and-filter structures: Semantic Nets, Frames.

Strong slot-and –filler structures: Conceptual dependency, scripts, CYC.

Adversarial Search: Games, Optimal Decision in Games, Alpha-Beta Pruning, Imperfect Real- Time Decisions, Stochastic Games, Partially Observable Games, State-Of-The-Art Game Programs, Alternative Approaches.

UNIT-V **12 Periods**

Learning From examples: Forms of learning, Supervised learning, Learning decision trees, Evaluating and choosing the best hypothesis, The theory of learning ,PAC, Regression and Classification with linear models, Nonparametric models, Support vector machines, Ensemble learning.

Learning Probabilistic Models: Statistical learning, learning with complete data, learning with hidden variables: The EM algorithm.

Learning Resources:

Text Books:

1. Elaine Rich, Kevin Knight, Shiva Shankar B Nair, Artificial Intelligence, Tata MCGraw Hill 3rd edition. 2013. Chapter 1,2,3,4,78,9 & 10.
2. Stuart Russel, Peter Norvig, Artificial Intelligence, A Modern Approach, Pearson 3rd edition 2013.Chapter 2,5,6,13,18 & 20.

Reference Books:

1. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, ISBN-13: 9780934613101.
2. George F.Luger, Artificial Intelligence Structures and Strategies for Complex Problem Solving, Pearson Education .PHI, 2002.

CSEL05	Semantic Web Technologies	L	T	P	C
		4	0	0	4

Course objectives:

1. To explain the analysis of the social Web and the design of a new class of applications that combine human intelligence with machine processing.
2. To describe how the Semantic Web provides the key in aggregating information across heterogeneous sources.
3. To understand the benefits of Semantic Web by incorporating user-generated metadata and other clues left behind by users.

Course Outcomes:

1. Be able to demonstrate the basics of Semantic Web and Social Networks.
2. Be able to understand electronic sources for network analysis and different Ontology languages.
3. Be able to modeling and aggregating social network data.
4. Be able to build up social-semantic applications.
5. Be able to evaluate Web- based social network and Ontology.

Course Content:

UNIT I **12 Periods**

Introduction to the Semantic Web and Social Networks: The Semantic Web- Limitations of the current Web, The semantic solution, Development of the Semantic Web, The emergence of the social web.

Social Network Analysis: What is network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis.

UNIT II **12 Periods**

Web data, Semantics and Knowledge Representation on the Semantic Web: Electronic sources for network analysis- Electronic discussion networks, Blogs and online communities, Web- based networks.

Knowledge Representation on the Semantic Web- Ontologies and their role in the Semantic Web, Ontology languages for the Semantic Web (RDF, OWL).

UNIT III **12 Periods**

Modeling and aggregating social network data: State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data.**UNIT IV** 12 Periods

Developing social-semantic applications: Building Semantic Web applications with social network features, Flink: the social networks of the Semantic Web community, open academia: distributed, semantic-based publication management.

UNIT V **12**
Periods

Evaluation of web-based social network extraction and Ontologies are us: Differences between survey methods and electronic data extraction, Context of the empirical study, Data collection, Preparing the data, Optimizing goodness of fit, Comparison across methods and networks, Predicting the goodness of fit, Evaluation through analysis. Ontologies are us: A tripartite model of Ontologies, Case studies, Evaluation.

Learning Resources:

Text Book:

1. Peter Mika, Social Networks and the Semantic Web, Springer, 2007.

Reference Books:

1. J.Davies, R.Studer, P.Warren, Semantic Web Technologies, Trends and Research in Ontology Based Systems, John Wiley & Sons.
2. Liyang Lu Chapman and Hal, Semantic Web and Semantic Web Services, l/CRC Publishers, (Taylor & Francis Group)
3. Heine rStucken Schmidt, Frank Van Harmelen, Information Sharing on the semantic Web, Springer Publications.
4. T.Segaran, C.Evans, J.Taylor, Programming the Semantic Web, O"Reilly, SPD.

