तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ B.U/Maths./1897

दिनांक 03/12/2022

The Minutes of Meeting of BOS

In reference to the BOS of department of Mathematical Sciences & Computer Applications Institute of Mathematical Sciences & Computer Applications..... held on 28-06-2022 regarding the revision of syllabus in tune with ~~CBCS~~/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

HOD/Coordinator
Dr. R. K. Saini
Head
Deptt. of Mathematical Sciences
& Computer Applications

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI Dated

Department of Mathematical Sciences and Computer Applications

Minutes of BOS Meeting

Today on 28th May 2022 from 12:15 PM onwards, a meeting of BOS (Board of Studies) for the session 2022-2023 as per New Education Policy (NEP-2020) for the courses BCA, B.Sc.(Mathematics/Statistics/Computer Science), M.Sc.(Statistics), MCA (As per AKTU), B.Sc. (CS & IT), M.Sc. (CS & IT) held in the department of Mathematical Science & Computer Applications, Bundelkhand University, Jhansi, UP. The following members present in the meeting:

1. Prof. R.K. Saini, BU Jhansi- HOD, Convener of BOS
2. Prof. Ravindra Patel RGPV, Bhopal- External Expert
3. Prof. Vijay Gupta, RGPV, Bhopal- External Expert
4. Prof. Avnish Kumar, BU Jhansi- Member
5. Dr. Alok Verma, BU Jhansi- Member
6. Dr. Saurabh Srivastava BU Jhansi- Member
7. Dr. Dharmendra Badal, BU Jhansi- Member
8. Dr. Dharmendra Kanchan, BU Jhansi- Member
9. Dr. D. Das Prajapati, BU Jhansi- Member
10. Dr. Anil Kevat, BU Jhansi- Member
11. Dr. Sachin Upadhyay, BU Jhansi- Member
12. Mr. Kamal Gupta, BU Jhansi- Member
13. Dr. Punit Matapurkar, BU Jhansi- Member
14. All Teaching Assistants, BU Jhansi- Member

After a through discussion, the following decisions are adopted:-

1. New Education Policy-2020 is adopted for the courses BCA, B.Sc.(Mathematics/Statistics/Computer Science), M.Sc.(Statistics), MCA(As per AKTU), B.Sc. (CS & IT), and M.Sc. (CS & IT), which will be effective session 2022-2023.
2. Panel of examiners for all courses running through the department are signed by members.
3. The syllabus of all the courses as BCA, B.Sc.(Mathematics/Statistics/Computer Science), M.Sc.(Statistics), MCA(As per AKTU), B.Sc. (CS & IT), and M.Sc. (CS & IT), takes a modification upto 20% form previous one, suggested by students and industry persons.
4. According NEP-2020, some value added courses, entrepreneurships programme and employability skill programme and courses are adopted.
5. Discussion for starting the course M.Sc.(Statistics with soft computing) in place of M.Sc.(Statistics) in the department from next academic session.
6. M.Sc. in Data Science, will be the new course in the deptt from session 2022-23.

(Prof. R. K. Saini)
Head

BUNDELKHAND UNIVERSITY,JHANSI (UP)

EVALUATION SCHEME & SYLLABUS
First Year
FOR

MASTER OF COMPUTER APPLICATION (MCA)
(Two Year Course)

As per

BUNDELKHAND UNIVERSITY (BU) (Adopted from AKTU)

MODEL CURRICULUM
(Effective from the Session:2020-21)

Program Overview

Master of Computer Applications (MCA)

Department of Mathematical Sciences & Computer Application
Bundelkhand University, Jhansi

The broad objective of the Master of computer Application, 2 years (4-Semesters)programme is to prepare post graduates students for dynamic careers in software and IT industry, corporate sector, Govt. organizations and academic world by providing skill based environment for teaching and research in the core and emerging areas of the discipline.
The Programmes driving force is on giving the students a thorough and sound background in theoretical and skill-oriented courses relevant to the latest computer software development. The programme emphasizes the application of software and IT technologies to solve mathematical, computing, communications/networking and commercial problems. This Master's Degree Programme has been designed with a semester approach in mind. The first year courses are aimed at skills development in computers using various technologies, the second year is more focused on core courses providing conceptual frame work and provides thespecialization and the project work.

Programme Educational Objectives

The Master of Computer Applications Programme Educational Objectives aims to:

1. MCA graduates who will have successful careers based on their understanding of formal and practical methods of Application Development using the concepts of computer programming, software and design principles.

2. MCA graduates will demonstrate analytical and design skills including the ability to generate creative solutions and foster team-oriented, professionalism through effective communication in their careers.

3. MCA graduates who will exhibit effective work ethics and be able to adapt to the challenges of a dynamic job environment.

Program Outcomes (POs)

The Master of Computer Applications (MCA) Programme will prepare its graduates to achieve:

PO1	Domain Knowledge	The understanding to apply knowledge of computing and technological advances appropriate to the programme.
PO2	Skill Enhancement	Skills to analyze a problem, and identify and define the logical modeling of solutions.
PO3	Design & Implementation	An ability to design implements and evaluate a computer-based system, process, component, or programme to meet stakeholder needs.
PO4	Project Management	The knack to function effectively in teams to accomplish a common goal.
PO5	Ethics	A sense of professional, ethical, legal, security and social issues and responsibilities.
PO6	Communication	Effectiveness in communicating with a wide range of audiences.
PO7	Investigation of complex problems.	An ability to analyze the local and global impact of business solutions on individuals, organizations, and society.
PO8	Life-long Learning	An identification of the need to engage in continuing professional development.

Program Specific Outcomes (PSOs)

Program Specific Outcomes (PSOs): PSOs are statements that describe what the students of MCA should be able to do.

PSO1: Produce knowledgeable and skilled human resources which are employable in IT and ITES.

PSO2: Impart knowledge required for planning, designing and building complex Application software Systems as well as provide support to automated systems or application.

PSO3: Produce entrepreneurs who can develop customized solutions for smallto large Enterprises.

PSO4: To develop academically competent and professionally motivated personnel, equipped with objective, critical thinking, right moral and ethical values that compassionately foster the scientific temper with a sense of social responsibility.

PSO5: To develop students to become globally competent.

PSO6: To inculcate Entrepreneurial skills among students.

Ordinance, Course Structure & Syllabus

1. **Introduction:** The **Master of Computer Applications (MCA)** Programme has been designed with asemester approach in mind. It is a three years degree course consisting six semesters and in each year there are two semesters. Courses in semester I to V are aimed at skills development in computer science and application using various recent technologies, while in VIth semester students has to develop a live project in any Industry/Software co. or any of the reputed institutions. In each semester student has to develop a software project (Practical) that can become students more expert in handling the programming language and the programming logics.

2. The candidate who have passed BCA/ B.Sc. (Mathematics)/ B.Sc. (Computer Science)/ B.Sc.(IT)/ B.Sc.(Statistics) and Mathematics as core subject at 10+2 level will be considered for equivalent at the entrance test for admission to the MCA Course, Subject to the admission procedure to be laid down by the university from time to time.

3. The examination in all odd Semester papers shall be conducted at the end of odd semester and an examination in all even semester papers shall be conducted at the end semesters.

4. Maximum duration of course will be six years.

5. English shall be the medium of instructions and examinations.

6. **Evaluation– Marks and Grading System:**

a) Evaluation will be done on a continuous basis. End semester practical examinations shall normally be held before the theory examinations. The Student's performance in a course will be evaluated by assigning a letter grade on the few point scale.
b) Semester examinations in each subject shall carry 100 marks. Syllabus of each paper will divided in three units. After completion of each unit there will be sessional examination. Each paper has one semester and three sessional examinations.
c) It is necessary that a candidate must secure **40%** marks in each subject separately (theory, sessional and practical examinations individually) in order to pass the examination.
d) If a candidate secure less than **40%** marks in two subjects separately (theory, sessional and practical examinations), He/She will be declared back paper in that subjects. The candidate shall be provisionally promoted to the next higher semester with the condition that he/she pass the back paper exam in one attempt of the subsequent semester examination.
e) If a candidate secure less than **40%** marks in more than two subjects including separately (theory, sessional and practical examinations), he/she will be declared fail in semester examination and the whole semester has to be repeated.

f) The internal component of 30% shall be based on 10% of total course weightage for Ist unit test, 10% of total course weightage for IInd unit test, and 10% of total course weightage for IIIrd unit test, be evaluated by the instructor. Instructor will evaluate this on the basis of assignments, seminars, quizzes, attendance and practical work etc. as announced at the beginning of the course.

g) Every candidate shall have to pass the MCA in I, II, III, IV, V & VI semester examinations separately but the division shall be awarded on the basis of the aggregate of marks obtained by a candidate in all six semester of the examination.

h) Division shall awarded on the basis of aggregate of the marks of the combined result of MCA in I, II, III, IV, V & VI semester examinations. A candidate who has obtain **40%** marks and above but less than 50% marks in the aggregate shall be placed in the Third Division. A candidate who has obtain 50% marks and above but less than 60% marks in the aggregate shall be placed in the Second Division. A candidate who has obtained 60% marks and above in the aggregate shall be placed in the First Division. A Candidate who has obtained 75% marks and above in the aggregate shall be placed in the First Division with Honors.

7. The minimum attendance for each paper for appearing the semester examination shall be 75 %.

8. Choice-Based Credit System (CBCS):

learn at their own pace,

Choose electives from a wide range of elective courses offered by the University departments,

Adopt an inter-disciplinary approach in learning, and Make best use of the expertise of available faculty.

(a) Credits: Credit is a kind of weightage given to the contact hours to teach the prescribed syllabus,which is in a modular form. Normally one credit is allocated to 15 contact hours.

(b) In each of the courses, credits will be assigned on the basis of the number of lectures / tutorials / laboratory work and other forms of learning required for completing the course contents in maximum 18 week schedule.

The instructional days as worked out by BU Jhansi for one academic year are 180 working days i.e. 90 days per semester.

Programmes have minimum five papers and one practical in each semester. It means student has to complete 24 credits in each semester.

Mechanism of contact hours: As per BU Jhansi standard 42 hours per semester.

Mechanism of Credit Calculation: As per BU Jhansi standard, **1Credit = 14 hours of lectures.**

Contact hours will include all the modes of teaching and it includes forms like lectures / tutorials / laboratory work or other forms. In determining the number of hours of instruction required for a course involving laboratory, 2 hours of laboratory is generally considered equivalent to 1 hour of lecture.

© **Credit Point, (P):** Credit point is the value obtained by multiplying the grade point (G) by the credit (C): P = GxC. Grade point is an integer indicating the numerical equivalent of the letter grade.

(d) Semester Grade Point Average (SGPA): Semester Grade Point Average (SGPA) is the valueobtained by dividing the sum of credit points (P) earned by a student in various courses taken in a semester by the total number of credits earned by the student in that semester. SGPA shall be rounded off to two decimal places.

(e) Cumulative Grade Point Average (CGPA): Cumulative Grade Point Average'**(CGPA)**is thevalue obtained by dividing the sum of credit points in all the courses earned by a student for the entire programme, by the total number of credits. CGPA shall be rounded off to two decimal places. CGPA indicates the comprehensive academic performance of a student in a programme.

An overall letter grade (Cumulative Grade) for the entire programme shall be awarded to a student depending on his/her CGPA.

(f) **Grading System:**

The grade points are the numerical equivalent of letter grade assigned to a student in the 07 points scale as given below:

% Mark Range	Grade	Grade Point
90 and above	A+	10
80-89	A	9
70-79	B+	8
60-69	B	7
50-59	C+	6
40-49	C	5
Below 40	F	0

(g) **Extra Credits:**Extra credits may be awarded to a student for achievements in co-curricular activitiescarried out outside the regular class hours, as decided by the University. These credits shall not be counted while considering the minimum credits for completing the programme. The University shall frame detailed guidelines for the award of co-curricular credits and grades.

(h) **Computation of (SGPA)and CGPA**

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

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

$$\text{SGPA}(\mathbf{Si}) \quad \frac{(Ci \quad Gi)}{Ci}$$

where Ci is the number of credits of the ith course.
Gi is the grade point scored by the student in the ith course.

(ii) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\text{CGPA} \quad \frac{(Ci \ Si)}{Ci}$$

where Si is the SGPA of the ith semester.
Ci is the total number of credits in that semester.

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

Illustration for SGPA

Course	Credit	Grade Letter	Grade Point	Credit Point
Course 1	4	A+	10	10x40=40
Course 2	4	B+	8	8x4=32
Course 3	3	C	5	5x3=15
Course 4	3	B	7	7x3=21
	14			108

Thus, **SGPA** =108/14 =7.71

Illustration for CGPA

Semester I	**Semester II**	**Semester III**	**Semester IV**	**Semester V**	**Semester VI**
Credit: 26 SGPA: 6.37	Credit: 20 SGPA: 7.55	Credit: 25 SGPA: 6.35	Credit: 22 SGPA: 6.75	Credit: 19 SGPA: 5.98	Credit: 24 SGPA: 7.00

Thus, CGPA $\frac{26x6.37 \quad 20x7.55 \quad 25x6.35 \quad 22x6.75 \quad 19x5.98 \quad 24x7.00}{6.63\ 136}$

9. Declaration of Results and Award of Degree:

For MCA the degree shall be awarded to the students on the basis of CGPA (Cumulative Grade Point Average) after completion of all semester examination.

After completion of the evaluation process, result will be declared by the University, Candidate declared successful may get the provisional degree certificate. Degree will be conferred at the time convocation or as decided by the Vice Chancellor.

10. Successful candidate shall be classified on the basis of the combined results of semester I, II, III, IV,V,VI examination as follows:

Candidate securing in aggregate:

75 % and above	**First Division with Distinction**
60 % to less than 75 %	**First Division**
50 % to less than 60 %	**Second Division**

The minimum pass marks for the whole year would be 50%

11. Improvement Examinations: A candidate may be allowed to reappear in any two theory papers
(maximum) of any of the semester in subsequent semester examinations to improve the division.

a) If a candidate has availed the chance of appearing in the back paper, he/she will not be allowed to appear in an improvement examination in that next semester.
b) Improvement will not be allowed for practical examination.
c) Improvement will not be allowed in a special back examination.

12. Discontinuation: Discontinuation may be permitted on medical grounds. Discontinuation may bepermitted in the first five semesters, and only for a maximum period of two semesters.

13. **Scrutiny:** Scrutiny will be allowed to the student in two papers on payment of prescribed fees asdecided by the University with the permission of V.C. provided the student applies for the same within one month of declaration of result of particular semester.

14. **Restructuring of course structure**: The design course structure and content of the syllabi ofMCA will be decided by the Board of Studies from time to time. The BOS may add a new theory paper or practical or delete an already existing theory paper or practical from the course if necessary based on the need of the time and trends in science.

15. **Amendment:** The rules described in the ordinance will be applicable for minimum period of threeyears. After this period the rules may be reconsidered by the appropriate bodies of the Universities if necessary. The BOS shall be the primary body which frames the ordinance.

