Barrackpore Rastraguru Surendranath College

Teaching Plan

Department of Computer Science

2022-23

NAMEOFTHEPROGRAMME

MASTEROFSCIENCE(M.Sc.)INCOMPUTERSCIENCE

PROGRAMMEOUTCOME

- Toprovidetechnology-orientedstudentswiththeknowledgeandability to develop creative solutions.
- Todevelopskillstolearnnewtechnology.
- To apply computer science theory and software development concepts to construct computing-based solutions.
- To design and develop computer programs/computer-based systems in the areas related to algorithms, networking, web design, cloud computing, Artificial Intelligence, Mobile applications.
- To be technology-oriented with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society.
- To get ability to apply knowledge of Computer Science to the real-world issues.
- To be familiar with current research within various fields of Computer Science.
- Tousecreativity,criticalthinking,analysisandresearchskill.

Semester			**I**		
CourseTitle	DISCRETEMATHEMATICS				
CourseCode	CMSMCOR01T	**Credit**	4		
CourseOutcome	Aftercompletion ofthecoursethe studentswill be able to 1. Applymathematicalknowledgeincomputationalproces s, algorithm design and complexity analysis. 2. Mapacomputationalproblemintoagraphtheoreticalproble m for its better understanding and elegant solution. 3. Applyknowledge onProbabilityTheoryandrelatedtopicsin variousapplications				
Schemeof Instruction					
Total Duration	60 Lectures	**Class/Week**	4	**Hours/wee k**	4
InstructionMode	DirectpersonalteachingwithICTbasedtechniques				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35

CourseMapping

Units	Course Content	LectureHour(Cumulative)
1	**Combinatorics and Generating function** PermutationsandCombinations,Multinomial theorem, Principle of Inclusion-Exclusion, Pigeon-hole Principle, Recurrence relation/difference equation, Generating functions, Solution of recurrence relations by Generatingfunctions.	6

2	**GraphTheory** BriefReview,PathsandCycles,Trees,Centreof graphs and trees. Bipartite graphs. Graph isomorphism.Labeledand¬unlabeled graphs.	36
	Sub-graph, Complement of a graph. Directed Graphs, Binary trees. Representation of graphs and digraphs. Planer Graphs: Planer representation,Euler'sformula,Planarity-testing, Statement of Kuratowski's theorem, Dual of a planer graph. Graph Coloring and related topics: Vertex-coloring, Chromatic number, Independence numberandcliquenumber,RamseyTheorem, Coloring-algorithms. GraphAlgorithms:Spanningtrees,Allcycles, Cliques,Isomorphism¬	
3	**Finite Fields** Setswithtwooperations,ModularArithmetic, CongruenceandGaloisfields,Vectorandvector spaces with application in graphs	40
4	**ProbabilityTheory** Random variables: Discrete Probability Distributions,ConceptsofJointdistributionand Independent variables, Expectation values, VariancesSpecial ProbabilityDistributionsandtheirproperties: Binomial, Poisson, Exponential, selection of appropriate distribution Normal distribution	60

Semester			**I**		
CourseTitle	**ADVANCEDDATASTRUCTURE**				
CourseCode	**CMSMCOR02T**	**Credit**	**4**		
CourseOutcome	Aftercompletionofthecoursethe studentswill beable to 1. Handle operations like, insertion, deletion, traversing, searching, sorting etc. on various linear and non-linear data structureslike,array,stack,queue,list,tree,heap,hashtable etc. 2. Chooseappropriatedatastructureforaspecifiedproblem definition. 3. Understandtheimportanceofdatastructuresfordesignof algorithms.				
Schemeof Instruction					
Total Duration	60	**Class/Week**	**4**	**Hours/week**	**4**
InstructionMode	**Offline**				
Schemeof Examination					
MaximumScore	35	**Internal**	15	**EndSemester**	50

CourseMapping

Units	Course Content	LectureHour(Cumulative)
1.	**BriefReview**	
	TimeandSpacecomplexity:Big-O ΩΘ.	1(1)
	Worstcase&Averagecase complexity	1(2)
	ADT	1(3)
	basiclinear andnon-lineardata-structures	1(4)
2.	**Recursion**	
	BriefReviewandLimitationsofRecursion	1(5)
	Convertinga recursivealgorithmtoanon-recursiveone	2(7)

	IllustrationbyfamiliarexampleslikeHanoi problem	2(9)
3.	**Sortingandselectionproblems**	
	Reviewofheap-sort	1(10)
	quicksort	2(12)
	mergesort and their complexity	2(14)
	Othersortingalgorithms(bothrecursiveandnon-recursiveversionswhereapplicable)	2(16)
	Tournamentsort	1(17)
	Radixsort	1(18)
	ExternalSorting(PolyphaseMergingCascade Merging)	3(21)
4.	**Searchingandsetmanipulation**	
	Searchinginstatictable:Interpolationsearch	2(23)
	Searchingin dynamictable: Randomlygrown binarysearch trees	2(25)
	AVLtrees	3(28)
	(2,3)trees	3(31)
	Red-black trees	2(33)
	B-trees	2(35)
	B+trees	3(38)
	B* trees	3(41)
	AmortizedAnalysis	2(43)
	Binomialheaps	2(45)
	Fibonacciheaps	2(47)
	Disjointsetmaintenancetechniques	2(49)
	SetmanipulationalgorithmlikeUNION–FIND	1(50)

	Unionbyrank	1(51)
	Path-compression	1(52)
	PseudoAckermannfunctionandits applications	1(53)
5.	**Hashingtechniques**	
	Reviewofbasictechniques	1(54)
	Linearprobing	2(56)
	Chaining	2(58)
	CoalescedChaining	1(59)
	Loadfactor	1(60)