Web Resources:

1. http://onlinevideolecture.com/index.php?course_id=142&lecture_no=18.
2. https://docs.google.com/file/d/0B8p6899iTnn3a1Q4NnBqOUJ6R3c/edit. https://docs.google.com/file/d/0B8p6899iTnn3bkNSUG1sTkR0Rms/edit

CSEL06	Information Security	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand key terms and critical concepts of information security.
2. To describe how riskis identified and assessed.
3. To identify the technology that enable sthe use of firewall sand virtual private networks.
4. To discuss the placement, nature and execution of the domain and tethods used in cryptosystems.

Course Outcomes:

1. To enumerate the phases of the system security development life cycle.
2. To recognize the existing conceptua lframeworks for evaluating risk controls and formulate a cost benefit analysis.
3. To recognize the import anceof access control in computerized information systems and identify widely used intrusion detection and prevention systems.
4. To describe the operating principles of the most popular cryptographic tools.
5. To describe the significance of the project manager's role in the success of an information Security project and review procedures intoinformation security maintenance.

CourseContent:

UNITI **12Periods**

Introduction to Information Security: What is Information Security? CNSS Security Model, Components o finformation security,Balancing information Security and Access, The Security SDLC.

NeedforSecurity: BusinessNeeds, Threats ,Attacks, And Secure Software Development.

UNITII **12Periods**

Risk Management: Introduction, Overview of risk management, Risk Identification, Risk Assessment, Risk Control Strategies.

SecurityTechnology: Firewallsand VPNs. Introduction, Access Control, Firewalls, Protecting Remote Connections.

UNITIII **12Periods**

Security Technology: Intrusion Detection and Prevention Systems, Introduction, Intrusion Detection and Prevention systems, Honeypots and Honey nets and Padded cell systems, Scanning and analysis tools, Biometric Access Controls.

Cryptography: Cryptographic Tools, Protocols for Secure Communications, Attackson Crypto systems.

UNITIV **12Periods**

Implementing Information Security: Introduction, Information Security Project management, Technica laspects of implementation, Information Systems Security Certification and accreditation.

Security and Personnel: Introduction, Positioning and staffing these curity functions, Credentials for information Security Professionals.

UNITV **10Periods**

Information Security Maintenance: Introduction, Security Management Maintenance Protocols, DigitalForensics.

Learning Resources:

TextBook:

1. Michael EWhitman and Herbert J Mattord, Principles of Information Security,Vikas PublishingHouse, New Delhi, 2003.

ReferenceBooks:

1. MickiKrause, HaroldF. Tipton, Hand book of Information Security Management,
    a. Vol1-3CRCPressLLC, 2004.
2. StuartMcClure, Joel Scrambray, GeorgeKurtz, Hacking Exposed, TataMcGraw-Hill,2003.
3. MattBishop, Computer Security Art and Science, Pearson.

CSEL07	Software Project Management	L	T	P	C
		4	0	0	4

Course Objectives:

1. To Introduce the basics of software project management and taught the Four basic building blocks of software project management
2. To Demonstrate about successful software projects that support organization's strategic goals and Match organizational needs to the most effective software development model
3. To Explain how to plan and manage projects at each stage of the software development life cycle (SDLC)
4. To teach the skills for tracking and controlling software deliverables.
5. To understand project plans that address real-world problems.

Course Outcomes:

1. Plan and manage projects at each stage of the SDLC.
2. Apply theoretical knowledge on project management and software development into practice
3. Gain knowledge on ethical issues related to software project management and can apply this ethical knowledge in practical situations.
4. Understands how different management and development practices affect software and process quality.
5. Create Software project teams and project management that address real-world challenges.

Course Content:

UNIT I **12 Periods**

Project Evaluation & Project Planning: Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II **12 Periods**

Project Life Cycle & Effort Estimation: Software process and Process Models – Choice of Process models – mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern.

UNIT III **12 Periods**

Activity Planning & Risk Management: Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

UNIT IV **12 Periods**

Project Management &Control: Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.

UNIT V **12 Periods**

Staffing in Software Projects: Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications genres – Communication plans.