Structure of the Syllabus MCA (Two Year Course)

MCA- Semester-I

Paper Code	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
6621(N)	Fundamental of Computers & Emerging Technologies	04	30	70	100	04
6622(N)	Problem Solving using C	04	30	70	100	04
6623(N)	Principles of Management & Communication	04	30	70	100	04
6624(N)	Discrete Mathematics	04	30	70	100	04
6625(N)	Computer Organization & Architecture	04	30	70	100	04
60626(N)	Problem Solving using C Lab	02	-	100	100	04
60627(N)	Computer Organization & Architecture Lab	02	-	50	50	02
60628(N)	Professional Communication Lab	02	-	50	50	02
		26	**150**	**550**	**700**	**28**

MCA- Semester-II

Paper Code	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
6626(N)	Object Oriented Programming	04	30	70	100	04
6627(N)	Theory of Automata & Formal Languages	04	30	70	100	04
6628(N)	Database Management System	04	30	70	100	04
6629(N)	Operating System	04	30	70	100	04
6630(N)	Data Structure & Analysis of Algorithm	04	30	70	100	04
60631(N)	Object Oriented Programming **Lab**	02	-	100	100	04
60632(N)	DBMS **Lab**	02	-	50	50	02
60633(N)	Data Structure & Analysis of Algorithm **Lab**	02	-	50	50	02
		26	**150**	**550**	**700**	**28**

MCA- Semester-III

Paper Code	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
7621(N)	Artificial Intelligence	04	30	70	100	04
7622(N)	**Elective-2** Web Technology	04	30	70	100	04
7623(N)	Software Engineering	04	30	70	100	04
7624(N)	**Elective-1** Cryptography & Network Security	04	30	70	100	04
7625(N)	Computer Network	04	30	70	100	04
70626(N)	Mini Project **Lab**	04	-	150	150	04
70627(N)	Web Technology **Lab**	02	-	50	50	02
		26	**150**	**550**	**700**	**28**

Elective-1	Cryptography & Network Security
	Data Warehousing & Data Mining
	Software Project Management
	Cloud Computing
	Compiler Design
Elective-2	Web Technology
	Big Data
	Simulation & Modeling
	Software Testing & Quality Assurance
	Digital Image Processing

MCA- Semester-IV

Paper Code	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
7631(A)	**SET** – (A) Soft Computing (Elective-III)	04	30	70	100	04
7632(A)	(A) Internet of Things (Elective-IV)	04	30	70	100	04
7633(A)	(A) Computer Graphics & Animation (Elective-V)	04	30	70	100	04
70634	70629(N) Major Project Based on Elective Papers (I To V)	04	-	200	200	08
70635	70630(N) Presentation Based on Major Project	04	-	100	100	04
70636	70631(N) Viva-Voce Based on Major Project	04	-	100	100	04
		26	**90**	**610**	**700**	**28**

Paper Code	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
7631(B)	**SET** – (B) Data Analytic (Elective-III)	04	30	70	100	04
7632(B)	(B) Block Chain Architecture (Elective-IV)	04	30	70	100	04
7633(B)	(B) Machine Learning (Elective-V)	04	30	70	100	04
70634	70629(N) Major Project Based on Elective Papers (I To V)	04	-	200	200	08
70635	70630(N) Presentation Based on Major Project	04	-	100	100	04
70636	70631(N) Viva-Voce Based on Major Project	04	-	100	100	04
		26	**90**	**610**	**700**	**28**

Syllabus

MCA1st Year
Ist Semester

MCA(MASTEROFCOMPUTERAPPLICATION)FI RSTYEARSYLLABUS
SEMESTER-I

MCA-6621:FUNDAMENTALOFCOMPUTERS&EMERGINGTECHNOLOGIES		
Course Outcome(CO)	**Bloom's KnowledgeLevel(KL)**	
At the end of course, the student will be able to		
CO1	Demonstrate the knowledge of the basic structure, components, features and Generations of computers.	K_1,K_2
CO2	Describe the concept of computer languages, language translators and construct Algorithms to solve problems using programming concepts.	K_2,K_3
CO3	Compare and contrast features, functioning & types of operating system and computer networks.	K_4
CO4	Demonstratearchitecture,functioning&servicesoftheInternetandbasicsof multimedia.	K_2
CO5	Illustratetheemergingtrendsandtechnologiesinthefieldof Information Technology.	K_1,K_2
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Computer:** Definition, Computer Hardware&Computer Software**Components:**Hardware– Introduction,Inputdevices,Outputdevices,Central ProcessingUnit,Memory-PrimaryandSecondary.Software-Introduction,Types –SystemandApplication. **ComputerLanguages:**Introduction,ConceptofCompiler,Interpreter&Assembler **Problemsolvingconcept:**Algorithms–Introduction,Definition, Characteristics, Limitations,Conditionsinpseudo-code,Loopsinpseudocode.	**08**
II	**Operatingsystem:**Definition,Functions,Types,Classification,Elementsof command based and GUIbased operating system. **ComputerNetwork:**Overview,Types(LAN,WANandMAN),Data communication, topologies.	**08**
III	**Internet:**Overview,Architecture,Functioning,BasicserviceslikeWWW,FTP, Telnet,Gopher etc.,Search engines,E-mail, Web Browsers. **InternetofThings(IoT):**Definition,Sensors,theirtypesandfeatures,Smart Cities, Industrial Internet of Things.	**08**
IV	**Blockchain:**Introduction,overview,features,limitationsandapplicationareas fundamentals of Block Chain. **Cryptocurrencies:**Introduction,Applicationsanduse cases **CloudComputing:**Itnatureandbenefits,AWS,Google,Microsoft&IBM Services	**08**
V	**EmergingTechnologies:** Introduction, overview, features, limitations and applicationareasofAugmentedReality,VirtualReality,Gridcomputing,Green computing,Bigdataanalytics,QuantumComputingandBrainComputer Interface	**08**

SuggestedReadings:

1. RajaramanV.,"FundamentalsofComputers",Prentice-HallofIndia.
2. NortonP.,"IntroductiontoComputers",McGrawHillEducation.
3. GoelA.,"ComputerFundamentals",Pearson.
4. BalagurusamyE.,"FundamentalsofComputers",McGrawHill
5. TharejaR.,"FundamentalsofComputers",OxfordUniversity Press.
6. BindraJ.,"TheTechWhisperer-onDigitalTransformationandtheTechnologiesthatEnableit",Penguin

MCA-6622:PROBLEMSOLVINGUSINGC		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Describethefunctionalcomponentsandfundamentalconceptsofa digitalcomputersystemincludingnumbersystems.	K_1,K_2
CO2	Constructflowchartandwritealgorithmsforsolvingbasicproblems.	K_2,K_3
CO3	Write'C'programsthatincorporateuseofvariables,operatorsand expressionsalongwithdatatypes.	K_2,K_3
CO4	Writesimpleprogramsusingthebasicelementslikecontrolstatements, functions,arraysandstrings.	K_2,K_3
CO5	Writeadvancedprogramsusingtheconceptsofpointers,structures, unionsandenumerateddatatypes.	K_2,K_3
CO6	Applypre-processordirectivesandbasicfilehandlingandgraphics operationsinadvancedprogramming.	K_2,K_3
DETAILEDSYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Basicsofprogramming:** Approaches to problem solving, Use of high level programming language for systematic development of programs, Concept of algorithm and flowchart, Concept and role of structured programming. **BasicsofC**: History of C, Salient features of C, Structure of C Program, Compiling C Program, Link and Run C Program, Character set, Tokens, Keywords,Identifiers,Constants,Variables,Instructions,Datatypes, StandardInput/Output,Operatorsandexpressions.	**08**
II	**ConditionalProgramExecution:** if, if-else, and nested if-else statements, Switch statements, Restrictions on switch values, Use ofbreak and default with switch, Comparison of switch and if-else. **LoopsandIteration:** for, while and do-while loops, Multiple loop variables, Nested loops, Assignment operators, break and continue statement. **Functions:** Introduction, Types, Declaration of a Function, Functioncalls, Defining functions, Function Prototypes, Passing arguments to a functionReturnvaluesandtheirtypes,Writingmultifunctionprogram, Callingfunctionby value,Recursivefunctions.	**08**
III	**Arrays:** Array notation and representation, Declaring one-dimensional array, Initializing arrays, Accessing array elements, Manipulating array elements, Arrays of unknown or varying size, Two-dimensional arrays, Multidimensional arrays. **Pointers:** Introduction, Characteristics, * and & operators, Pointer type declarationandassignment, Pointer arithmetic, Call by reference,Passing pointers to functions, arrayof pointers, Pointers to functions, Pointer to pointer, Array of pointers. **Strings:** Introduction, Initializing strings, Accessing string elements, Array of strings, Passing strings to functions, String functions.	**08**

IV	**Structure:** Introduction, Initializing, defining and declaring structure, Accessing members, Operations on individual members, Operations on structures, Structure within structure, Array of structure, Pointers to structure. **Union:** Introduction, Declaring union, Usage of unions, Operations on union. Enumerated data types **Storageclasses**:Introduction,Types-automatic,register,staticand external.	**08**
V	**DynamicMemoryAllocation**:Introduction,Libraryfunctions– malloc, calloc, realloc and free. **FileHandling:** Basics, File types, File operations, File pointer, File opening modes, File handling functions, File handling through command line argument, Record I/O in files. **Graphics:** Introduction, Constant, Data types and global variables usedingraphics,Libraryfunctionsusedindrawing,Drawingandfilling images,GUI interactionwithintheprogram.	**08**

SuggestedReadings:

1. KanetkarY.,"LetUsC",BPBPublications.
2. Hanly J. R. and Koffman E. B.,"Problem Solving and Program Design in C", Pearson Education.
3. SchildtH.,"C-TheCompleteReference",McGraw-Hill.
4. GoyalK.K.andPandeyH.M.,TroubleFreeC",UniversitySciencePress
5. GottfriedB.,"Schaum'sOutlines- ProgramminginC", McGraw-HillPublications.
6. KochanS.G.,"ProgramminginC",Addison-Wesley.
7. Dey P. and Ghosh M., "Computer Fundamentals and Programming in C", Oxford University Press.
8. GoyalK.K.,SharmaM.K.andThapliyalM.P."ConceptofComputerandC Programming",UniversitySciencePress.

MCA- 6623 PrinciplesofManagement&Communication		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Describeprimaryfeatures,processesandprinciplesofmanagement.	K_1,K_2
CO2	Explainfunctionsofmanagementintermsofplanning,decisionmakingand organizing.	K_3,K_4
CO3	Illustratekeyfactorsofleadershipskillindirectingandcontrollingbusinessresources andprocesses.	K_5,K_6
CO4	Exhibitadequateverbalandnon-verbalcommunicationskills	K_1,K_3
CO5	Demonstrateeffectivediscussion,presentationandwritingskills.	K_3,K_5
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**ProposedLecture**
I	**Management**: Need,Scope,MeaningandDefinition.TheprocessofManagement, DevelopmentofManagementthoughtF.W.TaylorandHenryFayol,Horothorne Studies,QualitiesofanEfficientManagement.	**08**
II	**Planning&Organising:**Need,ScopeandImportanceofPlanning,Stepsinplanning, Decisionmakingmodel.OrganisingneedandImportance,OrganisationalDesign, Organisationalstructure,centralisationandDecentralisation,Deligation.	**08**
III	**Directing&Controlling:** Motivation—Meaning, Importance, need.Theories of Motivation,Leadership—meaning,needandimportance,leadershipstyle,Qualitiesof effective leader, principles of directing, Basic control process, Different control Techniques.	**08**
IV	**IntroductiontoCommunication:** WhatisCommunication,Levelsofcommunication, Barriers to communication, ProcessofCommunication, Non-verbalCommunication, TheflowofCommunication:Downward,Upward,LateralorHorizontal(Peergroup) Communication, Technology Enabled communication, Impact of Technology, SelectionofappropriatecommunicationTechnology,ImportanceofTechnical communication.	**08**
V	**Businessletters:** Sales&Creditletters;ClaimandAdjustmentLetters;Job application and Resumes. **Reports:**Types;Structure,Style&WritingofReports. **TechnicalProposal:**Parts;Types;WritingofProposal;Significance. NuancesofDelivery;BodyLanguage;DimensionsofSpeech:Syllable;Accent;Pitch; Rhythm; Intonation; Paralinguistic features of voice; Communicationskills,Presentationstrategies,GroupDiscussion;Interviewskills; Workshop; Conference; Seminars.	**08**

SuggestedReadings:

1. P.C.Tripathi,P.N.Reddy,"PrinciplesofManagement",McGrawHillEducation6th Edition.
2. C.B.Gupta,"ManagementPrinciplesandPractice",SultanChand&Sons3rd edition.
3. T.N.Chhabra,"BusinessCommunication",SunIndiaPublication.
4. V.N.AroraandLaxmiChandra,"ImproveYourWriting",OxfordUniv.Press,2001,NewDelhi.
5. MadhuRaniandSeemaVerma,"TechnicalCommunication:APracticalApproach",AcmeLearning, New Delhi-2011.
6. MeenakshiRaman&SangeetaSharma,"TechnicalCommunication-PrinciplesandPractices",Oxford Univ. Press, 2007, New Delhi.
7. KoontzHarold&WeihrichHeinz,"EssentialsofManagement",McGrawHill5th Edition2008.
8. RobbinsandCoulter, "Management",PrenticeHallofIndia,9th edition.
9. JamesA.F.,Stoner,"Management",PearsonEducationDelhi.
10. P.D.Chaturvedi,"BusinessCommunication",PearsonEducation.

MCA-6624DiscreteMathematics		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Usemathematicalandlogicalnotationtodefineandformallyreasonaboutbasic discretestructuressuchasSets,RelationsandFunctions	K_1,K_2
CO2	Applymathematicalargumentsusinglogicalconnectivesandquantifierstocheck the validity ofanargumentthroughtruthtablesandpropositionalandpredicatelogic	K_2,K_3
CO3	IdentifyandprovepropertiesofAlgebraicStructureslikeGroups,RingsandFields	K_3,K_4
CO4	Formulateandsolverecurrencesandrecursivefunctions	K_3,K_4
CO5	Applytheconceptofcombinatoricstosolvebasicproblemsindiscretemathematics	K_1,K_3
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**ProposedLecture**
I	**SetTheory:**Introduction, SizeofsetsandCardinals, Venndiagrams,Combinationof sets, Multisets, Ordered pairs and Set Identities. **Relation:**Definition, Operationsonrelations,Compositerelations,Properties of relations, Equality of relations, Partial order relation. **Functions:**Definition,Classificationoffunctions,Operationsonfunctions, Recursively defined functions.	**08**
II	**Posets,HasseDiagramandLattices:**Introduction,Partialorderedsets,Combination ofPartialordered sets,Hassediagram, Introductionoflattices,Propertiesoflattices– Bounded, Complemented, Modular and Complete lattice. **BooleanAlgebra:**Introduction,AxiomsandTheoremsofBooleanalgebra, Boolean functions.SimplificationofBooleanfunctions,Karnaughmaps,Logicgates.	**08**
III	**Propositional:**Propositions,Truthtables,Tautology,Contradiction,Algebraof Propositions,Theoryof Inference and Natural Detection. **PredicateLogic:**TheoryofPredicates,Firstorderpredicate,Predicateformulas, Quantifiers, Inference theory of predicate logic.	**08**
IV	**AlgebraicStructures:**Introduction to algebraic Structures and properties. Types of algebraic structures:Semi group, Monoid, Group, Abelian group and Properties of group. Subgroup, Cyclic group, Cosets, Permutation groups, Homomorphism and Isomorphism of groups. **RingsandFields:**DefinitionandelementarypropertiesofRingsandFields.	**08**
V	**NaturalNumbers:** Introduction, Piano's axioms, Mathematical Induction, Strong Induction and Induction with Nonzero Base cases. **RecurrenceRelation&Generatingfunctions:** Introduction and properties of Generating Functions. Simple Recurrence relation with constant coefficients and Linear recurrence relation without constant coefficients. Methods of solving recurrences. **Combinatorics:**Introduction,CountingtechniquesandPigeonholeprinciple, Polya'sCountingtheorem.	**08**

SuggestedReadings:

1. KennethH.Rosen,"DiscreteMathematicsandItsApplications",McGrawHill,2006.
2. B.Kolman,R.CBusbyandS.CRoss,"DiscreteMathematicsStructures",PrenticeHall,2004.
3. R.PGirimaldi,"DiscreteandCombinatorialMathematics",AddisonWesley,2004.
4. Y.N.Singh,"DiscreteMathematicalStructures",Wiley-India,Firstedition,2010.
5. SwapankumarSarkar,"ATextbookofDiscreteMathematics",S.Chand&CompanyPVT.LTD.V.
6. Krishnamurthy,"CombinatoricsTheory&Application",East-WestPressPvt.Ltd.,NewDelhi.
7. Liptschutz,Seymour,"DiscreteMathematics",McGrawHill.
8. J.P.Trembely&R.Manohar,"DiscreteMathematicalStructurewithapplicationtoComputerScience", McGraw Hill.