	Semester	**SEMESTERI**	
CourseTitle	**AnalysisofAlgorithms**		
CourseCode	**CMSMCOR03T**	**Credit**	**4**
CourseOutcome	Aftercompletionofthecoursethestudentswillbeableto, 1. **understand**theimportanceofanalgorithmfor theory of computation perspective. 2. **choose**appropriatealgorithmsforaspecified problem definition. 3. **design**and**verify**algorithmsforaspecified real life problem. 4. **analyze**complexityissuesofalgorithms. 5. **Identify**theconceptofnon-polynomialproblems and **apply** in various design perspective; up to Boolean Satisfiability. 6. **deals**withtractableandintractableproblems.		
Schemeof Instruction			

Total Duration	60	**Class/Week**	4	**Hours/week**	4
InstructionMode	**BlendedMode(ICT+Direct Teaching)**				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35

CourseMapping

Units	Course Content	LectureHour(Cumulative)
1	**Paradigms for Algorithm-design:** Basic concepts, Foundation of computer science, Theoryof computationbasic etc.	2
1	Definition: Formal and informal definition of algorithms, characteristics,what makes an algorithmgood,Runningtimeofanalgorithm, time-spacecomplexity	4
1	Basic design and analysis techniques of algorithms, Asymptotic representations, Correctness of Algorithm.	5
1	DecisionandOptimizationproblems	6
1	**DivideandConquer:** Basicmethod,Master'stheorem,use,examples (partition exchange, merge ,BST etc.)	8
2	**Dynamic Programming:** Basicmethod,use,Examples:Allpairshortest paths, single-source shortest path problems.	10
2	TravelingSalesmanproblem(TSP)	12
3	**BranchandBound:** Basic method,theoryin use	13
3	The15-puzzleproblem,integerprogramming problem,TSPetc.	15
4	**Backtracking:** Basicmethod,use,recursion	16
3	Recap:DFS,BFS,with examples	17
3	Eightqueensproblem,n-queensproblems	19

3	Graph coloring problem (chromatic number, 4-color conjecture, 3-colorability) , vertex coloring, edge coloring, face/regioncoloring	22
3	Hamiltonianpathproblem	23
4	**Greedy Method:** General characteristic of greedy algorithms, Why greedy, examples and use	24
4	Minimum spanning tree: Optimal greedy algorithms(Prim'sandKruskal'salgorithms),and complexities	25
4	Non-optimal greedy algorithms: Knapsack problem, Complexity analysis of Knapsack problem.	28
4	Schedulingproblemandapplications;Sequential vertex-coloringalgorithms.	30
5	**Heuristicapproaches:** Fundamentals and basic, decision problems, optimization problem, types etc.	32
5	Vertex coloring of non-planer graphs (plane, planar graph, 4-color conjecture) , planar graph coloring etc.	34
5	Introduction to Genetic algorithm(GA), crossover, mutation,fitness calculation,Graphcoloringusing GA,TSPusingGA	37
5	Approximation algorithms (TSP by MST approximation, approximate covering problem), Knapsack problem etc.	39
5	Binpackingproblem(first-fit,best-fit,worst-fit etc.), greedyheuristics	41
6	**NP-completeness**:IntroductiontotheoryofNP-completeness	42
6	Decisionvs.Optimizationproblemsrevise	43
6	Polynomial vs. Non-polynomial problems, exponentialproblems	45
6	P,NP,NP Hard, NP Complete : theoryand examples	48

6	Polynomial reducibility, Satisfiability: cook's theorem,3-SAT,Booleansatisfiability,Halting problem.	51
6	Intractableproblems,paradox,Russell'sparadox etc.	53
6	**Question-answerdiscussionclass**	55
6	**InternalAssesment**	57
6	**Seminar**	60

		Semester	**I**		
CourseTitle	**DATACOMMUNICATION**				
CourseCode	**CMSMCOR04T**	**Credit**	**4**		
CourseOutcome	Aftercompletionofthecoursethestudentswillbeableto 1. Understandvariouscomponentsofcommunication systems. 2. Obtainabasicideaofsignalprocessingand information theory. 3. Applytheknowledgeinreal-lifecommunication scenario.				
Schemeof Instruction					
Total Duration	60	**Class/Week**	4	**Hours/week**	4
InstructionMode	**BlendedMode(ICT+DirectTeaching)**				
Schemeof Examination					
MaximumScore	50	**Internal**	7+8	**EndSemester**	35
CourseMapping					

Units	Course Content	LectureHour(Cumulative)
1	**Introductiontocommunicationsystems:** Data,SignalandTransmission:analog& digitaldata,periodic&aperiodicsignal	2
1	transmission (analog & digital, difference between them, Advantage of digital transmission)	4
1	Transmission modes, Transmission Impairments: Performance criteria of a communicationsystem,Attenuation,Delay distortion, noise, Hartley Theorem	7
2	**Encoding&modulation:** DigitaldatatoDigitalsignal(Unipolar, Polar: NRZ-L, NRZ-I, RZ, Biphase:	10
	Manchester,differentialManchester, Bipolar:AMI)	
2	AnalogtoDigital(PAM,PCM,Delta modulation)	13
2	DigitaltoAnalog(ASK,PSK,FSK,QAM)	18
2	Modem,5Lineandblock coding	19
2	Types of errors, Error detection & correctionmethods(Detection:VRC,LRC, CRC, Checksum, Correction: Hamming code)	22
3	**BasicsofSignalTheory:** Fouriertransform, Transformpairs, Standardfunction&theirtransform, Transformtheorem	25
3	Bandwidthutilizationtechniques:TDM, FDM,WDM;Spreadspectrumconcepts	28
3	Switching(Circuitswitching,Packet switching,Messageswitching)	31
3	ApplicationinTelephonenetwork	33