Learning Resources:

Text Book:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management, Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

References:

1. Robert K. Wysocki, Effective Software Project Management, Wiley Publication,2011.
2. Walker Royce, Software Project Management, Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, Managing Global Software Projects, McGraw Hill Education (India), Fourteenth Reprint 2013.

CSEL08	Multimedia Computing	L	T	P	C
		3	0	0	3

Course Objectives:

This course is aimed at:

1. To learn the basics and Fundamentals of Multimedia.
2. To introduce Multimedia components and Tools.
3. To understand how Multimedia can be incorporated
4. To design and create interactive multimedia products
5. To identify the current and future issues related to multimedia technology.

Course Outcomes:

Upon successful completion of the course the student should be able to:

1. Co1: Understand multimedia components using various tools and techniques.
2. Co2: Discuss about different types of media format and their properties.
3. CO3: Describe how to use text-related element in multimedia design correctly.
4. Co4: Justify the right way of manipulating multimedia systems.
5. CO5: Analyse and interpret Multimedia data.
6. Co6: Create a multimedia project for the desktop or Internet.

Course Content:

UNIT I **15 periods**

Multi Media Fundamentals: What is multimedia, where to use multimedia, Delivering multimedia.

Text: The Power of Meaning, About Fonts and Faces, Using Text in Multimedia, Computers and Text, Font Editing and Design Tools, Hypermedia and Hypertext, Hypertext Tools.

Image: Making Still Images, Color, Image File Formats.

UNIT II **15 periods**

Sound: The Power of Sound, Digital Audio, MIDI Audio, MIDI vs. Digital Audio, Audio File Formats.

Animation: The Power of Motion, Principles of Animation, Animation by Computer.

Video: Using Video, How Video Works and Is Displayed, Digital Video Containers.

Making Multimedia: The Stages of a Multimedia Project, What You Need: Hardware, What You Need: Software. What You Need: Authoring Systems.

UNIT III **15 periods**

Interrupts: Micro Processor Architecture, Interrupt Basics, The shared data problem, Interrupt Latency

Survey of Software Architectures: Round-Robin, Round-Robin with Interrupts, Function Queue-Scheduling Architecture, Real Time Operating System Architecture, Selecting an Architecture.

UNIT IV **10 periods**

The Internet and Multimedia: Internet History, Internetworking, Multimedia on the Web.

Designing for the World Wide Web: Developing for the Web, Text for the Web, Images for the Web, Sound for the Web, Animation for the Web, Video for the Web.

Learning Resources:

Text Book:

1. Tay Vaughan, Multimedia: Making it Work, 8th Edition, McGraw Hill Education. (Units I, II and IV).
2. David E. Simon, An Embedded Software Primer, Pearson Education Asia., 2000. (Units III).

Reference Books:

1. Ranjan Parekh, Principles of Multimedia, 2nd Edition, McGraw Hill Education, 2013.
2. D. Gajski, F. Vahid, Narayan, J. Gong, Specification and Design of Embedded Systems, Prentice Hall of India Pvt. Ltd. 2. Raj Kamal, Embedded Systems.

Web References:

1. https://spin.atomicobject.com/.../learn-embedded-systems-programming/ http://esd.cs.ucr.edu/
2. www.montefiore.ulg.ac.be/~boigelot/cours/embedded/slides/embedded.pdf

CSEL09	High Performance Computing (LBD)	L	T	P	C
		3	0	0	3

Course objectives:

1. Concepts of high performance computing architectures.
2. Concepts of Cluster computers and parallel scalability.
3. Concepts of parallel programming using MPI.

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

1. Analyse the functionality of Modern Processor.
2. Comprehend and implement various optimization techniques for serial code.
3. Design the concept of parallel computing paradigm.

Course Content:

UNIT I **12 Periods**

Modern Processors-Stored- Program Computer Architecture, General-Purpose cache- based microprocessor architecture - Performance metrics and benchmarks, Moore's Law, Pipelining, Super scalarity, SIMD, Memory hierarchies- cache, Cache mapping, Pre-fetch, Multicore processors, Multithreaded processors, Vector Processors

UNIT II **12 Periods**

Requirements and General Issues-Scalable parallel computer Architectures, A cluster computer and its Architecture, clusters classifications, Commodity components for clusters, Network services/Communication SW, Cluster middleware and single system Image(SSI),Resource Management and Scheduling(RMS),Programming environments and Tools, Representative cluster Systems. High speed Networks: Design issues, Fast Ethernet, High Performance parallel interface (HPPI), Asynchronous transfer mode (ATM), Myrinet.