MCA - 6625COMPUTERORGANIZATION&ARCHITECTURE		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Describefunctionalunitsofdigitalsystemandexplainhowarithmeticandlogical operationsareperformedbycomputers	K_2,K_3
CO2	Describetheoperationsofcontrolunitandwritesequenceofinstructionsforcarrying outsimpleoperationusingvariousaddressingmodes.	K_2,K_4
CO3	Designvarioustypesofmemoryanditsorganization.	K_3
CO4	DescribethevariousmodesinwhichIOdevicescommunicatewithCPUandmemory.	K_2,K_3
CO5	Listthecriteriaforclassificationofparallelcomputeranddescribevarious architecturalschemes.	K_1,K_2
DETAILEDSYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:**Functionalunitsofdigitalsystemandtheirinterconnections,buses,bus architecture, typesofbusesandbusarbitration.Register,busandmemorytransfer. **Processororganization:**generalregistersorganization,stackorganizationand addressing modes.	**08**
II	**Arithmeticandlogicunit:**Lookaheadcarriesadders.Multiplication:Signedoperand multiplication,Boothsalgorithmandarraymultiplier.Divisionandlogicoperations. Floatingpointarithmeticoperation,Arithmetic&logicunitdesign.IEEEStandardfor Floating Point Numbers.	**08**
III	**ControlUnit:** Instructiontypes,formats,instructioncyclesandsubcycles(fetchand executeetc),microoperations,executionofacompleteinstruction.ProgramControl, Reduced Instruction Set Computer, Pipelining. Hardwire and micro programmed control:micro-programsequencing,conceptofhorizontalandvertical microprogramming.	**08**
IV	**Memory:**Basicconceptandhierarchy,semiconductorRAMmemories,2D&21/2D memoryorganization.ROMmemories.Cachememories:conceptanddesignissues& performance,addressmappingandreplacementAuxiliarymemories:magneticdisk, magnetictapeandopticaldisksVirtualmemory:conceptimplementation.	**08**
V	**Input/Output:** Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O,interruptinitiatedI/OandDirect MemoryAccess.,I/Ochannelsandprocessors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.	**08**

SuggestedReadings:

1. JohnP.Hayes,"ComputerArchitectureandOrganization",McGrawHill.
2. WilliamStallings,"ComputerOrganizationandArchitecture-DesigningforPerformance",Pearson Education.
3. M.MorrisMano,"ComputerSystemArchitecture",PHI.
4. CarlHamacher,ZvonkoVranesic,SafwatZaky,"ComputerOrganization",McGraw-Hill.
5. BehroozParahami,"ComputerArchitecture",OxfordUniversityPress.
6. DavidA.PattersonandJohnL.Hennessy,"ComputerArchitecture-AQuantitativeApproach", ElsevierPub.
7. Tannenbaum,"StructuredComputerOrganization",PHI.

MCA - 60626PROBLEMSOLVINGUSINGCLAB		
CourseOutcome(CO)		**Bloom's KnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	Write,compile,debugandexecuteprogramsinaCprogramming environment.	K_3
CO2	Writeprogramsthatincorporateuseofvariables,operatorsand expressions along with data types.	K_3
CO3	Writeprogramsforsolvingproblemsinvolving useof decisioncontrol structures and loops.	K_3
CO4	Writeprogramsthatinvolvetheuseofarrays,structuresanduser defined functions.	K_3
CO5	Writeprogramsusinggraphicsandfilehandlingoperations.	K_3

1. Programtoimplementconditional statementsinClanguage.
2. Programtoimplementswitch-case statementinClanguage
3. ProgramtoimplementloopingconstructsinClanguage.
4. Programtoperformbasicinput-outputoperationsinClanguage.
5. ProgramtoimplementuserdefinedfunctionsinClanguage.
6. ProgramtoimplementrecursivefunctionsinClanguage.
7. Programtoimplementone-dimensionalarraysinClanguage.
8. Programtoimplementtwo-dimensionalarraysinClanguage.
9. Programtoperformvariousoperationsontwo-dimensionalarraysinClanguage.
10. Programtoimplementmulti-dimensionalarraysinC language.
11. ProgramtoimplementstringmanipulationfunctionsinClanguage.
12. Programtoimplementstructurein Clanguage.
13. Programtoimplement unioninClanguage.
14. ProgramtoperformfilehandlingoperationsinClanguage.
15. ProgramtoperformgraphicaloperationsinClanguage.

Note:TheInstructormayadd/delete/modifyexperiments,whereverhe/shefeelsinajustifiedmanner.

MCA - 60627COMPUTERORGANIZATION&ARCHITECTURELAB		
CourseOutcome(CO)		**Bloom's KnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	Designandverifycombinationalcircuits(adder,codeconverter, decoder, multiplexer) using basic gates.	K_6
CO2	Designandverifyvariousflip-flops.	K_3
CO3	DesignI/OsystemandALU.	K_3
CO4	Demonstratecombinationalcircuitusingsimulator	K_2

1. ImplementingHALFADDER, FULLADDERusingbasiclogicgates.
2. ImplementingBinary-to-Gray,Gray-to-Binarycodeconversions.
3. Implementing3-8lineDECODER.Implementing4x1and8x1MULTIPLEXERS.
4. VerifytheexcitationtablesofvariousFLIP-FLOPS.
5. Designofan8-bitInput/Outputsystem withfour8-bitInternalRegisters.
6. Designofan8-bitARITHMETICLOGICUNIT.
7. Designthedatapathofacomputerfromitsregister transferlanguagedescription.
8. Design the control unit of a computer using either hardwiring or microprogramming based on its register transfer language description.
9. Implementasimpleinstructionsetcomputerwithacontrolunitandadatapath.

Note:TheInstructormayadd/delete/modify/tuneexperiments,whereverhe/shefeelsinajustifiedmanner.

MCA- 60628PROFESSIONALCOMMUNICATIONLAB		
CourseOutcome(CO)		**Bloom's KnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	Developtheability towork asa teammember as anintegral activity in the workplace.	K_3
CO2	Increaseconfidenceintheirability toread,comprehend, organize,and retain written information. Improve reading fluency.	K_4
CO3	Write coherent speech outlines that demonstrate their ability to use organizational formatswitha specificpurpose; Deliver effective speeches that are consistent with and appropriate for the audience and purpose.	K_5,K_6
CO4	Developproperlisteningskills;articulateandenunciatewordsand sentences clearly and efficiently.	K_3
CO5	Show confidence and clarity in public speaking projects; be schooledinpreparation and research skills for oral presentations.	K_5

1. Group Discussion: participating in group discussions- understanding group dynamics.
2. GD strategies-activities to improve GD skills. Practical based on Accurate and Current Grammatical Patterns.
3. Interview Etiquette-dress code, body language attending job interview – Telephone/Skype interview one to one interview &Panel interview.
4. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic/ Kinesics, practicing word stress, rhythm in sentences, weak forms, intonation.
5. Oral Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics voice modulation ,Audience Awareness, Presentation plan visual aids.
6. Speaking:-Fluency & Accuracy in speech- positive thinking, Improving Self expression Developing persuasive speaking skills, pronunciation practice (foraccept neutralization) particularly of problem sounds, in isolated words as well as sentences.
7. IndividualSpeechDelivery/Conferenceswithskillstodefend Interjections/Quizzes.
8. ArgumentativeSkills/RolePlayPresentationwithStressandIntonation.
9. Comprehension Skills based on Reading and Listening Practical's on a modelAudio-Visual Usage.

Syllabus

MCA1stYearI IndSemester

MCA(MASTEROFCOMPUTERAPPLICATION)FI RSTYEARSYLLABUS

SEMESTER-II

MCA- 6627THEORYOFAUTOMATA&FORMALLANGUAGES		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Definevarioustypesofautomatafordifferentclassesofformal languagesandexplaintheirworking.	K_1,K_2
CO2	Stateandprovekeypropertiesof formallanguages andautomata.	K_1,K_3
CO3	Constructappropriateformalnotations(suchasgrammars,acceptors, transducersandregularexpressions)forgivenformallanguages.	K_3,K_4
CO4	Convertamongequivalentnotationsforformallanguages.	K_3
CO5	ExplainthesignificanceoftheUniversalTuringmachine,Church-Turingthesisandconceptof Undecidability.	K_2
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**BasicConceptsandAutomataTheory:**IntroductiontoTheory ofComputation- Automata, Computability and Complexity, Alphabet, Symbol, String, Formal Languages, Deterministic Finite Automaton (DFA)- Definition, Representation, Acceptability of a String and Language, Non Deterministic Finite Automaton (NFA), Equivalence of DFAandNFA,NFAwithε-Transition,EquivalenceofNFA'swith andwithoutε-Transition,FiniteAutomatawithoutput-Moore machine, Mealy Machine, Equivalence of Moore and Mealy Machine, MinimizationofFiniteAutomata,Myhill-NerodeTheorem,Simulation ofDFAandNFA.	**08**
II	**RegularExpressionsandLanguages:**RegularExpressions,Transition Graph,Kleen'sTheorem,FiniteAutomataandRegularExpression-Arden'stheorem,AlgebraicMethodUsingArden'sTheorem,Regular andNon-Regular Languages- Closure properties of RegularLanguages,PigeonholePrinciple,PumpingLemma,Applicationof PumpingLemma,Decidability-Decisionproperties, Finite Automata and Regular Languages, Regular Languages and Computers, SimulationofTransitionGraphandRegular language.	**08**
III	**RegularandNon-RegularGrammars**: Context Free Grammar(CFG)-Definition,Derivations,Languages,Derivation Trees and Ambiguity, Regular Grammars-Right Linear and LeftLinear grammars, Conversion of FA into CFG and Regular grammar intoFA,SimplificationofCFG,NormalForms-Chomsky NormalForm(CNF),GreibachNormalForm(GNF),Chomsky Hierarchy,Programmingproblemsbasedonthepropertiesof CFGs.	**08**
IV	**PushDownAutomataandPropertiesofContextFreeLanguages**: NondeterministicPushdownAutomata(NPDA)-Definition,Moves, ALanguageAcceptedbyNPDA,DeterministicPushdown Automata(DPDA)andDeterministicContextfreeLanguages(DCFL),	**08**

	Pushdown Automata for Context Free Languages, Context Free grammars for Pushdown Automata, Two stack Pushdown Automata, PumpingLemmaforCFL,ClosurepropertiesofCFL,Decision ProblemsofCFL, Programming problems based on the properties of CFLs.	
V	**TuringMachinesandRecursiveFunctionTheory**:Basic TuringMachineModel, Representation of Turing Machines,Language Acceptability of Turing Machines, Techniques for Turing Machine Construction, Modifications of Turing Machine, Turing Machineas Computer of Integer Functions, Universal Turingmachine, Linear Bounded Automata, Church's Thesis, Recursive and RecursivelyEnumerablelanguage,HaltingProblem,Post CorrespondenceProblem,IntroductiontoRecursiveFunctionTheory.	**08**

SuggestedReadings:

1. J.E.Hopcraft,R.Motwani,andUllman,"IntroductiontoAutomatatheory, Languages and Computation", Pearson EducationAsia,2nd Edition.
2. J. Martin, "Introduction to languages and the theory of computation", McGraw Hill,3rd Edition.
3. C.PapadimitrouandC.L. Lewis,"ElementsandTheoryof Computation",PHI.
4. K.L.P.MishraandN.Chandrasekaran,"TheoryofComputer ScienceAutomata Languages and Computation" , PHI.
5. Y.N. Singh, "Mathematical Foundation of Computer Science", New Age International.

MCA - 6626OBJECTORIENTEDPROGRAMMING		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Listthesignificanceandkeyfeaturesofobjectorientedprogrammingandmodeling usingUML	K_4
CO2	Constructbasicstructural,behavioralandarchitecturalmodelsusingobjectoriented softwareengineeringapproach.	K_6
CO3	Integrateobjectorientedmodelingtechniquesforanalysisanddesignofasystem.	K_4, K_5
CO4	UsethebasicfeaturesofdataabstractionandencapsulationinC++programs.	K_4
CO5	Usetheadvancedfeatures suchasInheritance,polymorphism andvirtualfunctionin C++programs.	K_3, K_4
DETAILEDSYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Object Oriented Programming: objects, classes, Abstraction, Encapsulation, Inheritance,Polymorphism,OOPinJava,CharacteristicsofJava,The Java Environment, Java Source File Structure, and Compilation. Fundamental Programming Structures in Java: Defining classes in Java, constructors, methods, accessspecifies,staticmembers,Comments,DataTypes,Variables,Operators, ControlFlow,Arrays.	**08**
II	**Inheritance,Interfaces,andPackages:** Inheritance: Super classes, sub classes, Protected members, constructors in sub classes, Object class, abstract classes and methods.Interfaces:defining an interface,implementing interface,differencesbetween classes and interfaces and extending interfaces, Object cloning, inner classes. Packages: Defining Package, CLASSPATH Setting for Packages, Making JAR Files forLibraryPackages,ImportandStaticImportNamingConventionForPackages, Networkingjava.netpackage.	**08**
III	**ExceptionHandling,I/O**: Exceptions: exception hierarchy, throwing and catching exceptions,built-in exceptions, creatingownexceptions, StackTraceElements. Input/ Output Basics: Byte streams and Character streams, Reading and Writing, Console Reading and Writing Files.	**08**
IV	**MultithreadingandGenericProgramming:**Differencesbetweenmulti-threading andmultitasking,threadlife cycle,creatingthreads,synchronizing threads, Inter-thread communication,daemonthreads,threadgroups.GenericProgramming:Generic classes, genericmethods,BoundedTypes:Restrictionsand Limitations.	**08**
V	**EventDrivenProgramming:**Graphicsprogramming:Frame,Components,working with 2D shapes,Using colors, fonts, and images. Basics of event handling: event handlers,adapterclasses,actions,mouseevents,AWTeventhierarchy.Introductionto Swing: layout management, Swing Components: Text Fields, Text Areas, Buttons, CheckBoxes,Radio Buttons,Lists,choices, Scrollbars,WindowsMenusandDialog Boxes.	**08**

SuggestedReadings:

1. HerbertSchildt,"JavaThecompletereference",McGrawHillEducation,8thEdition,2011.
2. CayS.Horstmann,GaryCornell,"CoreJavaVolume–IFundamentals", PrenticeHall,9th Edition,2013.
3. StevenHolzner,"JavaBlackBook",Dreamtech.
4. BalagurusamyE,"ProgramminginJava",McGrawHill
5. Naughton,Schildt,"TheCompletereferencejava2",McGrawHill
6. KhalidMughal,"AProgrammer'sGuidetoJavaSE8OracleCertifiedAssociate(OCA)",Addison-Wesley.