3	Connection-orientedandconnection-less approachinpacketswitchingnetwork	35
	ClassTest	36
4	**TransmissionMedia:** GuidedandUnguided:Architecture, Transmission Characteristics and Applications	38
5	**Introductiontocomputernetworks:** Datarepresentation(ASCII,ISOetc.), direction of data flow	40
5	Network:distributedprocessing,network criteria, physical structure (type of connection, topology), categories of network(LAN,MAN,WAN),briefhistory	42
	ofInternetand Intranet	
5	Protocolsandstandards.OSIreference model,TCP/IPreferencemodel	44
5	Overviewofmailtransfer:DNS,TELNET, SMTP,FTP,HTTP&WWW	47
	Seminar	48
6	**InformationTheory:** Measureofinformation,Entropy,Discrete and Continuous Channel, Shannon's EncodingAlgorithms	50
7	**Security:** Introduction,Cryptography,Firewalls	54
8	**Introductiontomobilecommunication**	59
	InternalAssessment	60

Semester	**II**

CourseTitle	**Object-orientedTechnology**				
CourseCode	**CMSMCOR06T**	**Credit**	**4**		
CourseOutcome	1. Appreciatethestrengthsofobjectorientedprogrammingasa paradigm. 2. Develop theabilityto solve real-world problems usingJava 3. Demonstratethe conceptsofexceptionhandling,genericfunctions..				
Schemeof Instruction					
Total Duration	60Hours	**Class/Week**	15	**Hours/week**	4
InstructionMode	**Direct Teaching**				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35

CourseMapping

Units	Course Content	LectureHour(Cumulative)
1	Whyobjectorientation:Programdesign concepts, Software evolutionandcrisis;Procedure-Oriented(PO) approach	2
1	IntroductiontocommonPO-languages,Advantages anddisadvantagesofPO-methodology;Basic concepts of Object-oriented (OO) approach	4
1	Evolution of OO methodologyanditsbenefits,ComparisonofOO andPOapproaches,IntroductiontocommonOO Language	6
2	Constants;Variables;Declarationof variables;Givingvaluestovariables;Scopeof variables; Symbolic constants; Type casting	8

2	Standarddefault values;Arrays;Strings;Vectors;WrapperClass. Operators: Arithmetic, Relational, Logical, Assignment, Increment and decrement, Bitwise,Special operators;Expressions;Typeconversionin expression	10
3	Selectionstatements–ifandswitch;Iteration statements	12
3	while,do-while,for,for-each; nestedloops;Jumpstatements–Usingbreak,using continue, return.	14
4	Classfundamentals–thegeneralformofaclass; Declaring objects; Introducingmethods;	16
4	managerfunction-constructor; Introducingaccess controls	18
4	Introducingnestedand inner classes;overloadingmethods.	20
5	Inheritancebasics-memberaccessand inheritance	22
5	Creatingmultilevelhierarchy;Method overriding	24
5	UsingStandardJavaPackages(util, lang,io, net),	26
5	Abstractclasses;Casestudy:interfacesand packagesinJAVA.	28
6	Exception-Handlingfundamentals;Exception types; Uncaughtexceptions	30
6	Usingtryand catch statements	32
6	Multiplecatch clauses;Nested trystatements	34
6	Chainedexceptions;Usingexceptions.	36
	ClassTest	37
7	FileI/O,Opening/closingfiles,	39
7	specifyingtheposition,detectingend-of-file, character I/O, object I/O	41
7	binaryversuscharacter files,readinganobject from disk	43
7	Streamclasshierarchy,redirection, IOS flags, redirectinginputandoutput,	45

7	command-linearguments,overloadingtheextraction andinsertionoperators.	47
6	**StudentSeminar**	50
6	Basicsof thread,	52
6	threadlifecycle	54
6	synchronization	56
6	conceptofmultithreading	58
6	**InternalAssessment**	60

	Semester	**II**			
CourseTitle	**COMPUTERNETWORK**				
CourseCode	**CMSMCOR07T**	**Credit**	**4**		
CourseOutcome	AftercompletionoftheCoursethestudentswillbeableto 1. Distinguishbetweendatacommunicationandcomput er network. 2. Explainvariousswitchingtechniquesusedand implementthevariousroutingandrouterprotocols.				
	3. Explainmultiplexinganddemultiplexing,UDP,TCP/IP protocols and congestion control mechanisms. 4. Applytheknowledgeinreal-lifenetworkingscenario.				
Schemeof Instruction					
Total Duration	60	**Class/Week**	4	**Hours/wee k**	4
InstructionMode	**BlendedMode(ICT+DirectTeaching)**				
Schemeof Examination					
MaximumScore	50	**Internal**	7+8	**EndSemester**	35

CourseMapping		
Units	**Course Content**	**LectureHour(Cumulative)**
1	Reviewofbasicconcepts	1
2	**DataLinkControl:** Line Discipline, ENQ/ACK; Poll/Select, Flow control: Stop & Wait, Slidingwindow	3
2	**Error control:** Stop & Wait ARQ, Sliding window ARQ: Go-Back- N ARQ, Selective repeat ARQ	5
2	Protocol:HDLC	6
3	Virtual Circuit Switching: Global Addressing, Virtual Circuit Identifier, Three Phases – Data transfer, Set up, Tear down phases	8
3	Frame Relay, Asynchronous Transfer Mode (ATM)	10
4	**Protocolbasics:** ErrorControl,IdleRQ,ContinuousRQ,	12
	Link management. Data link control protocols: Application environments, Character-orientedprotocols,Bit-oriented protocols	
5	Medium access protocols: Point to point protocol,Ethernet,tokenbus,tokenring, FDDI;Reservation,polling,concentration	14
5	WirelessLANs,Wireless Media	16
5	MACSubLayerServices,LLCSubLayer, NetworkLayer	18