UNIT III **12 Periods**

Parallel Computers: Taxonomy of parallel computing paradigm, Shared memory computers, Distributed memory computers, Hierarchical systems, Basics of parallelization.

UNIT-IV **12 Periods**

Parallel Scalability- Factors that limit parallel execution-, Scalability metrics, Simple scalability laws, parallel efficiency, serial performance Vs Strong scalability, refined performance models-, Choosing the right scaling baseline, Case Study: Can slow processors compute faster- Load balance

UNIT V **12 Periods**

Distributed memory parallel programming with MPI: Message Passing,Messages' and point-to-point communication - collective communication – Non blocking point-to-point communication-virtual topologies, MPI parallelization of Jacobi solver- MPI implementation - performance properties.
Efficient MPI Programming-MPI performance tools, communication parameters, Synchronization, serialization.

Learning Resources:

Text Books:

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series.
2. High Performance cluster computing,Volume1: Architecture and Systems,RajkumarBuyya,Pearson Education.

Reference Books:

1. Gene Wagenbreth and John Levesque, High performance Computing: Programming and Application, CRC press, Taylor and francis group.
2. MaciejBrodowicz, Matthew Anderson, and Thomas Sterling, High Performance Computing: Modern Systems and Practices, Morgankaufmann publishers.

CSEL10 **Web and Micro services (LBD)**

CSEL11	**Mobile Application Development**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

1. To demonstrate their understanding of the fundamentals of Android operating systems.
2. To demonstrate their skills of using Android software development tools.
3. To demonstrate their ability to develop software with reasonable complexity on mobile platform.
4. To demonstrate their ability to deploy software to mobile devices.
5. To demonstrate their ability to debug programs running on mobile devices.

Course Outcomes:

1. Develop the basic Android App using Activity Lifecycle methods.
2. Design Android User Interfaces & Event Handling mechanisms.
3. Implement the different Intents and Notifications.
4. Design and Implement back end Android App using SQLite database.
5. Develop advanced Android App using location based services.

Course Content:

UNIT I **12 Periods**

Android Programming: What Is Android? Obtaining The Required Tools, Creating Your First Android Application.
Android studio for Application development: Exploring IDE, Using code completion, Debugging your Application, Generating a signed APK.

UNIT II **12 Periods**

Activities, Fragments, and Intents: Understanding Activities, Linking Activities Using Intents, Fragments, Displaying Notifications.

Android User Interface: Components of a Screen, Adapting To Display Orientation, Managing Changes to Screen Orientation, Utilizing the Action Bar, Creating the User Interface Programmatically, Listening For UI Notifications.

UNIT III **12 Periods**

User Interface With Views: Using Basic Views, Using Picker Views, Using List Views To

Display Long Lists, Understanding Specialized Fragments.

Pictures and Menus with Views: Using Image Views to Display Pictures, Using Menus with Views, Using Web View.

Notifications – Creating and Displaying notifications, Displaying Toasts.

UNIT IV **12 Periods**

Data Persistence: Saving and Loading User Preferences, Persisting Data to Files, Creating And Using Databases.

Content Providers: Using a Content Provider, Creating Your Own Content Providers.

Messaging: SMS Messaging, Sending E-Mail.

UNITV **12 Periods**

Location-Based Services: Displaying Maps, Getting Location Data, Monitoring A Location.

Developing Android Services: Creating Your Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading.

Learning Resources:

Text Book(s):

1. Beginning Android Programming with Android Studio, J.F.DiMarzio, Wiley India (Wrox), 2017.

Reference Books:

1. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley India (Wrox), 2012.
2. Reto Meier, Professional Android 4 Application Development, Wiley India, (Wrox), 2012.
3. James C Sheusi, Android Application Development for Java Programmers, Cengage Learning, 2013.