MCA- 6629 OPERATINGSYSTEMS		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeableto		
CO1	Explainmaincomponents,services,typesandstructureofOperatingSystems.	K_2
CO2	Applythevariousalgorithmsandtechniquestohandlethevariousconcurrency controlissues.	K_3
CO3	Compareandapply variousCPUschedulingalgorithmsforprocessexecution.	K_2
CO4	Identifyoccurrenceofdeadlockanddescribewaystohandleit.	K_3
CO5	Explainandapplyvariousmemory,I/Oanddiskmanagementtechniques.	K_5
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction**: Operating System Structure- Layered structure, System Components, Operating system functions, Classification of Operatingsystems- Batch,Interactive,Timesharing,RealTimeSystem, MultiprocessorSystems,MultiuserSystems,MultiprocessSystems, Multithreaded Systems, Operating System services, Reentrant Kernels, Monolithic and Microkernel Systems.	**08**
II	**ConcurrentProcesses**:ProcessConcept,PrincipleofConcurrency, Producer / Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Test and Set operation, Classical Problem in Concurrency- Dining Philosopher Problem, Sleeping BarberProblem,InterProcessCommunicationmodelsandSchemes, Processgeneration.	**08**
III	**CPUScheduling:** Scheduling Concepts, Performance Criteria, ProcessStates, Process Transition Diagram, Schedulers, Process Control Block(PCB), Processaddress space, Processidentificationinformation, Threads and their management, Scheduling Algorithms, Multiprocessor Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recoveryfromdeadlock.	**08**
IV	**MemoryManagement:** Basic bare machine, Resident monitor, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Protection schemes, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging,Performanceofdemandpaging,Pagereplacementalgorithms,Thrashing, Cachememoryorganization,Localityofreference.	**08**
V	**I/OManagementandDiskScheduling**:I/Odevices,andI/Osubsystems, I/O buffering, Disk storage and disk scheduling, RAID. File System: File concept, File organization and access mechanism,Filedirectories,andFilesharing,Filesystemimplementation issues,Filesystemprotectionandsecurity.	**08**

SuggestedReadings:

1. Silberschatz,GalvinandGagne,"OperatingSystemsConcepts",WileyPublication.
2. SibsankarHalderandAlexAArvind,"OperatingSystems",PearsonEducation.
3. HarveyMDietel,"AnIntroductiontoOperatingSystem",PearsonEducation.
4. William Stallings, "Operating Systems: Internals and Design Principles", 6th Edition, Pearson Education.
5. Harris,Schaum'sOutlineOfOperatingSystems,McGrawHill

MCA-6628:DATABASEMANAGEMENTSYSTEMS

CourseOutcome(CO)		Bloom'sKnowledgeLevel(KL)
Attheendofcourse,thestudentwillbeableto		
CO1	Describethefeaturesofadatabasesystemanditsapplicationandcomparevarious typesofdatamodels.	K_2
CO2	ConstructanERModelfora givenproblemandtransformitintoarelationdatabase schema.	K_5,K_6
CO3	FormulatesolutiontoaqueryproblemusingSQLCommands,relationalalgebra,tuple calculusanddomaincalculus.	K_5,K_6
CO4	Explaintheneedofnormalizationandnormalizeagivenrelationtothedesirednormal form.	K_2,K_3
CO5	Explaindifferentapproachesoftransactionprocessingandconcurrencycontrol.	K_2
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**ProposedLecture**
I	**Introduction:**Overview,DatabaseSystemvsFileSystem,DatabaseSystemConcept andArchitecture,DataModelSchemaandInstances,DataIndependenceandDatabase Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. DataModeling Using theEntityRelationship Model:ER ModelConcepts, NotationforERDiagram,MappingConstraints,Keys,ConceptsofSuperKey, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams toTables,ExtendedERModel,Relationship ofHigherDegree.	**08**
II	**RelationaldataModelandLanguage:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. IntroductiontoSQL:CharacteristicsofSQL,AdvantageofSQL.SQLDataTypeand Literals. Types ofSQLCommands.SQLOperatorsand their Procedure. Tables,Views andIndexes.QueriesandSubQueries.AggregateFunctions.Insert,UpdateandDelete Operations,Joins,Unions,Intersection,Minus,Cursors,Triggers,Proceduresin SQL/PLSQL	**08**
III	**DataBaseDesign&Normalization:** Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design	**08**
IV	**TransactionProcessingConcept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, RecoveryfromTransactionFailures,LogBasedRecovery,Checkpoints,Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, DirectorySystem	**08**
V	**ConcurrencyControlTechniques:** Concurrency Control, Locking Techniques for ConcurrencyControl, Time StampingProtocols for ConcurrencyControl, Validation BasedProtocol,MultipleGranularity,MultiVersionSchemes,Recoverywith ConcurrentTransaction,CaseStudyofOracle.	**08**

SuggestedReadings:

1. Korth,Silbertz,Sudarshan,"DatabaseConcepts",McGrawHill.
2. DateCJ,"AnIntroductiontoDatabaseSystems",AddisionWesley.
3. Elmasri,Navathe,"FundamentalsofDatabaseSystems",AddisionWesley.
4. O'Neil,"Databases",ElsevierPub.
5. Ramakrishnan,"DatabaseManagementSystems",McGrawHill.
6. Leon&Leon,"DatabaseManagementSystems",VikasPublishingHouse.
7. BipinC.Desai,"AnIntroductiontoDatabaseSystems",GagotiaPublications.
8. Majumdar&Bhattacharya,"DatabaseManagementSystem",McGrawHill.

MCA-6630:DATASTRUCTURES&ANALYSISOFALGORITHMS		
CourseOutcome(CO)		**Bloom'sKnowledge Level(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	Explaintheconceptof datastructure,abstractdatatypes, algorithms, analysis of algorithms and basic dataorganization schemes suchas arrays and linked lists.	K_2
CO2	Describetheapplicationsofstacksandqueuesandimplementvarious operationsonthemusingarraysandlinkedlists.	K_3
CO3	Describethepropertiesofgraphsandtreesandimplementvarious operationssuchassearchingandtraversalonthem.	K_3
CO4	Compareincrementalanddivide-and-conquerapproachesofdesigning algorithmsforproblemssuchassortingandsearching.	K_4
CO5	ApplyandanalyzevariousdesignapproachessuchasDivide-and-Conquer, greedy anddynamicforproblemsolving.	K_4
DETAILEDSYLLABUS		**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introductiontodatastructure:** Data, Entity, Information, Difference between Data and Information, Data type , Build in data type, Abstract data type,Definitionofdatastructures, Typesof DataStructures:Linear and Non-Linear Data Structure, Introduction to Algorithms: Definition of Algorithms, Difference between algorithm and programs, properties of algorithm, Algorithm Design Techniques, Performance Analysis of Algorithms, Complexity of various code structures, Order of Growth, Asymptotic Notations. **Arrays:** Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulaefor1-D,2-DArrayApplicationofarrays,SparseMatricesand their representations. **Linkedlists:** Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition Subtraction & Multiplications of Single variable.	**08**
II	**Stacks**: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. **Queues:** Operations on Queue: Create, Add, Delete, Full and Empty,Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue. **Searching:** Concept of Searching, Sequential search, Index SequentialSearch,BinarySearch.ConceptofHashing&Collisionresolution TechniquesusedinHashing.	**08**

III	**Sorting:** Insertion Sort, Selection Sort, Bubble Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time: Counting Sort and Bucket Sort. **Graphs:** Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal:DepthFirstSearchandBreadthFirstSearch,Connected Component.	**08**
IV	**Trees:** Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Complete Binary Tree, A Extended Binary Trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Constructing Binary Tree from given Tree Traversal, Operation of Insertion, Deletion,Searching&ModificationofdatainBinarySearchTree. Threaded Binary trees, Huffman coding using Binary Tree, AVL Tree and B Tree.	**08**
V	Divide and Conquer with Examples Such as Merge Sort, Quick Sort, Matrix Multiplication: Strassen's Algorithm Dynamic Programming: Dijikstra Algorithm, Bellman Ford Algorithm, All-pair Shortest Path: Warshal Algorithm, Longest Common Sub-sequence GreedyProgramming:PrimsandKruskalalgorithm.	**08**

SuggestedReadings:

1. CormenT.H.,LeisersonC.E.,RivestR.L., andSteinC.,"IntroductiontoAlgorithms",PHI.
2. Horowitz Ellis, Sahni Sartaj and Rajasekharan S., "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press.
3. DaveP.H.,H.B.Dave,"DesignandAnalysisofAlgorithms",2ndEdition,PearsonEducation.
4. LipschutsS.,"TheoryandProblemsofDataStructures",Schaum'sSeries.
5. Goyal K. K., Sharma Sandeep & Gupta Atul, "Data Structures and Analysis of Algorithms", HP Hamilton.
6. Lipschutz, DataStructuresWithC-SIE -SOS,McGraw Hill
7. SamantaD.,"ClassicDataStructures",2nd EditionPrenticeHallIndia.
8. Goodrich M. T. and Tomassia R., "Algorithm Design: Foundations, Analysis and Internet examples", John Wiley and sons.
9. SridharS.,"DesignandAnalysisofAlgorithms",OxfordUniv.Press.
10. Aho,UllmanandHopcroft,"DesignandAnalysisofalgorithms",PearsonEducation.
11. R. Neapolitan and K. Naimipour, "Foundations of Algorithms",4th edition, Jones an Bartlett Student edition.
12. ReemaThareja,DataStructuresusingC,OxfordUniv.Press

MC-60631:OBJECTORIENTEDPROGRAMMINGLAB		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	UsetheConceptofDataAbstractionandEncapsulationinC++ programs.	K_3
CO2	DesignandDevelopC++programusingtheconceptsuchas polymorphism, virtual function, exception handling and template.	K_3
CO3	Applyobjectorientedtechniquestoanalyze,designanddevelopa complete solution for a given problem.	K_3

1. UseJavacompilerandeclipseplatformtowriteandexecutejava program.
2. Creatingsimplejavaprograms,
3. UnderstandOOPconceptsandbasicsofJavaprogramming.
4. CreateJavaprogramsusinginheritanceandpolymorphism.
5. Implementerror-handlingtechniquesusingexceptionhandlingandmultithreading.
6. Understandtheuseofjavapackages.
7. Filehandlingandestablishmentofdatabaseconnection.
8. Developacalculatorapplicationinjava.
9. DevelopaClientServer Application.
10. DevelopGUIapplicationsusingSwingcomponents.

MC-60632:DATABASEMANAGEMENTSYSTEMSLAB		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	UsetheConceptofDataAbstractionandEncapsulationinC++ programs.	K_6
CO2	WriteSQLcommandstoqueryadatabase.	K_3
CO3	WritePL/SQLprogramsforimplementingstoredprocedures,stored functions, cursors, trigger and packages.	K_6

1. Installingoracle/MYSQL.
2. CreatingEntity-RelationshipDiagramusingcasetools.
3. WritingSQLstatementsUsingORACLE/MYSQL:
   a.Writing basic SQL SELECT statements.
   b.Restricting and sorting data.c.Displaying data from multiple tables. d.Aggregating data using group function. e.Manipulating data.
   f.Creatingandmanagingtables.
4. Normalization.
5. Creatingcursor.
6. Creatingprocedureandfunctions.
7. Creatingpackagesandtriggers.
8. Designandimplementationof payrollprocessingsystem.
9. DesignandimplementationofLibraryInformationSystem.
10. Designandimplementationof StudentInformationSystem.
11. AutomaticBackupofFilesandRecoveryofFiles.

MC-60633:DATASTRUCTURES&ANALYSISOFALGORITHMSLAB		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto		
CO1	Writeandexecuteprogramstoimplementvarioussearchingandsorting algorithms.	K_3
CO2	Writeandexecuteprogramstoimplementvariousoperationsontwo-dimensional arrays.	K_3
CO3	ImplementvariousoperationsofStacksandQueuesusingboth arrays and linked lists data structures.	K_3
CO4	Implementgraphalgorithmtosolvetheproblemofminimum spanning tree	K_3

PrograminCorC++forfollowing:

1. Toimplementadditionandmultiplicationoftwo2Darrays.
2. Totransposea2Darray.
3. Toimplementstackusingarray
4. Toimplementqueueusingarray.
5. Toimplementcircularqueueusingarray.
6. Toimplementstackusinglinkedlist.
7. Toimplementqueueusinglinkedlist.
8. ToimplementBFS usinglinkedlist.
9. ToimplementDFSusinglinkedlist.
10. ToimplementLinearSearch.
11. 11.ToimplementBinary Search.
12. ToimplementBubbleSorting.
13. ToimplementSelectionSorting.
14. ToimplementInsertionSorting.
15. ToimplementMergeSorting.
16. ToimplementHeapSorting.
17. ToimplementMatrixMultiplicationbystrassen'salgorithm
18. FindMinimumSpanning TreeusingKruskal'sAlgorithm

SECONDYEARSYLLABUS
SEMESTER-III

MC-7621:ArtificialIntelligence		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Definethemeaningofintelligenceandstudyvariousintelligentagents.	K_1
CO2	Understand,analyzeandapplyAIsearchingalgorithmsindifferentproblem domains.	K_2,K_3,K_4
CO3	Studyandanalyzevariousmodelsforknowledgerepresentation.	K_1,K_3
CO4	Understand the basic concepts of machine learning to analyze and implement widely used learning methods and algorithms.	K_2,K_4,K_6
CO5	Understandtheconceptofpattern recognition and evaluate various classificationandclusteringtechniques	K_2,K_5
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Artificial Intelligence:** Introduction to artificial intelligence, Historical development and foundation areas of artificial intelligence, Tasks and applicationareasofartificialintelligence.Introduction,typesandstructureof intelligentagents,ComputerVision,Naturallanguageprocessing.	**08**
II	**SearchingTechniques:**Introduction,Problemsolvingbysearching,Searching for solutions, Uniformed searching techniques, Informed searching techniques, Localsearchalgorithms,Adversarialsearchmethods,Searchtechniquesused ingames,Alpha-Betapruning.	**08**
III	**Knowledge Representation and Reasoning:** Propositional logic, Predicate logic, First order logic, Inference in first order logic, Clause form conversion, Resolution. Chaining- concept, forward chaining and backward chaining, Utility theory and Probabilistic reasoning, Hidden Markov model, Bayesian networks.	**08**
IV	**Machine Learning:** Introduction, types and application areas, Decision trees, Statisticallearningmethods,Learningwithcompletedata-conceptandNaïve Bayes models, Learning with hidden data- concept and EM algorithm, Reinforcementlearning.	**08**
V	**Pattern Recognition:** Introduction and design principles, Statistical pattern recognition, Parameter estimation methods - Principle component analysis and Linear discrimination analysis, Classification techniques - Nearest neighbor rule and Bayes classifier, K-means clustering, Support vector machine.	**08**

SuggestedReadings:

1. RussellS.andNorvigP.,"ArtificialIntelligence–AModernApproach",PearsonEducation.
2. RichE.andKnightK.,"ArtificialIntelligence",McGrawHillPublications.
3. CharnikE.andMcDermottD.,"IntroductiontoArtificialIntelligence",PearsonEducation.
4. PattersonD.W.,"ArtificialIntelligenceandExpertSystems",PrenticeHallofIndiaPublications.
5. KhemaniD.,"AFirstCourseinArtificialIntelligence",McGrawHill.
6. WinstonP.H.,"ArtificialIntelligence",PearsonEducation.
7. Thornton C.and Boulay B.," ArtificialIntelligence-Strategies,ApplicationsandModelsthrough Search", New Age International Publishers.