5	Bridges, Transparent Bridges, Source RoutingBridges,InternetworkingWith DifferentTypes	21
6	**Multipleaccessprotocols:** Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD,CSMA/CA,FDMA,TDMA, CDMA	24
6	LAN Interconnection Technologies and HighSpeedLANs,VirtualLANs,Virtual CircuitApproachinWANs	27
	ClassTest	28
7	**HosttoHost Communication:** Reviewofbasicconceptsanddevices: Hubs,Bridges,Switches,Router,Gateway. Repeaters	30
8	**Routing:** Techniques,staticvs.dynamicrouting, routingtableforclassfuladdresss; Protocols: ARP, RARP, IP, IPV4.	33
8	Routing algorithms: shortest path algorithm, flooding, distance vector routing,linkstaterouting,Hierarchical routing, Unicast and multicast routing protocols	37
9	**Internetworking:** IP-Address–Subnetting,NAT,IP	40
	datagrams.	
9	Addressmapping,Errorreporting and multicastinginnetworklayer	43
	Seminar	44
10	**Processtoprocessdelivery:** UDP;TCP	46

10	Congestion control algorithm: Leaky bucketalgorithm,Tokenbucketalgorithm, chokespackets	48
11	**Advancedtopics:** ISDNservices;DSLtechnology	50
11	Introductiontoblue-tooth,VLAN's	54
	InternalAssessment	60

	Semester	**II**			
CourseTitle	ADVANCEDOPERATING SYSTEMS				
CourseCode	CMSM COR 08T	**Credit**	**4**		
CourseOutcome	**Aftersuccessfullycompletingcoursestudentwillbeableto** □ Outline the potential benefits of distributed systems □ Summarize the major security issues associated with distributedsystemsalongwiththerangeoftechniques available for increasing system security. □Applystandarddesignprinciplesintheconstructionof these systems Select appropriate approaches for building a range of distributed systems, including some that employmiddleware.				
Schemeof Instruction					
Total Duration	60	**Class/Week**	4	**Hours/week**	4
InstructionMode	**BlendedMode(ICT+DirectTeaching)**				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35

CourseMapping		
Units	**Course Content**	**Lecture Hour (Cumulative)**
1	**Review of OS:**Reviewofbasic concepts	1
1	Process Synchronization: Concept of process, Concurrent processes	4
1	Threads (Overview, Motivation, Benefits, Difference between process and thread, Multicore programmingandMulti-threadmodel,Pthreads,WindowsThreads, JavaThreads, Implicitthreading,Threadingissues)	7
1	Overview of different classical synchronization problem, Monitors, Communication Sequential processes(CSP)	9
1	ProcessDeadlocks:Introduction,causesofdeadlocks, Deadlockhandlingstrategies,Modelsofdeadlock.	12
2	**ArchitectureofDistributedOperatingSystem& DistributedMutualExclusion:**Architecture,Issues, LimitationsofDistributed Systems	14
2	Lamport'slogicalclock (vectorclocks)	16
2	Globalstates,Chandy-Lamport'sglobalstaterecording algorithm	17
2	Basic concepts of Distributed Mutual Exclusion, Lamport'sAlgorithm,Ricart -AgarwalaAlgorithm (comparison)	19
3	**Distributed Deadlock:** Preliminaries, deadlock handlingstrategiesindistributed system	21
3	Centralized deadlock detection algorithm – Ho-Ramamoorthy1 phaseand 2– phase algorithm	22
3	distributeddeadlockdetectionalgorithms–Obermark's algorithm, Chandy-Misra-Haas's algorithm, Sinha- Natarajan's Algorithm	25
3	Hierarchicaldeadlock detectionalgorithms–Menasce-MuntzAlgorithm,Ho-RamamoorthyAlgorithm	27
4	**DistributedScheduling:**Whatisload,loadbalancing vsload sharing	29

4	Components of a load distribution algorithm– transfer policy,selectionpolicy,locationpolicy,information policy	31
4	SenderInitiatedload distribution algorithms	32
4	ReceiverInitiatedloaddistributionalgorithms	33
4	SymmetricallyInitiatedloaddistributionalgorithms	34
4	comparisonamongthreeapproaches(overalldiscussion basedonpracticalexamples)	35
5	**DistributedSharedMemory:**Architecture,Client-server algorithm	37
5	MigrationAlgorithm,Read-Replication Algorithm	39
5	MemoryCoherence, Coherenceprotocols	41
6	**DistributedFileSystems:**Architecture,Mechanisms– mounting,caching,hints, bulkdatatransfer	43
6	encryption	44
6	Design issues – naming and name resolution, selection of memory (cache or main), writing policy, cache consistency,replication, scalability	46
7	**Security&Protection:**Security-threats&goals, Penetrationattempts	48
7	SecurityPolicies& mechanisms	49
7	Authentication,Protections&accesscontrol,formal models of protection	51
7	Cryptography	52
7	Worms & viruses	53
8	**Advanced topics:** Introduction to Real Time Operating System (BASICSOFREAL-TIME CONCEPTS: Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations:logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel PIPESMEMORYMANAGEMENT:- Process stack management, run-time buffer size, swapping,overlays,block/pagemanagement,	58

	replacementalgorithms,real-timegarbage collection CASE STUDIES: CasestudyLinux POSIX system)	
	Seminar	59
	InternalAssessment/Mid-termExamination	60

Semester		**M.Sc.SemesterII**	
CourseTitle	**SOFTWAREENGINEERING**		
CourseCode	**CMSMCOR09T**	**Credit**	**4**
CourseOutcome	Aftercompletionofthe Coursethestudentswill beable to 1. Analyzethedesign issuesof asoftware system. 2. Designasolutiontoagivenproblemusingoneormoredesign paradigms. 3. Understandcommonlife-cycleprocessesincludingwaterfall (linear),incrementalapproaches(suchasUnifiedprocess),and agile approaches. 4. Applysoftwaretestingandqualityassurancetechniquesatthe module level, and understand these techniques at the system and organization level.		
Schemeof Instruction			

Total Duration	60 Lectures	**Class/Week**	4	**Hours/week**	4
InstructionMode	FacetofaceteachingprocessandalsoICTbasedteaching-learning process.				
Schemeof Examination					
MaximumScore	50	**Internal**	8+7=15	**EndSemester**	35