CSEL12	Internet of Things (LBD)	L	T	P	C
		3	0	2	4

Course Objectives:

Course Outcomes

1. Understand internet of Things and its hardware and software components
2. Interface FOdevices ,sensors & communication modules
3. Remotely monitor data and control devices
4. Develop real life IoT based projects

Course Content:

UNIT I **9 Periods**

Introduction to Internet of Things – Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing,Actuation, Basics of Networking,

UNIT II **9 Periods**

M2M and IoT Technology Fundamentals- Devices andgateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role ofCloudinIoT,SecurityaspectsinIoT.

UNIT III **14 Periods**

ElementsofHardwareComponents-
Computing(Arduino,RaspberryPi),Communication,Sensing,Actuation,I/Ointerfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for CommunicationProtocols-MQTT,ZigBee,Bluetooth,CoAP,UDP,TCP.

UNIT IV **14 Periods**

IoTApplicationDevelopment:Solution framework for IoT applications- Implementation of Device integration,Data acquisitionandintegration, Devicedatastorage-Unstructured data storage on cloud / localserver, Authentication, authorizationofdevices.

UNIT V **14 Periods**

IoTCaseStudies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture,Healthcare,HomeAutomation

Learning Resources:

Text Books:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things,"A Hands on Approach",University Press
2. Dr.SRNReddy, Rachit Thukral and Manasi Mishra, "Introduction toInternet of Things: Apractical Approach ", ETILabs
3. Pethuru Rajand Anupama C.Raman, "TheInternet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. JeevaJose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things ", Wiley
6. RajKamal, "Internet of Things: Architecture and Design ", McGrawHill
7. CunoPfister, "Getting Started with the Interne tof Things", OReilly Media

Elective Courses for II Semester M.Tech(CSE)

CSEL13	Block Chain Technologies	L	T	P	C
		3	0	0	3

Course objectives:

1. Realize the working of block chain systems.
2. To securely interact with them.
3. Design, build, and deploy smart contracts and distributed applications,
4. Integrate ideas from block chain technology into their own projects.

Course outcomes:

1. Summarize the functioning of Block chain technology.
2. Examine the working of Smart Contracts.
3. Illustrate and simplify the working of Hyper ledger.
4. Apply the knowledge of solidity on Ethereum.
5. Define and distinguish between various concesus algorithms.
6. Design, build, and deploy a block chain application.

Course Content:

UNIT I **12 Periods**

Distributed System Concepts: Distributed Database, Two General Problem, Byzantine General Problem and Fault Tolerance, P2P Systems

Cryptography: Digital Signatures, Hashing, public & private key cryptosystems.

Block chain Basics: Blockchain, Blockchain Networks, History of block chain, Blockchain Challenges, Block chain Transactions. Private and Public blockchain, Life of Blockchain application.

UNIT II **12 Periods**

Distributed Consensus: The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW), Proof of Stake (PoS) - Hybrid models (PoW + PoS).

UNIT III **12 Periods**

Bitcoin: Bitcoin Mining, Bitcoin Wallets, Decentralization, MerkleTree,double spending - mathematical analysis of properties of Bitcoin, Distributed Ledger, Bitcoin protocols.

Ethereum - Ethereum Virtual Machine (EVM), Construction, DAO, GHOST, Consensus Mechanisms, Solidity - Smart Contracts - some attacks on smart contracts.

UNIT IV **12 Periods**

Hyper ledger: Distributed Ledger Challenges, projects in hyper ledger, Hyper ledger Fabric, Hyper ledger Composer.

Solidity Programming: Smart Contract languages, Installing Solidity &Ethereum Wallet, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address)

UNIT V **12 Periods**

Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

Trends: Zero Knowledge proofs and protocols in Blockchain**,**Zero Knowledge proofs and protocols in Blockchain.

Learning Resources:

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).