MC-7623:Software Engineering		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Atthe endof course, thestudentwill beable to understand		
CO1	Explainvarioussoftwarecharacteristicsandanalyzedifferentsoftware DevelopmentModels.	K_1,K_2
CO2	Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.	K_1,K_2
CO3	Compareandcontrastvariousmethodsforsoftwaredesign.	K_2,K_3
CO4	Formulatetestingstrategyfor softwaresystems, employtechniquessuch as unit testing, Test driven development and functional testing.	K_3
CO5	Managesoftwaredevelopmentprocessindependentlyaswellasin teamsandmakeuseofvarioussoftwaremanagementtoolsfor development,maintenanceandanalysis.	K_5
DETAILEDSYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	**08**
II	**Software Requirement Specifications (SRS):** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA):VerificationandValidation,SQAPlans,SoftwareQuality Frameworks,ISO9000Models,SEI-CMMModel.	**08**
III	**Software Design:** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, FunctionPoint(FP)BasedMeasures,CyclomaticComplexityMeasures: Control Flow Graphs.	**08**
IV	**Software Testing:** Testing Objectives, Unit Testing, IntegrationTesting, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top Down and Bottom- Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White BoxTesting),FunctionalTesting(BlackBoxTesting),TestData Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies:FormalTechnicalReviews(PeerReviews),WalkThrough,	**08**

	CodeInspection,CompliancewithDesignandCodingStandards.	
V	**Software Maintenance and Software Project Management:** SoftwareasanEvolutionaryEntity,NeedforMaintenance,Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process,SoftwareVersionControl,AnOverviewofCASE Tools.EstimationofVariousParameterssuchasCost,Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.	**08**

Suggested Readings:

1. RSPressman,"SoftwareEngineering:APractitionersApproach",McGrawHill.
2. PankajJalote,"SoftwareEngineering",Wiley
3. RajibMall,"FundamentalsofSoftwareEngineering",PHIPublication.
4. KKAggarwalandYogeshSingh,"SoftwareEngineering",NewAgeInternational Publishers.
5. Ghezzi,M.Jarayeri,D.Manodrioli,"FundamentalsofSoftwareEngineering",PHI Publication.
6. IanSommerville,"SoftwareEngineering",AddisonWesley.
7. KassemSaleh,"SoftwareEngineering",CengageLearning
8. Pfleeger,"SoftwareEngineering",MacmillanPublication

MC-7625: Computer Networks		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Atthe endof course, thestudentwill beable to understand		
CO 1	DescribecommunicationmodelsTCP/IP,ISO-OSImodel,network topologiesalong withcommunicatingdevicesandconnectingmedia.	K2
CO 2	Applyknowledgeoferrordetection,correctionandlearnconceptsof flow control along with error control.	K3
CO 3	ClassifyvariousIPaddressingtechniques,subnettingalongwith network routing protocols and algorithms.	K4
CO 4	Understand various transport layer protocols and their design considerations along with congestion control to maintain Quality of Service.	K2
CO5	Understandapplications-layerprotocolsandelementarystandardsof cryptographyandnetwork security.	K2
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Data Communications**: Introduction: Data communication Components and characteristics, Data representation and Data flow. **Networks:**LAN,WAN,MAN, Topologies. **Protocols and Standards**: ISO-OSI model and TCP-IP Model. **NetworkConnectingDevices:**HUB,Bridge,Switch,Routerand Gateways. **TransmissionMedia:**GuidedandunguidedMedia **ClassificationandArrangement:**WiredLANsandWireless LANs	**08**
II	**DataLinkLayer:** **Error Detection and Error Correction:**Types of errors, LRC, VRC, Checksum, CRC, and Hamming Code. **Flow Control and Error Control:** Stop and Wait Protocol, Sliding Window, Go-back-N-ARQ Protocol and Selective-Repeat ARQ Protocol. **Channel Allocation Protocols:** Random Access, Controlled and Channelization techniques such as ALOHA, CSMA, CSMA/CD, CDMA/CA, TDMA, FDMA, Token Passing, etc.	**08**
III	**Network Layer:** **SwitchingTechniques:** CircuitSwitching,PacketSwitching,and Message Switching. **Logicaladdressing:** IPv4andIPv6Addressschemes,Classesand subnetting **NetworkLayerProtocols:**ARP,RARP,BOOTPandDHCP **RoutingTechniques:**InterdomainandIntradomainroutingwithexamples.	**08**
IV	**Transport Layer:** **Introduction to Transport Layer**: Process-to-Process Delivery:	**08**

	Reliable and unreliable Connection, Port and Socket Addressing **TransportLayerProtocolswithpacketformats:**UserDatagramProtocol (UDP), Transmission Control Protocol (TCP), Stream Control Transmission Protocol (SCTP). **Congestion Control:** Techniques for handling the Congestion Control. **QualityofService(QoS):**FlowCharacteristicsandtechniquestoimprove QoS.	
V	**Application Layer:** **Basic Concept of Application Layer:** Domain Name System, World Wide Web, Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login. **Introduction to Cryptography:** Definition, Goal, Applications, Attacks, Encryption, decryption, public-key and private key cryptography.	**08**

Suggested Readings:

1. BehrouzForouzan,"DataCommunicationandNetworking",McGraw Hill
2. AndrewTanenbaum"ComputerNetworks",PrenticeHall.
3. WilliamStallings,"DataandComputerCommunication", Pearson.
4. KuroseandRoss,"ComputerNetworking-ATop-DownApproach", Pearson.
5. Petersonand Davie,"Computer Networks:A SystemsApproach", Morgan Kaufmann
6. W.A.Shay,"UnderstandingCommunicationsandNetworks",CengageLearning.
7. D.Comer,"ComputerNetworksandInternets",Pearson.
8. BehrouzForouzan,"TCP/IPProtocolSuite",McGraw Hill.

ELECTIVE-1

MC-7624:Cryptography&NetworkSecurity		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Understandvarioussecurityattacksandtheirprotectionmechanism.	K_2
CO2	Applyandanalyzevariousencryptionalgorithms.	K_3, K_4
CO3	Understand functions and algorithms to authenticate messages and study andapply different digital signature techniques.	K_1,K_2,K_3
CO4	Analyzedifferenttypesofkeydistributions.	K_4
CO5	StudyandappraisedifferentIPandsystemsecuritymechanism.	K_1,K_5
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction to security attacks, Services and mechanism, Classical encryption techniques substitution ciphers and transposition ciphers, Cryptanalysis, Steganography, Stream and block ciphers. **Modern Block Ciphers:** Block ciphers principles, Shannon's theory of confusionanddiffusion,Feistelstructure,Dataencryptionstandard(DES), Strength of DES, Idea of differential cryptanalysis, Block cipher modes of operations, Triple DES	**08**
II	Introduction to group, field, finite field of the form GF(p), Modular arithmetic, Prime and relative prime numbers, Extended Euclidean Algorithm, Advanced Encryption Standard (AES). Fermat's and Euler's theorem, Primality testing, Chinese Remainder theorem, Discrete Logarithmic Problem, Principals of public key crypto systems, RSA algorithm, Security of RSA	**08**
III	**Message Authentication Codes:** Authentication requirements, Authentication functions, Message authentication code, Hash functions, Birthday attacks, Security of hash functions, Secure hash algorithm (SHA). **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), Proof of digital signature algorithm.	**08**
IV	**Key Management and distribution:** Symmetric key distribution, Diffie-HellmanKeyExchange,Publickeydistribution,X.509Certificates,Publickey Infrastructure. **Authentication Applications:** Kerberos Electronic mail security: pretty good privacy (PGP), S/MIME.	**08**
V	**IPSecurity:**Architecture,Authenticationheader,Encapsulatingsecurity payloads, Combining security associations, Key management. Introduction to Secure Socket Layer, Secure electronic transaction (SET). **System Security:** Introductory idea of Intrusion, Intrusion detection, Viruses and related threats, firewalls.	**08**

SuggestedReadings:

1. StallingsW.,"CryptographyandNetworkSecurity:PrincipalsandPractice",Pearson Education.
2. FrouzanB.A.,"CryptographyandNetworkSecurity",McGrawHill.
3. KahateA.,"CryptographyandNetworkSecurity",TataMcGrawHill.

MC-(E-I-2):DataWarehousing&DataMining		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Atthe end of course, thestudentwill beable to understand		
CO1	Demonstrateknowledgeof DataWarehouse andits components.	K_1, K_2
CO2	DiscusstheprocessofWarehousePlanningandImplementation.	K_1,K_2
CO3	Discuss and implement various supervised and Non supervisedlearning algorithms on data.	K_6
CO4	Explain the various process of Data Miningand decide best according to type of data.	K_2,K_5
CO5	Explainprocessofknowledgediscoveryindatabase(KDD).DesignData Mining model.	K_2,K_5
	DETAILEDSYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Data Warehousing**: Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between DatabaseSystemandDataWarehouse,MultiDimensionalDataModel, DataCubes,Stars,SnowFlakes,FactConstellations,Concept.	08
II	**Data Warehouse Process and Technology:** Warehousing Strategy, Warehouse /management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/ServerComputingModel&DataWarehousing.ParallelProcessors & Cluster Systems, Distributed DBMS implementations, Warehousing Software, Warehouse Schema Design	08
III	**Data Mining**: Overview, Motivation, Definition & Functionalities, Data Processing, Form of Data Pre-processing, Data Cleaning: Missing Values, Noisy Data, (Binning, Clustering, Regression, Computer and Human inspection), Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Discretization and Concept hierarchy generation, Decision Tree	08
IV	**Classification:** Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-BasedAlgorithms. **Clustering**: Introduction, Similarity and Distance Measures, Hierarchical and Partitional Algorithms. Hierarchical Clustering- CURE and Chameleon. Density Based Methods DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method – Statistical Approach, Association rules: Introduction, Large Item sets, Basic Algorithms,Parallel and Distributed Algorithms, Neural Network approach.	08
V	**DataVisualizationandOverallPerspective**:Aggregation,Historical information,QueryFacility,OLAPfunctionandTools.OLAPServers, ROLAP,MOLAP,HOLAP,DataMininginterface,Security,Backupand	

	Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications and Recent Trends: Types of Warehousing Applications, Web Mining, Spatial Mining and Temporal Mining.	08

SuggestedReadings:

1. AlexBerson,StephenJ.Smith"Data Warehousing,Data-Mining&OLAP", TMH.
2. MarkHumphries,MichaelW.Hawkins,MichelleC.Dy,"DataWarehousing:Architecture and Implementation", Pearson.
3. I.Singh,"DataMiningandWarehousing",KhannaPublishing House.
4. MargaretH.Dunham,S.Sridhar,"DataMining:IntroductoryandAdvancedTopics" Pearson Education 5. Arun K. Pujari, "Data Mining Techniques" Universities Press.
5. PieterAdriaans,DolfZantinge,"Data-Mining",PearsonEducation

MC-(E-I-3):SoftwareProjectManagement

CourseOutcome(CO)		Bloom'sKnowledgeLevel(KL)
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Identifyprojectplanningobjectives,alongwithvariouscost/effortestimationmodels.	K_3
CO2	Organize&scheduleprojectactivitiestocomputecriticalpathforriskanalysis	K_3
CO3	Monitorandcontrolprojectactivities.	K_4,K_5
CO 4	FormulatetestingobjectivesandtestplantoensuregoodsoftwarequalityunderSEI-CMM	K_6
CO5	Configurechangesandmanagerisksusingprojectmanagementtools.	K_2,K_4
DETAILEDSYLLABUS		**3-0-0**

Unit	Topic	Proposed Lecture
I	**Project Evaluation and Project Planning:** Importance of Software Project Management – Activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Projectportfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	**08**
II	**Project Life Cycle and Effort Estimation:** Software process and Process Models – Choice of Process models – RapidApplication development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactiveprocesses–BasicsofSoftwareestimation–EffortandCost estimationtechniques–COSMICFullfunctionpoints–COCOMOII–aParametric ProductivityModel.	**08**
III	**ActivityPlanningandRiskManagement:** ObjectivesofActivityplanning– Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management—PERTtechnique–MonteCarlosimulation–ResourceAllocation –CreationofCriticalpaths–Costschedules.	**08**
IV	**ProjectManagementandControl:**FrameworkforManagementandcontrol– Collectionofdata–Visualizingprogress–Costmonitoring–EarnedValueAnalysis –PrioritizingMonitoring–Projecttracking–ChangecontrolSoftware ConfigurationManagement–Managingcontracts–ContractManagement.	**08**
V	**Staffing in Software Projects:** Managing people – Organizational behavior – Best methodsofstaffselection–Motivation–The Oldham–Hackmanjob characteristic model– Stress– Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – DispersedandVirtualteams– Communicationsgenres–Communicationplans– Leadership.	**08**

SuggestedReadings:

1. BobHughes,Mike CotterellandRajib Mall:"SoftwareProjectManagement" –Fifth Edition, McGraw Hill,New Delhi, 2012.
2. RobertK.Wysocki—"EffectiveSoftwareProjectManagement"–WileyPublication,2011.
3. WalkerRoyce:—"SoftwareProjectManagement"-Addison-Wesley,1998.
4. Gopalaswamy Ramesh, — "Managing GlobalSoftware Projects"–McGraw HillEducation (India), FourteenthReprint 2013.
5. KoontzHarold&WeihrichHeinz,"EssentialsofManagement",McGrawHill5th Edition2008.
6. RobbinsandCoulter,"Management",PrenticeHallofIndia,9th edition.
7. JamesA.F.,Stoner,"Management",PearsonEducationDelhi.
8. P.D.Chaturvedi,"BusinessCommunication",PearsonEducation.