CourseMapping

Units	Course Content	LectureHour(Cumulative)
1.	**Brief review:** Software Crisis & Myths, System Development Life Cycle, Feasibility Assessment, Changeover, Software Life Cycle Models – Waterfall, Prototyping, Spiral, RAD etc. CMM, Project Management Concepts – Management,People,Product,Process,Project, W5HH Principle .	4Lectures
2.	**Software Metrics :**Definition, Areas of application,Problemsduringimplementation, LOC, Token Count, Function Count.	6Lectures
3.	**Software Project Planning:** Cost estimation, Static single variable & multiple variablemodels,COCOMO,Putnam-Resource AllocationModel,SoftwareRiskManagement.	6Lectures

4.	**SoftwareRequirementAnalysisand Specification:** Requirements Engineering, ProblemAnalysis–DFD,DataDictionary,E-R	8Lectures
	Diagram,DecisionTable,SoftwareRequirement Specification	
5.	**SoftwareDesign:**WhatisSoftwareDesign, DesignProcess,Designconcepts,Modularity–Coupling and Cohesion, Dependence Matrix, Strategy of Design – Bottom-up, Top-down, Hybrid; User Interface Design.	10Lectures
6.	**SoftwareTesting:**TestingProcess,TestCase Design, Verification & Validation, White Box Testing, Black Box Testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Debugging.	8Lectures
7.	**ObjectOrientedSoftwareEngineering:** Object Oriented concepts, Identifying the elements of an object model, Conventional vs. Object Oriented approach, Relationshipdiagrams:Classdiagram,Usecasediagram,State Transition Diagram.	10Lectures

8.	**Software Quality, Reliability & Maintenance:** Softwarereliability,reliability metrics, Software Quality, Software Quality Assurance (SQA), Software Maintenance – categories of maintenance, problems during maintenance,maintenanceprocess,maintenance models.	8Lectures

<table>
<tr><td colspan="3">Semester</td><td colspan="3">SEMESTERIII</td></tr>
<tr><td>CourseTitle</td><td colspan="5">AdvancedComputerArchitecture</td></tr>
<tr><td>CourseCode</td><td>CMSMCOR11T</td><td>Credit</td><td colspan="3">4</td></tr>
<tr><td>CourseOutcome</td><td colspan="5">Aftercompletionofthecoursethestudentswillbe able to,
1. Acquireknowledgeandunderstanding of evolution of design philosophy evolved in modern computing systems.
2. Comparevariousdesignprinciplesinrespect of advantages, disadvantages, and computational complexity.
3. Understand various components and their interdependence including multiprocessor systems,interconnectionnetworksandtheir applications.
4. Apply the theoretical knowledge in real-life computingapplicationsandsuggestasuitable system for a specific application.
5. Analyzethedesignandperformanceissues of a computing system.</td></tr>
<tr><td colspan="6">Schemeof Instruction</td></tr>
<tr><td>TotalDuration</td><td>15 weeks</td><td>Class/Week</td><td>4</td><td>Hours/week</td><td>4</td></tr>
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InstructionMode	DirectTeaching(withICT)				
MaximumScore	50	Internal	15	End Semester	35

Course Mapping

Units	Course Content	LectureHour (Cumulative)
1	Brief review: Evolution of Computer Architecture,DesiredPropertiesofthe instruction set, Addressing Modes.	2
1	ArchitecturalClassificationbasedonMultiplicity of Data and Instruction (SISD, SIMD, MISD, MIMD structures), CISC versus RISC architecture.	4
2	MemorySystem:Associativememory,Cache memory, Virtual memory.	8
3	Pipeline Architecture: Basic Concepts, Performance of a static linear pipeline, InstructionpipeliningHazards(Structural,data & control hazards).	12
3	Instructionlevelparallelism,Superpipelining, Super scalar processing, Vector processing.	16
4	Array Processor: Comparison with vector processors(examplesofarrayprocessors).	20
5	Multiprocessors:Centralizedsharedmemory architecture, Distributed shared memory architecture.	24

5	Synchronizationissues,modelsofmemory consistency, Example systems.	26
	Class Test	28
6	DataFlowArchitecture:StaticandDynamic models, data flow graph.	30
7	SystolicArchitecture:Systolicarray,systolic processors.	34
8	Interconnection network with examples: Static network:Lineararray,Ring,Star,Tree,Systolic Array.	37
8	Completelyconnectednetwork,Cube&3-Cube network. Dynamic Network: Single-Stage network,Multi-stagenetwork:CrossbarSwitch,	40
8	BlockingNetwork:Omeganetwork,Non-blocking network, Mesh connected Illiac Network, Scuffle Exchange.	46
9	CaseStudy:Microprocessor(8080,8085,8086, 80486 up to Pentium), Subroutine and delay.	50
9	Interfacing using 8155, 8255 and 8279, Programmingandinterfacingusing8085.	54
10	Advanced topics: Basic features of Current Architecturaltrends,DSPProcessors,DualCore processors, Grid computing	58
	Studentseminar	59
	Internal Assessment	60

	Semester	**SEMESTERIV**			
CourseTitle	**ADVANCEDDATABASEMANAGEMENT SYSTEM**				
CourseCode	**CMSMCOR12T**	**Credit**	**4**		
CourseOutcome	Aftercompletionofthecoursethestudentswillbeableto, 1. Demonstratethelogicaldesignofthedatabase systems using data modeling concepts. 2. Demonstratedistributeddatabasetechnologyto tackle deficiencies of the centralized database systems. 3. Use the structural part of the object data model; suchasObjectDefinitionLanguage;ObjectQuery Language; create the manipulation part of the object data model; build Object Database application. 4. Understandperformanceissuesandoptimization strategies including query rewriting. 5. Gainknowledgeoncurrentrecenttrendsof database management systems.				
Schemeof Instruction					
Total Duration	60	**Class/Week**	4	**Hours/week**	4
InstructionMode	**BlendedMode(ICT+Direct Teaching)**				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35