Reference Books:

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper.2014.
4. Nicola Atzei, Massimo Bartlett, and TizianaCimoli, A survey of attacks on Ethereumsmart contracts.
5. Antonopoulos and G. Wood, Mastering Ethereum.
6. D.Drescher, Blockchain Basics. Apress, 2017.

Web sources:

1. NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#
2. Udemy: https://www.udemy.com/course/build-your-blockchain-az/
3. EDUXLABSOnlinetraining:https://eduxlabs.com/courses/blockchaintechnologytraining/?tab=tab-curriculum

CSEL14 **Virtual Reality**

CSEL15 **Knowledge Graphs**

CSEL16 **GPU Programming**

CSEL17	Software Testing & Quality Assurance	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basics of testing, test planning &design and test team organization.
2. To study the various types of test in the life cycle of the software product.
3. To build design concepts for system testing and execution.
4. To learn the software quality assurance, metrics, defect prevention techniques
5. To learn the techniques for quality assurance and applying for applications.

Course Outcomes:

Up on completion of this course, the students should be able to

1. Understand software testing and quality assurance as a fundamental component of software life cycle.
2. Explain system testing and test execution process.
3. Create test strategies and plans, design test cases, prioritize and execute them.
4. Discuss the quality assurance process and its role in software development.
5. Analyze the impact of maturity models on software quality and testing.

Course Content:

UNIT I **12Periods**

SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES: Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Teambuilding..

UNIT II **12Periods**

SYSTEM TESTING: System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models

UNIT III **12Periods**

SYSTEM TEST CATEGORIES: System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote. system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. system test execution- Modeling Defects,

Metrics for Monitoring Test Execution .Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

UNIT IV **12Periods**

SOFTWARE QUALITY : Five Views of Software Quality , McCall's Quality Factors and Criteria , Quality Factors , Quality Criteria, Relationship between Quality Factors and Criteria ,Quality Metrics , Quality Characteristics , ISO 9000:2000 Software Quality Standard

UNIT V **12Periods**

MATURITY MODELS : Basic Idea in Software Process , Capability Maturity Model , CMM Architecture , Five Levels of Maturity and Key Process Areas, Application of CMM , Capability Maturity Model Integration (CMMI) , Test Process Improvement ,Testing Maturity Model.

Learning Resources:

Text Book:

1. Software Testing and Quality Assurance-Theory and Practice, KshirasagarNakPriyadarshiTripathy, John Wiley & Sons Inc,2008

Reference Books:

1. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
2. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
3. Software Quality Assurance, MilindLimaye, TMH, New Delhi, 2011
4. WilliamPerry,EffectiveMethodsofSoftwareTesting,ThirdEdition,WileyPublishing 2007.
5. SrinivasanDesikanandGopalaswamyRamesh,SoftwareTestingPrinciplesandPractices, Pearson Education,2007.

CSEL18 **Search Engine Internals**

CSEL19	Natural Language Processing	L	T	P	C
		4	0	0	4

Course Objectives:

1. Understand and apply fundamental algorithms and techniques in the area of natural language processing (NLP).
2. Understand approaches to syntax and semantics in NLP.
3. Understand current methods for statistical approaches to machine translation.
4. Understand language modelling.
5. Understand machine learning techniques used in NLP.

Course Outcomes:

1. Show sensitivity to linguistic phenomena.
2. An ability to model linguistic phenomena with formal grammars.
3. Ability to design, implement and analyze NLP algorithms.

Course Content:

UNIT - I **12 Periods**

Introduction to Natural Language Understanding, Syntactic Processing: Grammars and Parsing

UNIT-II **12 Periods**

Features and Augmented Grammars, Grammars for Natural Language, Toward Efficient Parsing

UNIT-III **12 Periods**

Ambiguity Resolution: Statistical Methods: Probabilistic Context-Free Grammars, Best-First Parsing.

UNIT-IV **12 Periods**

Semantic Interpretation:

Linking Syntax and Semantics, Ambiguity Resolution, other Strategies for Semantic Interpretation.

UNIT-V **12 Periods**

Context and World Knowledge: Using World Knowledge, Discourse Structure, Defining a Conversational Agent.