MC-(E-I-4):CloudComputing		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	UnderstandtheconceptsofCloudComputing,keytechnologies, strengthsand limitationsof cloud computing.	K_1,K_2
CO2	Developtheabilitytounderstandandusethearchitecturetocompute and storage cloud, service and models.	K_1,K_3
CO3	Understandtheapplicationincloudcomputing.	K_4,K_5
CO4	Learnthekeyandenablingtechnologiesthathelpinthedevelopmentof cloud.	K_3,K_4
CO5	Explainthecoreissuesofcloudcomputingsuchasresource management and security.	K_2,K_6
DETAILEDSYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed, History of Cloud Computing - Cloud Architecture - Types of Clouds - BusinessmodelsaroundClouds–MajorPlayersinCloudComputing-issuesinClouds-Eucalyptus-Nimbus-OpenNebula, CloudSim.	08
II	**Cloud Services:** Types of Cloud services: Software as a Service-Platform as a Service –Infrastructure as a Service - Database as aService - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.	08
III	**Collaborating Using Cloud Services:** Email Communication over the Cloud - CRM Management – Project Management-EventManagement - Task Management – Calendar - Schedules - Word Processing – Presentation–Spreadsheet-Databases–Desktop-SocialNetworksand Groupware.	08
IV	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System VM, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation andbinarytranslation,HLLVM-supervisors–Xen,KVM, VMware, VirtualBox,Hyper-V.	08
V	**Security, Standards and Applications:** Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloudcomputing, Mobile Internet devices and the cloud. Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine	08

SuggestedReadings:

1. DavidE.Y.Sarna,"ImplementingandDevelopingCloudApplication",CRCpress2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, "Cloud Computing : A Practical Approach", Tata McGraw-Hill 2010.
4. Haley Beard, "Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008.
5. G. J. Popek, R.P. Goldberg, "Formal requirements for virtualizable third generation Architectures, Communications of the ACM", No.7 Vol.17, July 1974

MC-(E-I-5):CompilerDesign		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto:		
CO1	Acquireknowledgeofdifferentphasesandpassesofthecompilerandalsoabletousethe compiler tools like LEX, YACC, etc. Students will also be able to design different types of compiler tools to meet the requirements of the realistic constraints of compilers.	K_3,K_6
CO2	Understandtheparseranditstypesi.e.Top-DownandBottom-upparsersandconstruction ofLL,SLR,CLR,andLALRparsingtable.	K_2,K_6
CO3	Implement the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.	K_4,K_5
CO4	Acquireknowledgeaboutruntimedatastructurelikesymboltableorganizationand differenttechniquesusedinthat.	K_2,K_3
CO5	Understandthetargetmachine'sruntimeenvironment,itsinstructionsetforcode generationandtechniquesusedforcodeoptimization.	K_2,K_4
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Compiler**: Phases and passes, Bootstrapping, Finitestate machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity,YACC.Thesyntacticspecificationofprogramminglanguages:Contextfree grammars,derivationandparsetrees,capabilitiesofCFG.	**08**
II	**Basic Parsing Techniques:** Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.	**08**
III	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a topdownparser.Moreabouttranslation:Arrayreferencesinarithmeticexpressions, procedurescall,declarationsandcasestatements.	**08**
IV	**Symbol Tables**: Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation inblockstructuredlanguage.ErrorDetection&Recovery:LexicalPhaseerrors,syntactic phaseerrorssemanticerrors.	**08**
V	**Code Generation:** Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	**08**

Textbooks:

1. K.Muneeswaran,CompilerDesign,FirstEdition,OxfordUniversityPress.
2. J.P.Bennet,“IntroductiontoCompilerTechniques”,SecondEdition,TataMcGraw-Hill,2003.
3. HenkAlblasandAlbertNymeyer,“PracticeandPrinciplesofCompilerBuildingwithC”,PHI,2001.
4. Aho,Sethi&Ullman,"Compilers:Principles,TechniquesandTools”,PearsonEducation
5. VRaghvan,“PrinciplesofCompilerDesign”,TMH
6. KennethLouden,”CompilerConstruction”,CengageLearning.
7. CharlesFischerandRicardLeBlanc,”CraftingaCompilerwithC”,PearsonEducation

ELECTIVE-2

MC-(E-2-I):WebTechnology		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto:		
CO1	ApplytheknowledgeofHTMLandCSStodevelopwebapplicationand analyzetheinsightsofinternetprogrammingtoimplementcomplete application over the web.	K3,K6
CO2	Understand,analyzeandapplytheroleofJavaScriptintheworkingsofthe web and web applications.	K2,K3
CO3	Understand,analyzeandbuilddynamicwebapplicationsusingservletandJSP.	K_2,K_3
CO4	DevelopSpring-basedJavaapplicationsusingJavaconfiguration,XML configuration,annotation-basedconfiguration,beansandtheirscopes,and properties.	K_2,$K_{4,K6}$
CO5	DevelopwebapplicationusingSpringBootandRESTFulWebServices	K_3,K_6
DETAILEDSYLLABUS		**3-1-0**

Unit	Topic	Proposed Lecture
I	**Web Page Designing:** Introduction and Web Development Strategies, History of Web and Internet, Protocols Governing Web, HTML-Introduction, HTML Tags, HTML-Grouping Using Div & Span, HTML-Lists, HTML-Images, HTML-Hyperlink, HTML-Table, HTML-Iframe, HTML-Form, Introduction of CSS, CSS Syntax, External Style Sheet using < link >, Multiple Style Sheets, Value Lengths and Percentages, CSS-Selectors, CSS-Box Model, Floats, Clear, Introduction to Bootstrap.	**08**
II	**Scripting:** Introduction to JavaScript, Creating Variables in JavaScript, Creating Functions in JavaScript, UI Events, Returning Data from Functions, Working with Conditions, looping in JavaScript, Block Scope Variables, Working with Objects, Creating Object using Object Literals, Manipulating DOM Elements with JavaScript	**08**
III	**Web Application development using JSP & Servlets:** Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to OtherResources, Session Tracking, Cookies, Session Tracking with Http Session. Java Server Pages (JSP): Introduction, Java Server Pages Overview, A First Java Server PageExample,ImplicitObjects,Scripting,StandardActions,Directives,Custom TagLibraries.	**08**
IV	**Spring:**Spring Core Basics-Spring Dependency Injection concepts, Introductionto Design patterns, Factory Design Pattern, Strategy Design pattern, Spring Inversion of Control, AOP, Bean Scopes- Singleton, Prototype, Request, Session, Application, WebSocket, Auto wiring, Annotations, Life Cycle Call backs, Bean Configuration styles	**08**
V	**Spring Boot:** Spring Boot- Spring Boot Configuration, Spring Boot Annotations, Spring Boot Actuator, Spring Boot Build Systems, Spring Boot Code Structure, SpringBootRunners,Logger,BUILDINGRESTFULWEBSERVICES,Rest Controller, Request Mapping, Request Body, Path Variable, Request Parameter, GET, POST, PUT, DELETE APIs, Build Web Applications	**08**

Textbooks:

1. Burdman,Jessica,“CollaborativeWebDevelopment”AddisonWesley
2. Xavier,C,“WebTechnologyandDesign”,NewAgeInternational
3. IvanBayross,”HTML,DHTML,JavaScript,Perl&CGI”,BPBPublication
4. Bhave,“ProgrammingwithJava”,PearsonEducation
6. HansBergsten,“JavaServerPages”,SPDO’Reilly
7. Naughton,Schildt,“TheCompleteReferenceJAVA2”,TMH
8. CraigWalls,“SpringBootinAction”

MC-(E-2-2):BigData		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	DemonstrateknowledgeofBigDataAnalyticsconceptsanditsapplicationsin business.	K_1,K_2
CO2	DemonstratefunctionsandcomponentsofMapReduceFrameworkandHDFS.	K_1,K_2
CO3	DevelopqueriesinNoSQLenvironment.	K_6
CO4	ExplainprocessofdevelopingMapReducebaseddistributedprocessing applications.	K_2,K_5
CO5	ExplainprocessofdevelopingapplicationsusingHBASE,Hive,Pigetc.	K_2,K_5
	DETAILEDSYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventionalsystems,intelligentdataanalysis,natureofdata,analyticprocesses andtools,analysisvsreporting,moderndataanalytictools.	**08**
II	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System. **Map-Reduce:** Map-Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, taskexecution,MapReducetypes,inputformats,outputformats,MapReduce features,Real-worldMapReduce	**08**
III	**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: Compression, serialization, Avro and file-based data structures. Hadoop Environment: Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, securityinHadoop,administeringHadoop,HDFSmonitoring&maintenance,Hadoop benchmarks,Hadoopinthecloud	**08**
IV	**Hadoop Eco System and YARN:** Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features – Name Node high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. **NoSQL** Databases: Introduction to NoSQL MongoDB: Introduction, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections **Spark**: Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed Databases, anatomy of a Spark job run, Spark on YARN **SCALA:** Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.	**08**
V	**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase **Pig**:IntroductiontoPIG,ExecutionModesofPig,ComparisonofPigwithDatabases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, **Hive**-ApacheHivearchitectureandinstallation,Hiveshell,Hiveservices,Hive	**08**

	metastore,comparisonwithtraditionaldatabases,HiveQL,tables,queryingdataand user defined functions, sorting and aggregating, Map Reduce scripts, joins &subqueries. **HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schemadesign, advance indexing, Zookeeper – how it helps in monitoringa cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.	

SuggestedReadings:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: EmergingBusiness Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Big-DataBlackBook,DTEditorialServices,Wiley.
3. DirkdeRoos,ChrisEaton, GeorgeLapis,PaulZikopoulos,Tom Deutsch,“Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill.
4. ThomasErl,WajidKhattak,PaulBuhler,“BigDataFundamentals:Concepts,DriversandTechniques”, Prentice Hall.
5. BartBaesens“AnalyticsinaBigDataWorld:TheEssentialGuidetoDataScienceandits Applications (WILEY Big Data Series)”, John Wiley & Sons
6. ArshdeepBahga,VijayMadisetti,“BigDataScience&Analytics:AHandsOnApproach“, VPT
7. AnandRajaramanandJeffreyDavidUllman,“MiningofMassiveDatasets”,CUP
8. TomWhite,"Hadoop:TheDefinitiveGuide",O'Reilly.
9. EricSammer,"HadoopOperations",O'Reilly.
10. ChuckLam,“HadoopinAction”,MANNINGPublishers
11. DeepakVohra,“PracticalHadoopEcosystem:ADefinitiveGuidetoHadoop-Related Frameworks and Tools”, Apress
12. E.Capriolo,D.Wampler,andJ.Rutherglen,"ProgrammingHive",O'Reilly
13. LarsGeorge,"HBase:TheDefinitiveGuide",O'Reilly.
14. AlanGates,"ProgrammingPig",O'Reilly.
15. MichaelBerthold,DavidJ.Hand,“IntelligentDataAnalysis”,Springer.
16. BillFranks,“TamingtheBigDataTidalWave:FindingOpportunitiesinHugeDataStreamswith Advanced Analytics”, John Wiley & sons.
17. GlennJ.Myatt,“MakingSenseofData”,JohnWiley&Sons
18. PeteWarden,“BigDataGlossary”,O’Reilly

MC-(E-2-3):SimulationandModelling		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Atthe end ofcourse , thestudentwill beable to understand		
CO 1	Studythe conceptofsystem,itscomponentsandtypes.	K_1
CO 2	Understandandanalyzenatureandtechniquesofmajorsimulationmodels.	K_2,K_4
CO 3	Studyand analyze the idea of continuous and discrete system simulation.	K_1,K_4
CO 4	Understandthenotionofsystemdynamicsandsystemdynamics diagrams.	K_2
CO 5	FindingcriticalpathcomputationandunderstandingPERT networks	K_1,K_4
DETAILEDSYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	System definition and components, stochastic activities, continuous and discretesystems,Systemmodeling,Typesofmodels,staticanddynamic physical models, staticand dynamic mathematicalmodels, fullcorporate model,typesofsystemstudy.	**08**
II	System simulation, Need of simulation, Basic nature of simulation, techniques of simulation, comparison of simulation and analytical methods, types of system Simulation, real time simulation, hybrid simulation, simulation of pursuit problem, single-server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag model, Cobweb model.	**08**
III	Simulation of continuous Systems, analog vs digital simulation, simulation of water reservoir system, simulation of a servo system, simulation of an auto-pilot. Discrete system simulation, fixed time step vs. event-to-event model, generation of random numbers, test of randomness, Monte-Carlo computation vs. stochastic simulation.	**08**
IV	Systemdynamics,exponentialgrowthmodels,exponentialdecaymodels, logistic curves, system dynamics diagrams, world model.	**08**
V	Simulationof PERTnetworks,criticalpathcomputation,uncertaintiesin activityduration,resourceallocationandconsideration,Simulationlanguages, object oriented simulation	**08**

Suggested Readings:

1. GeoffreyGordon,"SystemSimulation",PHI
2. NarsinghDeo,"SystemSimulationwithdigitalcomputer",PHI.
3. AverillM.LawandW.DavidKelton,"SimulationModellingandAnalysis", TMH.

MC-(E-2-4):SoftwareTesting&QualityAssurance		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Test the software by applying testing techniques to deliver a product free from bugs.	K_3
CO2	Investigatethescenarioandselectthepropertestingtechnique.	K_1,K_4
CO3	Explorethe test automationconceptsand tools and estimation of cost,schedule based on standard metrics.	K_2,K_4
CO4	Understandhowtodetect,classify,preventandremovedefects.	K_1,K_2
CO5	Chooseappropriatequalityassurancemodelsanddevelopquality.Abilityto conduct formal inspections, record and evaluate results of inspections.	K_3,K_4
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Software Testing Basics:** Testing as an engineering activity, Role of processin software quality, Testing as a process, Basic definitions, Software testing principles,The tester'sroleina software developmentorganization,Originsof defects, Defectclasses, Thedefect repository and testdesign, Defectexamples, Developer / Tester support for developing a defect repository.	**08**
II	**Testing Techniques and Levels of Testing:**Using White Box Approach to Test design– Static Testing Vs. Structural Testing, Code Functional Testing, Coverage and Control Flow Graphs, Using Black Box Approaches to TestCase Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination.SystemTesting-UsabilityandAccessibilityTesting, ConfigurationTesting,CompatibilityTesting.	**08**
III	**SoftwareTestAutomationAndQualityMetrics:**SoftwareTestAutomation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation Tracking the Bug, Debugging. Testing Software System Security - Six-Sigma, TQM-ComplexityMetricsandModels,QualityManagementMetrics, Availability Metrics, Defect Removal Effectiveness, FMEA, Quality Function Deployment, Taguchi Quality Loss Function, Cost of Quality.	**08**
IV	**Fundamentals of Software Quality Assurance:** SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, 7 QC Tools and Modern Tools.	**08**
V	**SoftwareAssuranceModels:**ModelsforQualityAssurance,ISO-9000series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model- P-CMM. **Software Quality Assurance Trends:** Software Process- PSP and TSP, OO Methodology, Clean room software engineering, Defect Injection and prevention,InternalAuditingandAssessments,Inspections&Walkthroughs, CaseToolsandtheiraffectonSoftwareQuality.	**08**

SuggestedReadings:

1. SrinivasanDesikan,GopalaswamyRamesh,"SoftwareTesting:PrinciplesandPractices", Pearson.
2. DanielGalin,"SoftwareQualityAssurance:FromTheorytoImplementation",Pearson

AddisonWesley.