CourseMapping		
Units	**Course Content**	**LectureHour(Cumulative)**
1	**Briefreview:** Objectivesandarchitectureofdatabasedesign, Relational database design	2
1	Hashandinvertedfiles,Extended E-R diagram	5
2	**Queryprocessing:**queryprocessingbasicand steps,query tree	7
2	Queryoptimization:heuristicandrulebased optimizers, cost estimates	10
3	**Transaction Management:** Basicconcepts(ACID properties)	12
3	Transaction Concept, Transaction State- Implementation of ACID property, Different transactionproblems.	14
3	Concurrency control (ConcurrentExecutions, Serializability, Recoverability, Implementation of Isolation)	16
3	Testingforserializability,Lock–BasedProtocols, TimestampBasedProtocols.	18
4	**Objectorienteddatabasedesign:** Objects,methodsetc.	19
4	Querylanguages,implementations,Comparison withRelational systems	21
4	Objectorientationinrelationaldatabase systems,	23
4	Objectsupportincurrentrelationaldatabase systems,complexobjectmodel,implementation techniques	25
5	**Distributeddatabase:** Conceptsandbasic	26
5	Client/server model, integrity, security &repositions,	28

5	Casestudyof someinteractivedistributed systems	30
5	Integrity,Views&Security, Integrityconstraints,viewsmanagement,	33
5	Distributeddatasecurity	35
5	**ClassTest**	36
6	**ParallelDatabases:** ObjectivesofparallelDBMS,Architecture	38
6	Parallelism (Intra-query, Inter-query, Intra-operation,Interoperation)	40
6	**Seminar**	42
7	**CaseStudywith aDBMS package**	45
8	**Advancedtopics:Datawarehousing** DefinitionandideaonDataWarehousing,Data Warehousing models	47
8	Multidimensionaldatamodel,Data Warehousearchitecture withreallifeexamples	50
8	OLTPvs.OLAP,DataCube,Roll-up,Drill-down, slice,dice,pivoting,Schemas(likesnowflake, staretc.),	53
8	ROLAP,MOLAP,HOLAPetc.withexamples	55
8	Comparison between ROLAP, MOLAP & HOLAP with respect to any organizational pointof view.	57
8	Datamining applications	58
8	**InternalAssessment**	60

	Semester	**III**	
CourseTitle	**COMPILERDESIGN**		
CourseCode	**CMSMCOR13T**	**Credit**	**4**

CourseOutcome	Aftercompletion ofthecoursethe students willbeable to 1. Writeaparser,andsemanticanalyzerwithouttheaidof automatic generators. 2. Demonstratecodeoptimizationtechniquestoimproveth e performance of a program in terms of speed & space. 3. Usetheknowledgeofpatterns,tokens&regularexpressionsfor solving a problem in computer science. 4. Designthestructuresandsupportrequiredforcompilin g advanced language features.				
Schemeof Instruction					
Total Duration	60	**Class/Week**	4	**Hours/wee k**	4
InstructionMode	**BlendedMode(ICT+DirectTeaching)**				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35

CourseMapping

Units	Course Content	LectureHour(Cumulative)
1	**Review:**Reviewofautomatatheory:finitestate machine	2
1	Push-down-automata	4
1	Turingmachine	6
1	Regular and Context-FreeGrammar	9
1	PumpingLemma	10
2	**Introduction:**Analysisofthesourceprogram, Compiler	11
2	PhasesofCompiler	13
2	Cousins of compiler	15
3	**Lexical&SyntaxAnalysis:**Theroleofthe lexicalanalyzer	16
3	Tokens,Patterns,Lexemes,Input buffering, Specificationsof a token,Recognition of atokens, idea of LEX	18

3	Therole ofaparser,TopdownParsing	20
3	Non-recursivePredictiveparsing(LL)	21
3	Bottomupparsing, Handles,Viable prefixes	23
3	Operatorprecedenceparsing	26
3	LRparsers(SLR, LALR)	29
3	Parsergenerators (YACC/JavaCC)	31
4	**Syntaxdirectedtranslation&Typechecking:** Constructionofsyntaxtrees,Type Systems	34
4	Syntaxdirectordefinitions,Specificationofa simpletype checker	37
5	**Run time environments:** Source language issues (Activation trees, Control stack, scope of declaration, Binding ofnames)	39
5	Storageorganization(Subdivisionofrun-time memory,Activationrecords)	41
5	Storageallocationstrategies	42
5	Parameter passing (call by value, call by reference,copyrestore,call byname)	43
5	Symboltables	45
5	Dynamicstorageallocationtechniques	46
6	**Intermediate code generation**: Intermediate languages,Graphicalrepresentation	48
6	Three-addresscodes	49
6	Implementation of three address statements (Quadruples,Triples,Indirect triples)	51
7	**Codeoptimization:**Introduction,Basicblocks& flowgraphs,Transformationofbasic blocks	53
7	DAGrepresentationofbasicblocks	55
7	Principlesourcesofoptimization,Loopsinflow graph	57
7	Peephole optimization	58
	Seminar	59
	InternalAssessment/Mid-termExamination	60

Semester			**III**		
CourseTitle	**PATTERNRECOGNITION**				
CourseCode	**CMSMDSE01T (E09)**	**Credit**	**4**		
CourseOutcome	**Aftercompletionof thecoursethestudentswillbeableto** 1. Understandvariouscomponents,advantagesandchallenges of Pattern Recognition. 2. Obtainanideaof moderntoolsandapplicationsoftware availableforit.				
Schemeof Instruction					
Total Duration	60 Lectures	**Class/Week**	4	**Hours/week**	4
InstructionMode	Directteachingthrough ICTbasedtechniques				
Schemeof Examination					
MaximumScore	50	**Internal**	15	**EndSemester**	35
CourseMapping					
Units	**Course Content**			**LectureHour(Cumulative)**	

