Course Code	Course Name	Credit
CSC601	DataAnalyticsandVisualization	03

Pre-requisite:	
Course Objectives: The course aims:	
1	Understand the science of statistics and the scope of its potential applications.
2	Verifytheunderlyingassumptionsofaparticularanalysis.
3	Construct testable hypotheses that can be evaluated using common statistical analyses.
4	Conduct, present, and interpret common statistical analyses using any tool.
5	Summarize and present data in meaningful ways through visualization techniques.
Course Outcomes: **Aftersuccessful completion of the course students will be able to:**	
1	Apply qualitative and quantitative techniques to understand the data
2	Formulate testable hypotheses andevaluate them using common statistical analyses.
3	Perform regression analysis on a given data set for prediction and forecasting.
4	ApplyANOVAmethodtofindthestatistical differences between the means in a given data.
5	Fit anARIMAmodel for prediction and forecasting of time series data
6	Translatethedataintovisualcontextto identifypatterns,trendsandoutliersinlarge datasets.

Module		Detailed Content	Hours
1		IntroductiontotheScienceof Statistics.	5
	1.1	Fundamental Elements of Statistics, Qualitative and QuantitativeDataSummaries,Normaldistribution·Sampling,TheCentralLimit Theorem.	
2		ConfidenceIntervalsandHypothesisTests.	6
	2.1	StatisticalInference,Stating Hypotheses,TestStatisticsandp-Values,EvaluatingHypotheses.	
	2.2	SignificanceTestsandConfidenceIntervals,InferenceaboutaPopulationMean,Two-SampleProblems.	
3		Understanding the association between two continuous orquantitative factors.	5
	3.1	Simple Linear Regression, F-test and t-test for Simple Linear Regression.	
	3.2	Multiplelinearregression,F-testandt-testforMultipleLinear Regression.	
4		AnalysisofVariance(ANOVA)andAnalysisforProportions.	12
	4.1	One-WayandTwo-WayanalysisofVarianceandCovariance,F-testfor ANOVA,TypeIandTypeIIErrors.	

	4.2	Analysis for proportions: One-Sample Tests for Proportions,Significance Tests for a Proportion, Confidence Intervals for aProportion,Two-SampleTestsforProportions,ConfidenceIntervalsfor	

		DifferencesinProportions,SignificanceTestsforDifferencesin Proportions.	
5		**Time SeriesAnalysis**	6
	5.1	OperationsonTimeSeriesanalysis,TestingaTimeSeriesfor Autocorrelation, Plotting the Partial Autocorrelation Function, Fitting anARIMAModel,RunningDiagnosticsonanARIMAModel	
6		**DataVisualization**	5
	6.1	Bargraphs,Linegraphs,Histogram,Boxplots,Scatterplots,andChoropleth(map)plots,RadialBarplots	
	6.2	Timeseriesplots,CreatingDashboardusinganytool.	
		Total	39

Textbooks:	
1	Teetor,P.(2011).Rcookbook.Sebastopol,CA:O'Reilly.ISBN9780596809157.
2	Chang,W.(2013).Rgraphicscookbook.Sebastopol,CA:O'Reilly.ISBN 9781449316952.
References:	
1	AndyField,JeremyMilesandZoeField.(2012)DiscoveringStatisticsUsingR. Publisher:SAGEPublicationsLtd.ISBN-13:978-1446200469.
2	GarethJames,DanielaWitten,Trevor Hastieand RobertTibshirani. (2013)An Introduction toStatisticalLearningwithApplicationsinR. Springer.
3	Han,Kamber,"DataMiningConceptsandTechniques",MorganKaufmann3ndEdition

Assessment:	
InternalAssessment:	
Assessmentconsistsoftwoclasstestsof20markseach.Thefirst-classtestistobeconductedwhenapprox.40%syllabusiscompletedandsecondclasstestwhenadditional40%syllabusis completed.Durationofeachtestshallbeonehour.	
End SemesterTheory Examination:	
1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs45/preview
2	https://nptel.ac.in/courses/106107220

Course Code	Course Name	Credit
CSC602	Cryptographyand SystemSecurity	03

Pre-requisite:BasicconceptsofOSILayer	
Course Objectives: The course aims:	
1	The concepts of classical encryption techniques and concepts of finite fields and number theory.
2	Toexploretheworkingprinciplesandutilitiesofvariouscryptographicalgorithmsincluding secretkeycryptography,hashesandmessagedigests,andpublickeyalgorithms
3	Toexplorethedesignissuesandworkingprinciplesofvariousauthenticationprotocols,PKI standards.
4	Toexplorevarioussecurecommunicationstandardsincluding Kerberos,IPsec,andSSL/TLS and email.
5	The ability to use existing cryptographic utilities to build programs for secure communication.
6	The concepts of cryptographic utilities and authentication mechanisms to design secure applications
Course Outcomes:	
1	Identify information security goals, classical encryption techniques and acquire fundamental knowledgeontheconceptsoffinitefieldsandnumbertheory.
2	Understand,compare andapply differentencryption anddecryption techniques tosolve problems related to confidentiality and authentication
3	Applythe knowledgeof cryptographicchecksums and evaluatethe performanceof different message digest algorithms for verifying the integrity of varying message sizes
4	Applydifferent digitalsignature algorithmsto achieveauthentication and createsecure applications .
5	Applynetwork securitybasics, analyzedifferent attacks onnetworks andevaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP
6	Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