3. **AdityaP.Mathur,"FoundationsofSoftwareTesting",Pearson.**
4. **PaulAmmann,JeffOffutt,"IntroductiontoSoftwareTesting",CambridgeUniversityPress.**
5. **PaulC.Jorgensen,"SoftwareTesting:ACraftsman'sApproach",AuerbachPublications.**
6. **WilliamPerry,"EffectiveMethodsofSoftwareTesting",WileyPublishing,ThirdEdition.**
7. **Renu Rajani, Pradeep Oak, "Software Testing – Effective Methods,**

MC-(E-2-5):DigitalImageProcessing		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Explainthebasicconceptsoftwo-dimensionalsignalacquisition,sampling, quantization and color model.	K_1,K_2
CO2	Applyimageprocessingtechniquesforimageenhancementinboththespatial andfrequencydomains.	K_2,K_3
CO3	Apply and compare image restoration techniques in both spatial and frequency domain.	K_2,K_3
CO4	CompareedgebasedandregionbasedsegmentationalgorithmsforROI extraction.	K_3,K_4
CO5	Explaincompressiontechniquesanddescriptorsforimageprocessing.	K_2,K_3
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**DigitalImageFundamentals:**StepsinDigitalImageProcessing– Components– ElementsofVisualPerception–ImageSensingandAcquisition –ImageSamplingandQuantization–Relationshipsbetweenpixels–Color imagefundamentals–RGB,HSImodels,Two-dimensionalmathematical preliminaries,2Dtransforms–DFT,DCT.	**08**
II	**Image Enhancement:** Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	**08**
III	**ImageRestoration:**ImageRestoration–degradationmodel,Properties,Noise models –MeanFilters– OrderStatistics–Adaptivefilters–BandrejectFilters –BandpassFilters–NotchFilters–OptimumNotchFiltering–Inverse Filtering – Wiener filtering	**08**
IV	**Image Segmentation:** Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentationbymorphologicalwatersheds–basicconcepts–Dam construction–Watershedsegmentationalgorithm.	**08**
V	**Image Compression and Recognition:** Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors–Topologicalfeature,Texture–PatternsandPatternclasses– Recognitionbasedonmatching.	**08**

SuggestedReadings:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, Third Edition, 2010.
2. AnilK.Jain,"FundamentalsofDigitalImageProcessing",Pearson,2002.
3. KennethR.Castleman,"DigitalImageProcessing"Pearson,2006.
4. D, E. Dudgeon and R M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
5. WilliamK.Pratt,"DigitalImageProcessing"JohnWiley,NewYork,2002.
6. MilanSonkaetal,"Imageprocessing,analysisandmachinevisionBrookes/Cole",Vikas Publishing House, 2nd edition,1999.

SECONDYEARSYLLABUS
SEMESTER-IV

ELECTIVE-3

KCA031:PrivacyandSecurityinOnlineSocialMedia

CourseOutcome(CO)		Bloom'sKnowledgeLevel(KL)
Attheendofcourse,thestudentwillbeableto:		
CO1	Understandworkingofonlinesocialnetworks	K2
CO2	Describeprivacypoliciesofonlinesocialmedia	K2
CO3	Analysecountermeasurestocontrolinformationsharinginonlinesocial networks.	K3
CO4	Applyknowledgeofidentitymanagementin Onlinesocialnetworks	K3
CO5	Comparevariousprivacyissuesassociatedwithpopularsocialmedia.	K3

DETAILEDSYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Online Social Networks:** Introduction to Social Networks, From offline to Online Communities, Online Social Networks, Evolution of OnlineSocial Networks, Analysis and Properties, Security Issues in Online Social Networks, Trust Management in Online Social Networks, Controlled Information Sharing in Online Social Networks, Identity Management in Online Social Networks,datacollectionfromsocialnetworks,challenges,opportunities,and pitfallsinonlinesocialnetworks,APIs;CollectingdatafromOnlineSocialMedia.	**08**
II	**Trust Management in Online Social Networks:** Trust and Policies, Trust and Reputation Systems, Trust in Online Social, Trust Properties, Trust Components, Social Trust and Social Capital, Trust Evaluation Models, Trust, credibility, and reputations in social systems; Online social media and Policing, Information privacydisclosure,revelation,anditseffectsinOSMandonlinesocialnetworks; PhishinginOSM&Identifyingfraudulententitiesinonlinesocialnetworks	**08**
III	**Controlled Information Sharing in Online Social Networks:** Access Control Models, Access Control in Online Social Networks, Relationship-Based Access Control,PrivacySettingsinCommercialOnlineSocialNetworks,ExistingAccess ControlApproaches	**08**
IV	**Identity Management in Online Social Networks:** Identity Management, Digital Identity, Identity Management Models: From Identity 1.0 to Identity 2.0, Identity ManagementinOnlineSocialNetworks,IdentityasSelf-Presentation,Identity thefts,OpenSecurityIssuesinOnlineSocialNetworks	**08**
V	**Case Study:** Privacy and security issues associated with various social media such as Facebook, Instagram, Twitter, LinkedIn etc.	**08**

Textbooks:

1. SecurityandPrivacy-PreservinginSocialNetworks,Editors:Chbeir,Richard,AlBouna, Bechara (Eds.), Spinger, 2013.
2. SecurityandTrustinOnlineSocialNetworks,BarbaraCarminati,ElenaFerrari,MarcoViviani, Morgan & Claypool publications.
3. SecurityandPrivacyinSocialNetworks,Editors:Altshuler,Y.,Elovici,Y.,Cremers,A.B., Aharony, N., Pentland, A. (Eds.), Springer, 2013
4. Securityandprivacypreservinginsocialnetworks,ElieRaad&RichardChbeir,Richard Chbeir& Bechara Al Bouna, 2013
5. SocialMediaSecurity:LeveragingSocialNetworkingWhileMitigatingRisk,MichaelCross, 2013

MC- :SoftComputing		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Recognize the need of soft computing and study basic concepts and techniques of soft computing.	K_1,K_2
CO2	Understandthebasicconceptsofartificialneuralnetworktoanalyzewidely used neural networks.	K_2,K_4
CO3	Applyfuzzylogictohandleuncertaintyinvariousreal-worldproblems.	K_3
CO4	Studyvariousparadigmsofevolutionarycomputingandevaluategeneticalgorithm in solving optimization problems.	K_1,K_5
CO5	Applyhybridtechniquesinapplicationsofsoftcomputing.	K_3
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Soft Computing:** Introduction, Comparison with hard computing,Conceptoflearningandadaptation,Constituentsofsoftcomputing, Applications of soft computing. **Artificial Neural Networks:** Basic concepts of neural networks, Human brain, Biological neural network, History of artificial neural networks, Basic building blocksofanartificialneuron,Neuralnetworkarchitectures,Activation functions,Characteristicsandlimitationofneuralnetworks.	**08**
II	**Artificial Neural Networks:** Learning methods - Supervised, Unsupervised, Reinforcement, Hebbian, Gradient descent, Competitive, Stochastic. **Major classes of neural networks:** Perceptron networks, Multilayer perceptron model, Back-propagation network, Radial basis function network, Recurrentneuralnetwork,Hopfield networks,Kohonenself-organizing feature maps.	**08**
III	**Fuzzy Logic:** Introduction to Fuzzy Logic, Comparison with crisp logic, Properties of classical sets, Operations on classical sets, Properties of fuzzy sets,Operationsonfuzzysets,Classicalrelations,Fuzzyrelations,Featuresand types of fuzzy membership functions, Fuzzy arithmetic,Fuzzy measures. **Fuzzy Systems:** Crisp logic, Predicate logic, Fuzzy logic, Fuzzy propositions, Inferencerules,Fuzzyinferencesystems-Fuzzification,Inference, Defuzzification,Typesofinferenceengines.	**08**
V	**Evolutionary Computing:** Introduction, Evolutionary algorithm, Biological evolutionary process, Paradigms of evolutionary computing – Genetic algorithm and Genetic programming, Evolutionary strategies, Evolutionary programming. **GeneticAlgorithm:**Introduction,Traditionaloptimizationandsearch techniques, Comparison with traditional algorithms, Operations- Encoding, Selection, Crossover and Mutation, Classification of Genetic algorithm.	**08**
V	**Hybrid Soft Computing Techniques:** Introduction, Classification of hybrid systems, Neuro-fuzzy hybrid systems, Neuro-genetic hybrid systems, Fuzzy-genetic hybrid systems. **OtherSoftComputingTechniques:**TabuSearch,Antcolonybased	**08**

	optimization,SwarmIntelligence.	

SuggestedReadings:

1. SivanandamS.N.andDeepaS.N.,"PrinciplesofSoftComputing",Wiley-India.
2. RajasekaranS.andVijayalakshmiPaiG.A.,"NeuralNetworks,FuzzyLogicandGenetic Algorithms-Synthesis and Applications", PHI Learning.
3. Chakraverty S., Sahoo D.M. and Mahato N. R., "Concepts of Soft Computing- Fuzzy and ANNwith Programming", Springer.
4. KaushikS.andTiwariS.,"SoftComputing–Fundamentals,TechniquesandApplications', McGrawHill Education.
5. JangJ.-S.R.,SunC.-T.andMizutaniE.,"Neuro-FuzzyandSoftComputing",Prentice-Hallof India.
6. Karray F. O. and Silva C. D., "Soft Computing and Intelligent Systems Design – Theory, Toolsand Applications", Pearson Education.
7. Freeman J. A. and SkapuraD. M., "Neural Networks: Algorithms, Applications and Programming Techniques", Pearson.
8. SimanH.,"NeuralNetowrks",PrenticeHallofIndia.

MC- :PatternRecognition		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Study of basics of Pattern recognition.Understandthe designing principles and Mathematical foundation used in pattern recognition.	K_1,K_2
CO2	AnalysistheStatisticalPattenRecognition.	K_3,K_4
CO3	UnderstandingthedifferentParameterestimationmethods.	K_1,K_2
CO4	UnderstandingthedifferentNonparametricTechniques.	K_1, K_2,
CO5	Understand and Make use of unsupervised learning and Clustering in Patternrecognition.	$K_2$$K_3$,$K_4$
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, meanandcovariance,Normaldistribution,multivariatenormaldensities,Chi squaredtest.	**08**
II	**StatisticalPattenRecognition:**BayesianDecisionTheory,Classifiers, Normal density and discriminant functions	**08**
III	**Parameter estimation methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization(EM),HiddenMarkovModels(HMM),Gaussianmixture models.	**08**
IV	**NonparametricTechniques:**DensityEstimation,ParzenWindows,K- Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.	**08**
V	**UnsupervisedLearning&Clustering:**Criterionfunctionsforclustering, ClusteringTechniques:Iterativesquare-errorpartitionalclustering–Kmeans, agglomerativehierarchicalclustering,Clustervalidation.	**08**

SuggestedReadings:

1. DudaR.O.,HartP.E.andStorkD.G.,"PatternClassification",JohnWiley.
2. BishopC.M.,"NeuralNetworkforPatternRecognition",OxfordUniversityPress.
3. SinghalR.,"PatternRecognition:Technologies&Applications",OxfordUniversityPress.
4. TheodoridisS.andKoutroumbasK.,"PatternRecognition",AcademicPress.

MC- 7631(B):Data Analytics		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	DescribethelifecyclephasesofDataAnalyticsthroughdiscovery,planningand building.	K_1,K_2
CO2	UnderstandandapplyDataAnalysisTechniques.	K_2, K_3
CO3	ImplementvariousDatastreams.	K_3
CO4	Understanditemsets,Clustering,frameworks&Visualizations.	K_2
CO5	ApplyRtoolfordevelopingandevaluatingrealtimeapplications.	K_3,K_5,K_6
	DETAILEDSYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Data Analytics**: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability,analyticprocessandtools,analysisvsreporting,moderndataanalytic tools, applications of data analytics. **DataAnalyticsLifecycle**:Need,keyrolesforsuccessfulanalyticprojects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization	08
II	**Data Analysis:** Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, Neural Networks: Learning and generalisation, competitive learning, principal componentanalysisandneuralnetworks,fuzzylogic:extractingfuzzymodels fromdata,fuzzydecisiontrees,stochasticsearchmethods.	08
III	**Mining Data Streams:** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP)applications,Casestudies–Realtimesentimentanalysis,stockmarket predictions.	08
IV	**Frequent Itemsets and Clustering:** Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, Clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE andProCLUS,frequentpatternbasedclusteringmethods,clusteringinnon-euclidean space,clusteringforstreamsandparallelism.	08
V	**Frame Works and Visualization**: MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systemsand applications. **IntroductiontoR** - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.	08

SuggestedReadings:

1. MichaelBerthold,DavidJ.Hand,"IntelligentDataAnalysis",Springer.
2. AnandRajaramanandJeffreyDavidUllman,"MiningofMassiveDatasets",Cambridge University Press.
3. BillFranks,"TamingtheBigDataTidalwave:FindingOpportunitiesinHugeDataStreams

withAdvancedAnalytics",JohnWiley&Sons.
4. John Garrett, "Data Analytics for IT Networks : Developing Innovative Use Cases", Pearson Education.
5. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
6. DavidDietrich,BarryHeller,BeibeiYang,"DataScienceandBigDataAnalytics",EMC Education Series, John Wiley.
7. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SASBusiness Series.
8. ColleenMccue,"DataMiningandPredictiveAnalysis:IntelligenceGatheringandCrime Analysis", Elsevier.
9. MichaelBerthold,DavidJ.Hand,"IntelligentDataAnalysis",Springer.
10. PaulZikopoulos,ChrisEaton,PaulZikopoulos,"UnderstandingBigData:Analyticsfor Enterprise Class Hadoop and Streaming Data", McGraw Hill.
11. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning",Springer.
12. MarkGardner,"BeginningR:TheStatisticalProgrammingLanguage",WroxPublication.

MC:Software Quality Engineering

CourseOutcome(CO)		Bloom'sKnowledgeLevel(KL)
Attheendofcourse,thestudentwillbeableto:		
CO1	UnderstandbasicconceptsofSoftwareQualityalongwithitsdocumentsand process	K2
CO2	ApplyknowledgeofSoftwareQualityinvarioustypesofsoftware	K3
CO3	Comparethevariousreliabilitymodelsfordifferentscenarios	K4
CO4	IllustratethesoftwareQualityPlanningandAssurance	K2
CO5	Makeuseofvarioustestingtechniquesinsoftwareimplementation	K3

DETAILEDSYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Software Quality**: Definition, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, DefectPrevention,Reduction,andContainment,OverviewofDifferentTypesofSoftware Review, Introduction to Measurement and Inspection Process, Documents and Metrics.	**08**
II	**Software Quality Metrics Product Quality Metrics**: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, DefectRemovalEffectiveness,MetricsforSoftwareMaintenance:Backlog ManagementIndex,FixResponseTime,FixQuality,SoftwareQualityIndicators.	**08**
III	**Software Quality Management and Models**:Modeling Process, Software **Reliability Models**: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for ModelEvaluation,SoftwareQualityAssessmentModels:HierarchicalModelof SoftwareQualityAssessment.	**08**
IV	**SoftwareQualityAssurance**:QualityPlanningandControl,QualityImprovement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, MajorSQAIssues,ZeroDefectSoftware,SQATechniques,StatisticalQuality Assurance,TotalQualityManagement,QualityStandardsandProcesses.	**08**
V	**Software Verification, Validation & Testing:** Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-OrientedAnalysis&Testing,StaticandDynamicTestingTools, CharacteristicsofModernTestingTools.	**08**

Textbooks:

1. JeffTian,SoftwareQualityEngineering(SQE),Wiley-Interscience,2005;ISBN0-471-71345 -7
2. MetricsandModelsinSoftwareQualityEngineering,StephenH.Kan,AddisonWesley (2002), ISBN: 0201729156
3. NormanE.Fentonand ShariLawrencePfleeger, "SoftwareMetrics"Thomson, 2003
4. MordechaiBen–MenachemandGarryS.Marliss,"SoftwareQuality",ThomsonAsia Pte Ltd, 2003.