1	**Review of Statistical and Mathematical prerequisites:** Measures of central tendency: Measure ofDispersion; Correlation and Regression; Theory of Probability: Bayes theorem, Chebyshev inequality, Laws of large numbers, Central limit theorem; Theoretical distributions: Bernoulli distribution, Binomial distribution, Normal distribution, Multi- variate normal distribution; Theory of estimation: Estimator, Unbiased estimate, Consistent estimate, Maximum likelihood estimate; Positive definite matrix,Linearalgebra:Vectorspaces,Subspacesand Span,EigenvaluesandEigen vectors.	10
2	**IntroductiontoPattern Recognition:** Overview of pattern recognition and learning, Pattern recognition strategies, Applications.	4
3	**Discriminantfunction:** Linear and Non-linear discriminant function, Generation of decision functions and its generalization, Training and test sets, probability of misclassification	4
4	**Classification:** Statistical decision making: Bayesian decision rule, Likelihood estimation, Decision region and decision boundaries,Multivariatedecisionmaking,Estimation oferrorrates,Minimizationofriskfactor,Distance basedclassifier:standardization,normalization,	38
	Euclidian distance, Mahalanobis distance, Nearest Neighbour (NN) classifier: K-NN, Error rate, Modification for non-numeric attribute; Graph based classification:Decisiontree,Randomforests; AssessmentofClassifiers.	

5	**Clustering:** Measures of similarity, minimum within cluster distance criterion, K-means algorithm, Hierarchical clustering,Densitybasedclustering,FCM,cluster validation.	48
6	**Dimensionalityreduction:** Feature selection: Different criterion functions, Algorithms, BBA, Feature extraction: PCA, LDA	54
7	**NeuralPatternRecognition:** Introductiontobiological neural networks, Models of artificial neurons, thresholdlogic, binaryneurons and pattern dichotomizers, perceptron: its learning rule and convergence. Multilayered perceptron, learning algorithms, function approximation, generalization, regularizationnetworks,RadialBasisFunction (RBF) networkand learning.	60

		Semester	**III**		
CourseTitle	**Fundamentalsof Computers**				
CourseCode	**CMSMGEC01M**	**Credit**	**4**		
CourseOutcome	Aftercompletionofthecoursethe studentswill beable to - Appreciatethedesignandworkingprinciplesofacomputer - Useacomputerforeverydayneedssuccessfully				
Schemeof Instruction					
Total Duration	**60**	**Class/Week**	**4**	**Hours/week**	**4**
InstructionMode	**BothOfflineandonline**				

Schemeof Examination					
MaximumScore	35	**Internal**	15	**EndSemester**	50

CourseMapping		
Units	**Course Content**	**LectureHour(Cumulative)**
1.	FiveComponentModelofaComputer	1(1)
	SystemandApplication software(introduction)	1(2)
	storage devices: Primarymemory(RAMRAM,ROM,PROM, EPROM, cache) Secondarymemory(magnetictape,harddisk, Compact disks	2(4)
	peripheraldevices,printers	1(5)
2.	OperatingSystems:DOS, Internal, External commands	1(6)
	Windows(2000), Overviewof architectureof Windows,	1(7)
	OverviewofLinux architecture,simpleLinux commands	1(8)
	Filesystem:fileandpermissions	1(9)
	conceptofuserandgroup	1(10)
3.	Basicsofprogramming,Propertiesofalgorithm,	1(11)
	Representationofsimpleproblemsthroughflow chart	1(12)
	AlgorithmandDecision Tables.Basicconceptsof Networking	1(13)
	Typesofnetworks	2(15)
	varioustypesofcables	1(16)
	briefconcept ofsatellitecommunication	1(17)
	Networktopologiesandprotocols	1(18)
	OverviewofDatabaseManagement System	1(19)

	simplecommandsfordatahandling- insertion, deletionetc.	1(20)
4.	**WordProcessor:** Creating,editing,savingandprintingtext documents, Font and paragraph formatting, Simple character formatting, Inserting tables, smart art, page breaks, Using lists and styles, Working with images, Using Spelling and Grammar check, Understanding document properties, Mail Merge	5(25)
	Spreadsheet: Basics, Creating, editing, saving and printing spreadsheets, Working with functions & formulas, Modifying worksheets with color & auto-formats, Graphically representing data : Charts & Graphs, Speedingdata entry : Using Data Forms, Analysing data: Data Menu, Subtotal, Filtering Data, Formatting worksheets, Securing & Protecting spreadsheets	5(30)
	Presentationsoftware: Opening, viewing, creating, and printing slides, Applying auto layouts, Adding custom animation, Using slide transitions, Graphically representing data:Charts&Graphs, CreatingProfessionalSlide for Presentation	5(35)
	DBMSSQLcommands: CREATE,INSERT,ALTER,UPDATE,SELECT	5(40)

	Document preparation using Latex: Introduction: Introduction to LaTeX, its installation, and different IDEs. Document creation, Organization of content into sections and subsections;**StylingPages:**Differentpaper sizes,Packages,Settingmargins,Customizing	20(60)
	header and footer, Changing the page orientation, dividing the document into multiple columns; **Formatting Content:** Formatting text (styles, size, alignment), Adding colors to text, Adding bullets and numbered items; **Setting up mathematics**; T**ables and Images:** Basic tables, adding simple and dashed borders, merging rows and columns, Add an image, Rotate and Scale	

Semester	**SEMESTERIII/IV(Elective)**		
CourseTitle	**AdvancedImageProcessing**		
CourseCode	**CMSME01**	**Credit**	**4**