Learning Resources:

Text Books:

1. James Allen, **Natural Language Understanding**, Second Edition, Pearson Education.

Reference Books:

1. Daniel Jurafsky, James H. Martin, **Speech and Language Processing**.
2. Christopher Manning, HinrichSchutze, **Foundations of Statistical Natural Language Processing**, MIT Press.
3. Elaine Rich and Kevin Knight, **Artificial Intelligence**, Second Edition, Tata McGraw Hill.

CSEL20 Social Network Analysis

CSEL21	Visual Programming	L	T	P	C
		3	0	0	3

Course Objectives:

1. The C# language and the .NET Framework.
2. Working of Microsoft Visual Studio Development Environment.
3. Windows Forms applications with rich, highly responsive user interfaces.
4. Development of web applications and Services using ASP.NET.
5. The use of Language Integrated Query (LINQ).

Course Outcomes:

1. Apply basic concepts of C# programming.
2. Apply advanced concepts of C# programming.
3. Develop and deploy windows applications.
4. Develop and deploy web applications and web services using ASP.NET.
5. Develop database driven applications using XML and LINQ.

Course Content:

UNIT I **12 Periods**

Introducing C#: What is the .NET Framework, what is C#.
Variables and Expressions:Basic C# syntax, Basic C# Console Application Structure, Variables, Expressions.
Flow Control: Boolean Logic, Branching, Looping.
More about Variables: Type Conversion, Complex Variable Type, String Manipulation.
Functions: Defining and Using Functions, Variable Scope, The Main () Function, Struct Functions, Function Overloading,Using Delegates.

UNIT II **13 Periods**

Debugging and Error Handling: Error Handling.
Introduction to Object-Oriented Programming: What is Object-Oriented Programming, OOP Techniques.
Defining Classes: Class Definitions in C#, System. Object, Constructors and Destructors.
Defining Class Members: Member Definitions, Additional Class Member Topics, Interface Implementation.
Collections, Comparisons and Conversions: Collections- Using Collection, Defining Collections, Dictionaries, Iterators.
Generics: What are Generics, Using Generics, Defining Generic Types.

UNIT III **12 Periods**

Basic Desktop Programming: XAML, the Playground, Control Layout, the Game Control.
Advanced Desktop Programming: The Main Window, Creating and styling Controls.
Advanced Cloud Programming and Deployment: Creating an ASP.NET WebAPI, Deploying and Consuming an AP.NET web API on Microsoft Azure.

UNIT IV **13 Periods**

XML and JSON: XML Basics, JON Basic, XML Schemas, XML Document Object Model, Converting XML to JSON, searching XML with XPath.
LINQ: LINQ to XML, LINQ Providers, LINQ Query Syntax, LINQ Method Syntax, Ordering Query Results, Aggregates, Select Distinct Query, Group Queries, Joins.
DATABASES: Using Databases, Entity Framework, a code First Database, Using LINQ with Database, Navigates Database relationships, Creating and Querying XML from an Existing Database.

Text Book:

1. Karli Watson, Christian Nagel, Jacob Hammer Pedersen, Jon Reid, and Morgan Skinner, BEGINNING VISUAL C# 2015, Wiley Publishing, Inc.

Reference Books:

1. Stephen C. Perry, Core C# and .NET, Pearson Education, 2006.
2. Herbert Scheldt, C#: The Complete Reference, TATA McGraw Hill Publishing.
3. Andrew Troelsen, Pro C# and the .NET Platform, A! Press.
4. Kevin Hoffman, Microsoft Visual C# 2005 Unleashed, Sams Pearson India.

Web References:

1. https://en.wikipedia.org/wiki/.NET_Framework
2. www.dotnetjalps.com/.../Dynamic-URL-of-asp-net-web-service

CSEL22 **Concurrent Programming**

Course Objectives:

1. principles for programming secure, reliable and robust software in a multi-threaded or multi-process environment.
2. Introduce students to the fundamental theoretic and practical principals of concurrency, with emphasis on the correctness, design and implementation of models of concurrent computation using shared memory architectures.