ELECTIVE-4

MC-7632(B):Block chain Architecture		
CourseOutcome(CO)	**Bloom'sKnowledgeLevel(KL)**	
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Studyandunderstandbasicconceptsofblockchainarchitecture.	K_1,K_2
CO2	Analyzevariousrequirementsforconsensusprotocols.	K_4
CO3	Applyandevaluatetheconsensusprocess.	K_3, K_5
CO4	UnderstandtheconceptsofHyperledgerfabric.	K_1
CO5	Analyzeandevaluatevarioususecasesinfinancialsoftwareandsupplychain.	K_4, K_5
	DETAILEDSYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**IntroductiontoBlockchain:**DigitalMoneytoDistributedLedgers,Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. **Blockchain Architecture and Design:** Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Bitcoin Basic, Basic consensus mechanisms.	**08**
II	**Consensus:** Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols, distributed consensus, consensus in Bitcoin. **PermissionedBlockchains:**Designgoals,ConsensusprotocolsforPermissioned Blockchains	**08**
III	**HyperledgerFabric:**Decomposingtheconsensusprocess,Hyperledgerfabric components. **ChaincodeDesignandImplementationHyperledgerFabric:**Beyond Chaincode: fabric SDK and Front End, Hyperledger composer tool.	**08**
IV	**Usecase1:**BlockchaininFinancialSoftwareandSystems(FSS):(i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance. **Use case 2:** Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc.	**08**
V	**Usecase3:**BlockchainforGovernment:(i)Digitalidentity,landrecordsand otherkindsofrecordkeepingbetweengovernmententities,(ii)public distributionsystemsocialwelfaresystems,BlockchainCryptography,Privacy and Security on Blockchain	**08**

SuggestedReadings:

1. AndreasAntonopoulos,"MasteringBitcoin:UnlockingDigitalCryptocurrencies",O'Reilly
2. MelanieSwa,"Blockchain",O'Reilly
3. "HyperledgerFabric",https://www.hyperledger.org/projects/fabric
4. Bob Dill, David Smits, "Zero to Blockchain - An IBM Redbooks course", https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

MC:Internet of Things

CourseOutcome(CO)		Bloom'sKnowledgeLevel(KL)
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Demonstratebasicconcepts,principlesandchallengesinIoT.	K1,K2
CO2	IllustratefunctioningofhardwaredevicesandsensorsusedforIoT.	K2
CO3	AnalyzenetworkcommunicationaspectsandprotocolsusedinIoT.	K4
CO4	ApplyIoTfordevelopingreallifeapplicationsusingArdunioprogramming.	K3
CP5	TodevelopIoTinfrastructureforpopularapplications	K_2,K_3

DETAILEDSYLLABUS		3-1-0
Unit	**Topic**	**Proposed Lecture**
I	**Internet of Things (IoT):** Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2Msystemslayersanddesignstandardization,communicationtechnologies, dataenrichmentandconsolidation,easeofdesigningandaffordability	**08**
II	**Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview ofIOTsupportedHardwareplatformssuchasArduino,NetArduino,Raspberrypi, BeagleBone,IntelGalileoboardsandARMcortex.	**08**
III	**Network&CommunicationaspectsinIoT:**WirelessMediumaccessissues, MACprotocolsurvey,Surveyroutingprotocols,Sensordeployment&Node discovery, Data aggregation & dissemination	**08**
IV	**ProgrammingtheArdunio:**ArdunioPlatformBoardsAnatomy,ArdunioIDE, coding,usingemulator,usinglibraries,additionsinardunio,programmingthe ardunioforIoT.	**08**
V	**Challenges in IoT Design challenges:** Development Challenges, Security Challenges, Other challenges IoT Applications: Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicatingdatawithH/Wunits,mobiles,tablets,Designingofsmartstreet lightsinsmartcity.	**08**

Textbooks:

1. OlivierHersent,DavidBoswarthick,OmarElloumi"TheInternetofThingskeyapplicationsand protocols",willey
2. JeevaJose,InternetofThings,KhannaPublishingHouse
3. MichaelMiller"TheInternetofThings"byPearson
4. RajKamal"INTERNETOFTHINGS",McGraw-Hill,1STEdition,2016
5. ArshdeepBahga,VijayMadisetti"InternetofThings(Ahandsonapproach)"1STedition,VPI publications,2014
6. AdrianMcEwen,HakinCassimally"DesigningtheInternetofThings"WileyIndia

MC: Distributed Database Systems		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Attheendofcourse,thestudentwillbeableto:		
CO1	Understandtheoreticalandpracticalaspectsofdistributeddatabasesystems.	K2
CO2	Studyandidentifyvariousissuesrelatedtothedevelopmentofdistributed database system	K3
CO3	Understandthedesignaspectsofobject-orienteddatabasesystemandrelated development	K4
CO4	Equipstudentswithprinciplesandknowledgeofdistributedreliability.	K3
CO5	Equipstudentswithprinciplesandknowledgeofparallelandobject-oriented databases.	K5
DETAILEDSYLLABUS		**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Distributed Data Processing, Distributed Database System, Promises of DDBSs, Problem areas. Distributed DBMS Architecture: ArchitecturalModelsforDistributedDBMS,DDMBSArchitecture.Distributed Database Design: Alternative Design Strategies, Distribution Design issues, Fragmentation, Allocation.	**08**
II	**Query processing and decomposition:** Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data. Distributed query Optimization: Queryoptimization,centralizedqueryoptimization,distributedquery optimizationalgorithms.	**08**
III	Transaction Management: Definition, properties of transaction, types of transactions, distributed concurrency control: Serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms, deadlock Management.	**08**
IV	**Distributed DBMS Reliability:** Reliability concepts and measures, fault-toleranceindistributedsystems,failuresinDistributedDBMS,local&distributed reliability protocols, site failures and network partitioning. Parallel Database Systems:Paralleldatabasesystemarchitectures,paralleldataplacement,parallel queryprocessing,loadbalancing,databaseclusters.	**08**
V	**Distributed object Database Management Systems:** Fundamental object concepts and models, object distributed design, architectural issues, object management, distributed object storage, object query Processing. **ObjectOrientedDataModel:**Inheritance,objectidentity,persistent programming languages, persistence of objects, comparison OODBMS and ORDBMS	**08**

Textbooks:

M.TamerOZSUandPatuckValduriez:PrinciplesofDistributedDatabaseSystems,PearsonEdn.Asia, 2001. 2. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases, McGraw Hill. REFERENCE BOOKS: 1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: "Database Systems: The Complete Book", Second Edition, Pearson International Edition

ELECTIVE-5

MC:Mobile Computing		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel(KL)**
Atthe endof course, thestudentwill beable to understand		
CO 1	Studyandaware fundamentalsofmobile computing.	K_1,K_2
CO 2	Studyandanalyzewirelessnetworkingprotocols,applicationsandenvironment.	K_1,K_4
CO3	Understandvariousdatamanagement issuesinmobilecomputing.	K_2
CO 4	Analyzedifferent type of security issues in mobile computing environment.	K_4
CO 5	Study,analyze,andevaluatevariousroutingprotocolsusedinmobile computing.	K_1,K_4,K_5
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction, Issues in mobile computing, Overview of wireless telephony, Cellular concept, GSM- air interface, channel structure; Locationmanagement-HLR-VLR,hierarchical,handoffs;Channel allocationincellularsystems, CDMA,GPRS,MACforcellular system.	**08**
II	Wireless Networking, Wireless LAN Overview- MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, Data broadcasting, Mobile IP, WAP-architecture, protocol stack, application environment, applications.	**08**
III	Data management issues in mobile computing, data replication for mobilecomputers,adaptiveclusteringformobilewirelessnetworks,File system, Disconnected operations.	**08**
IV	MobileAgentscomputing,Securityandfaulttolerance,Transaction processing in mobile computing environment.	**08**
V	Adhoc networks, Localization, MAC issues, Routing protocols, Global state routing (GSR), Destination sequenced distance vector routing (DSDV),Dynamicsourcerouting(DSR),Adhocondemanddistance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Adhoc Networks, applications	**08**

Suggested Readings:

1. SchillerJ.,"MobileCommunications", Pearson
2. UpadhyayaS.andChaudhuryA.,"MobileComputing",Springer
3. KamalR.,"MobileComputing",OxfordUniversityPress.
4. TalukderA.K.andAhmedH.,"MobileComputingTechnology,Applications and Service Creation", McGraw Hill Education
5. GargK.,"MobileComputingTheoryandPractice",Pearson.
6. KumarS.,"WirelessandMobileCommunication",NewAgeInternational Publishers
7. ManviS.S.and KakkasageriM.S.,"Wireless and Mobile Networks- Concepts and Protocols",WileyIndiaPvt.Ltd.

MC-7633:Computer Graphics and Animation

CourseOutcome(CO)		Bloom'sKnowledgeLevel(KL)
Attheendofcourse,thestudentwillbeabletounderstand		
CO1	Understandthegraphicshardwareusedinfieldofcomputergraphics.	K_2
CO2	Understandtheconceptofgraphicsprimitivessuch aslinesandcirclebasedon different algorithms.	K_2,K_4
CO3	Applythe2Dgraphicstransformations,compositetransformationandClipping concepts.	K_4
CO4	Applytheconceptsandtechniquesusedin3Dcomputergraphics,including viewing transformations, projections, curve and hidden surfaces.	K_2,K_3
CO5	Performtheconceptofmultimediaandanimationinreallife.	K_2,K_3
DETAILEDSYLLABUS		**3-0-0**

Unit	Topic	Proposed Lecture
I	**Introduction and Line Generation:** Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller,Pointsandlines,Linedrawingalgorithms,Circlegenerating algorithms, Mid-point circle generatingalgorithm, and parallel version of these algorithms.	08
II	**Transformations:** Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections andshearing. **Windowing and Clipping:** Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clippingalgorithm,LiangBarskyalgorithm,Lineclippingagainstnon rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping.	08
III	**Three Dimensional:** 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping. **CurvesandSurfaces:**Quadricsurfaces,Spheres,Ellipsoid,Blobbyobjects, Introductory concepts of Spline, Bspline and Bezier curves and surfaces.	08
IV	**Hidden Lines and Surfaces:** Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambientlight,Diffusereflection,SpecularreflectionandPhongmodel, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.	08
V	**MultimediaSystems:**DesignFundamentals,BackgroundofArt,Colortheory overview, Sketching & illustration, Storyboarding, different tools foranimation. **Animation:** Principles of Animations, Elements of animation and their use, PowerofMotion,AnimationTechniques,AnimationFileFormat,Making animation for Rolling Ball, making animation for a Bouncing Ball, Animation for the web, GIF, Plugins and Players, Animation tools for World Wide Web.	08

SuggestedReadings:

1. HearnD.andBakerM.P.,"ComputerGraphicsCVersion",Pearson Education
2. Foley,Vandam,Feiner,Hughes,"ComputerGraphicsprinciple",PearsonEducation.
3. Rogers,"ProceduralElementsofComputerGraphics",McGrawHill
4. NewmanW.M.,SproullR.F.,"PrinciplesofInteractivecomputerGraphics",McGrawHill.
5. SinhaA.N.andUdaiA.D.,"ComputerGraphics",McGrawHill.
6. Mukherjee,"FundamentalsofComputergraphics&Multimedia",PHILearningPrivateLimited.
7. VaughanT.,"Multimedia,MakingITWork",TataMcGrawHill.

MC-7633(B):Machine Learning Techniques		
CourseOutcome(CO)		**Bloom'sKnowledgeLevel (KL)**
Attheendofcourse,thestudentwillbeable:		
CO1	Tounderstandtheneedformachinelearningforvariousproblemsolving	K_1,K_2
CO2	Tounderstandawidevarietyoflearningalgorithmsandhowtoevaluate models generated from data	K_1,K_3
CO3	Tounderstandthelatesttrendsinmachinelearning	K_2,K_3
CO4	Todesignappropriatemachinelearningalgorithmsandapplythealgorithmsto a real-world problems	K_4,K_6
CO5	Tooptimizethemodelslearnedandreportontheexpectedaccuracythat can beachievedbyapplyingthemodels	K_4,K_5
DETAILEDSYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**INTRODUCTION** – Learning, Types of Learning, Well defined learning problems, Designing a Learning System, History of ML, Introduction of Machine Learning Approaches – (Artificial Neural Network, Clustering, Reinforcement Learning, Decision Tree Learning, Bayesian networks, Support Vector Machine, GeneticAlgorithm),IssuesinMachineLearningandDataScienceVsMachine Learning;	**08**
II	**REGRESSION:**LinearRegressionandLogisticRegression **BAYESIANLEARNING-**Bayestheorem,Conceptlearning,BayesOptimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. **SUPPORTVECTORMACHINE:**Introduction,Typesofsupportvectorkernel – (Linear kernel, polynomial kernel,and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.	**08**
III	**DECISION TREE LEARNING -** Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning. **INSTANCE-BASED LEARNING** – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.	**08**
IV	**ARTIFICIAL NEURAL NETWORKS** – Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks, Derivation of Backpropagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant; **DEEP LEARNING -** Introduction,concept of convolutional neural network , Types of layers – (Convolutional Layers , Activation function , pooling , fully connected),ConceptofConvolution(1Dand2D)layers,Trainingofnetwork, CasestudyofCNNforegonDiabeticRetinopathy,Buildingasmartspeaker, Self-derivingcaretc.	**08**
V	**REINFORCEMENT LEARNING**–Introduction to Reinforcement Learning , Learning Task,Example of Reinforcement Learning in Practice, Learning Models forReinforcement – (Markov Decision process , Q Learning - Q Learning function, QLearning Algorithm), Application ofReinforcement Learning,Introduction to Deep Q Learning.	**08**

	GENETIC ALGORITHMS: Introduction, Components, GA cycle of reproduction, Crossover, Mutation,Genetic Programming, Models of Evolution and Learning, Applications.	

Textbooks:

1. TomM.Mitchell,—MachineLearning,McGraw-HillEducation(India)PrivateLimited,2013.
2. EthemAlpaydin,—IntroductiontoMachineLearning(AdaptiveComputationandMachineLearning), MIT Press 2004.
3. StephenMarsland,—MachineLearning:AnAlgorithmicPerspective,CRCPress,2009.
4. Bishop,C.,PatternRecognitionandMachineLearning.Berlin:Springer-Verlag.
5. M.Gopal,"AppliedMachineLearning",McGrawHillEducation