CourseOutcome	Aftercompletionofthecoursethestudentswillbe able to, 1. **Acquireknowledgeandunderstanding**ofth e concepts, principles, processes, application fields etc. of Digital Image Processing and its advanced topics. 2. **Identifyandformulate**appropriateDI P technique to solve a relevant problem. 3. **Compare** different techniques in respect of advantages,disadvantages,andcomputation al complexity. 4. **Implement**commonalgorithmsforDIP. 5. **Apply**thetheoreticalknowledgeinreal-life digital imagingapplications. 6. **Acquireknowledge**aboutcommonImag e databases. 7. **Understand**aboutImageprocessin g applications in detail.				
Schemeof Instruction					
TotalDuration	15 weeks	**Class/Week**	4	**Hours/week**	4
InstructionMode	**DirectTeaching(withICT)**				

MaximumScore	50	Internal	15	End Semester	35

Course Mapping		
Units	**Course Content**	**LectureHour (Cumulative)**
1	Introduction:Basicconcepts:Imageprocessing systems and its applications; Image formation: Geometric and photometric models.	2
1	Digitization:sampling,quantization;Image representation; Neighborhood concepts.	4
2	Spatialdomainfiltering:Enhancement,contrast stretching.	6
2	Histogram specification, local contrast enhancement. Smoothing, linear and order statisticfiltering,sharpening,spatialconvolution.	8
2	Gaussiansmoothing,DoG, LoG.	10
2	Fuzzytechniquesforintensitytransformations and spatial filtering.	12
3	Frequencydomainfiltering:Frequencydomain analysis, discrete Fourier transform,	14
3	Fast Fourier transform, convolution and correlationinfrequencydomain,frequency domain filtering.	16
3	Walshtransform;Hadamardtransform;Discrete cosine transform; Hotelling transform.	20
	Class Test	21

4	Segmentation:Pixelclassification;Greylevel thresholding, global/local thresholding;	23
4	Optimumthresholding-Bayesanalysis,Otsu method; Derivative based edge detection operators, edge detection/linking,	26
4	Canny edge detector; Region growing, split/mergetechniques,linedetection,Hough transform.	30
5	Image/Objectfeaturesextraction:Textural features-graylevelco-occurrencematrix; Moments;Connectedcomponentanalysis;	33
5	Convexhull;Distancetransform,medialaxis transform, skeletonization/thinning, shape properties.	36
6	Registration:Monomodal/multimodalimage registration; Global/local registration;	40
6	Transform and similarity measures for registration;Intensity/pixelinterpolation.	42
7	Color image processing: Fundamentals of differentcolormodels-RGB,CMY,HSI, YCbCr, Lab; False color; Pseudocolor; Enhancement; Segmentation.	44
8	Morphologicalimageprocessing:Erosion, dilation, opening, closing, Hit-or-Miss transformation.	46
8	Gray-scalemorphology,areamorphology; Watershade algorithm.	50

9	Compression: Lossy/lossless compression, error criteria;Huffmancoding,arithmeticcoding,run-length coding.	52

9	Blocktransformcoding,JBIG;transformdomain compression, vector quantization, block truncation compression, JPEG, wavelet basedcompression.	54
10	Imagedatabases: Attribute list, relational attributes,indexing,storageandretrieval.	55
10	Imageprocessingapplications:Biomedicalimage processing; Document image processing; Biometrics;Digitalwater-marking;Imagefusion; Image dehazing; Content based image retrieval.	57
	Studentseminar	59
	Internal Assessment	60

	Semester	**M.Sc.SemesterIV**	
CourseTitle	**CMSME12:VLSIDesign**		
CourseCode	**CMSMDSE03T**	**Credit**	**4**

CourseOutcome	Aftercompletionofthe Coursethestudentswill beableto 1. learnthevarious ICfabricationmethods. 2. DescribetheLayoutofasimpleMOScircuitusingdifferent design rules. 3. Applythedifferentphysical designsintocircuit models. 4. DifferentiatevariousFPGA architectures. 5:DesignanapplicationusingVerilogHDL.

Schemeof Instruction					
Total Duration	60 Lectures	**Class/Week**	4	**Hours/week**	4
InstructionMode	FacetofaceteachingprocessandalsoICTbasedteaching-learning process.				

Schemeof Examination					
MaximumScore	50	**Internal**	8+7	**EndSemester**	35

CourseMapping

Units	Course Content	LectureHour(Cumulative)

1.	**Introduction:** SwitchingCircuits,Transistor based Logic Synthesis, Reduction of Energy demand through gradual development of transistor technology.	6Lectures
2.	**MOSFET:** Basic science, realization using poly-siliconconductor,SiO2insulator,diffusion layer, Synthesis rule: nComplex, p-Complex, geometricdual,transmissiongate,realizationof circuit like (a·c + b·d + a·e·d+ b·e·c)′, (a + b·c + d·e)′ , Physical layout, stick diagram.	14Lectures
3.	**Fabrication:** photolithographicresolution, parameter, design rules, Large Scale Integrations.	4Lectures

4.	**VLSIDesignCycle:**	36Lectures
	Partitioning: KernighanLinHeuristics,Fidducia-Mattheyses heuristics.	4 Lectures
	Placement: RectangularDualGraphApproach.	4Lectures
	FloorPlanning: ChannelGraph,Sliceable and inherently non-sliceable channel graph, Slicing Theorem, Four Cycle Theorem .	6Lectures
	Routing: Interval Graph, Vertical Constraint Graph,HorizontalConstraintGraph,Constraint Graph, Zone – Margin, Chromatic Partitioning Global Routing: Lee's Approach, Soukop'sApproach..	8Lectures
	Clocking: Clocktreeanditsdelaycalculation, H-tree algorithm, Geometric-Matching based algorithm.	4Lectures
	Testing: Fault, Error, Stuck–at–fault Model, Path-delay Model, Collapse of fault – universe using fault dominance and fault equivalence, Path-sensitizationmethod,Faultactivation,Fault Propagation and Fault justification, Boolean Difference Method, D- Algorithm.	6Lectures
	DesignTools:ESPRESSO(Two-levelAND-ORMinimizer),MAGIC(Layouteditor),HOPE (Test Pattern Generation Tool), BENCHMARKS.	4Lectures