Course Outcomes:

1. Ability to implement the mechanisms for communication and co-ordination among concurrent processes.
2. Develop an outline of a concurrent program with shared variables using mutual exclusion and condition synchronization to synchronize threads such as locks, condition variables, barriers, semaphores and monitors.
3. Understand and apply mutual exclusion and condition synchronization in multithreaded programs with shared variables.
4. Ability to implement the locking and non-blocking mechanisms

Course Content:

UNIT I

Introduction - Shared Objects and Synchronization, A Fable, Properties of Mutual Exclusion, The Moral, The Producer–Consumer Problem, The Harsh Realities of Parallelization.

Mutual Exclusion - Time, Critical Sections, 2-Thread Solutions, The Peterson Lock, The Filter Lock, Lamport's Bakery Algorithm.

UNIT II

Concurrent Objects -Concurrency and Correctness, Sequential Objects, Quiescent consistency, Sequential Consistency, Linearizability, Linearization Points, Formal Definitions Linearizability, Compositional Linearizability, The Nonblocking Property, Progress conditions, Dependent Progress Conditions, The Java Memory Model, Locks and synchronized Blocks, Volatile Fields, Final Fields.

UNIT III

Synchronization Operations - Consensus Numbers, Consensus Protocols, the compareAndSet () Operation, Introduction Universality, A Lock-Free Universal, Construction Wait- Free Universal Construction, Spin Locks, Test-And-Set Locks

UNIT IV

Linked Lists: The Role of Locking, Introduction, List-Based Sets, Concurrent Reasoning, Coarse-Grained Synchronization, Fine-Grained Synchronization, Optimistic Synchronization, Lazy Synchronization, Non-Blocking Synchronization

UNIT V

Concurrent Queues and the ABA Problem - Concurrent Stacks and Elimination, Transactional Memories

Learning Resources

Text Book(S):

1. The Art of Multiprocessor Programming, by Maurice Herlihy and NirShavit, Morgan Kaufmman Publishers, 1st Edition, Indian Reprint 2012.

Reference Books:

1. Java Concurrency in Practice by Brian Goetz, Tim Peierls, Joshua Block, Joseph Bowbeer, David Holmes and Doug Lea, Addison Wesley, 1st Edition, 2006.
2. Concurrent Programming in Java™: Design Principles and Patterns, Second Edition by Doug Lea, Publisher: Addison Wesley, Pub Date: October 01, 1999.

CSEL23 **Full Stack Development(LBD)**

CSEL24	Deep Learning	L	T	P	C
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Course Objectives:

Course Outcomes:

Course Content:

UNIT I **12 Periods**

Introduction to Deep Learning: Why Deep Learning? What is a neural network? Three reasons to go Deep, Your choice of Deep Net, An old problem: The Vanishing Gradient.

UNIT II **12 Periods**

Deep Learning Models: Restricted Boltzmann Machines, Deep Belief Nets, Convolutional Networks, Recurrent Nets.

UNIT III **12 Periods**

Additional Deep Learning Models: Auto encoders, Recursive Neural Tensor Nets, Deep Learning Use Cases.

UNIT IV **12 Periods**

Introduction to various CNN Architectures: VGG16, VGG19, Alex Net, Google Net, ResNet, etc. Sequence Models: RNN, LSTM, BURT, Image captioning, visual question answering, Generative Adversarial Networks (GAN) models, Deep Reinforcement Learning and Network Visualization.

UNIT V **12 Periods**

Deep Learning Platforms and Software Libraries: What is a Deep Learning Platform? H2O.ai, DatoGraph Lab, what is a Deep Learning Library? CPUs, GPUs, TPUs, PyTorch, Theano, Caffe, Tensor Flow, Dynamic vs Static computation graphs

Learning Resources:

Text Books:

1. Neural Networks and Deep Learning: A Textbook Book by Charu C. Aggarwal
2. Deep Learning: A Practitioner's Approach Book by Adam Gibson and Josh Patterson
3. Deep Learning by Aaron C. Courville, Ian Good fellow, and YoshuaBengio
4. Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using Tensor Flow and Keras by RajalingappaaShanmugamani ,Packt Publications