Module		DetailedContent	Hours
1		**Introduction&NumberTheory**	
	1.1	Services, Mechanisms and attacks-the OSI security architecture-Networksecurity model-Classical Encryption techniques (Symmetric cipher model,mono-alphabeticandpoly-alphabeticsubstitutiontechniques:Vignere cipher,playfaircipher,Hillcipher,transpositiontechniques:keyedand keyless transposition ciphers, steganography).	7
2		**BlockCiphers&PublicKeyCryptography**	7
	2.1	DataEncryptionStandard-Blockcipherprinciples-blockciphermodesofoperationAdvancedEncryptionStandard(AES)-TripleDES-Blowfish-RC5algorithm.Publickeycryptography:Principlesofpublickeycryptosystems-TheRSAalgorithm,Theknapsackalgorithm,El-GamalAlgorithm.Key management – Diffie Hellman Keyexchange	

3		**CryptographicHashes,MessageDigestsandDigitalCertificates**	7
	3.1	Authentication requirement – Authentication function , Types ofAuthentication,MAC–Hashfunction– SecurityofhashfunctionandMAC –MD5 – SHA– HMAC – CMAC, Digital Certificate: X.509, PKI	
4		**DigitalsignatureschemesandauthenticationProtocols**	6
	4.1	Digitalsignatureandauthenticationprotocols:NeedhamSchroederAuthentication protocol,DigitalSignature Schemes – RSA, EI Gamal andSchnorr,DSS.	
5		**SystemSecurity**	6
		Operating System Security: Memory and Address Protection, File ProtectionMechanism,UserAuthentication.LinuxandWindows:Vulnerabilities, FileSystem Security Database Security: Database Security Requirements, Reliability and Integrity,Sensitive Data, InferenceAttacks, Multilevel Database Security	
6		**Websecurity**	**6**
	6.1	WebSecurity Considerations,UserAuthenticationandSession Management, Cookies, SSL, HTTPS, SSH, Web Browser Attacks, WebBugs, Clickjacking, CrossSite Request Forgery, Session Hijacking andManagement, Phishing Technique, DNS Attack, Secure ElectronicTransaction,EmailAttacks,Firewalls,PenetrationTesting	

Textbooks:	
1	ComputerSecurityPrinciplesandPractice,WilliamStallings,SixthEdition,Pearson Education
2	SecurityinComputing,CharlesP.Pfleeger,FifthEdition,PearsonEducation
3	NetworkSecurityandCryptography,BernardMenezes,CengageLearning
4	NetworkSecurityBible,EricCole,SecondEdition,Wiley
5	MarkStamp'sInformationSecurityPrinciplesandPractice,Wiley
References:	
1	WebApplicationHackersHandbookbyWiley.
2	ComputerSecurity,DieterGollman,ThirdEdition,Wiley
3	CCNASecurityStudyGuide,Tim Boyle,Wiley
4	IntroductiontoComputerSecurity,MattBishop,Pearson.5.
5	CloudSecurityandPrivacy,TimMather,SubraKumaraswamy,ShahedLatif,O'Riely
6	Cryptographyand Network Security,AtulKahate,TataMcGrawHill

Assessment:

InternalAssessment:

Assessmentconsistsoftwoclasstestsof20markseach.Thefirst-classtestistobeconductedwhenapprox.40%syllabusiscompletedand second class test when additional40% syllabus is completed. Durationofeachtestshallbeonehour.
End SemesterTheory Examination:

1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://nptel.ac.in/courses/106105031
2	https://onlinecourses.nptel.ac.in/noc22_cs03/preview
3	https://www.coursera.org/learn/basic-cryptography-and-crypto-api

Course Code	Course Name	Credit
CSC603	SoftwareEngineeringand ProjectManagement	03

Pre-requisite:None	
Course Objectives: The course aims:	
1	Toprovidetheknowledgeofsoftwareengineeringdiscipline.
2	TounderstandRequirementsandanalyzeit
3	Todoplanningandapplyscheduling
4	Toapplyanalysis,anddevelopsoftwaresolutions
5	Todemonstrateandevaluaterealtimeprojectswithrespecttosoftwareengineeringprinciples andApply testing and assure quality in software solution.
6	Tounderstandneedofprojectmanagementandprojectmanagementlifecycle.
Course Outcomes:	
1	Understand and use basic knowledge in software engineering.
2	Identify requirements, analyze and prepare models.
3	Plan, schedule and track the progress of the projects.
4	Design & develop the software solutions for the growth of society
5	Apply testing and assure quality in software solutions
6	Generate project schedule and can construct, design and develop network diagram for differenttypeofProjects.Theycanalsoorganizedifferentactivitiesofproject

Module		DetailedContent	Hours
1		IntroductiontoSoftwareEngineering	
		Nature of Software, Software Engineering, Software Process, CapabilityMaturity Model (CMM) Generic Process Model, Prescriptive ProcessModels: The Waterfall Model, V-model, Incremental Process Models,Evolutionary ProcessModels, ConcurrentModels,Agileprocess,Agility Principles, Extreme Programming (XP), Scrum, Kanban model	08
2		RequirementsAnalysis and Cost Estimation	06
	2.1	Software Requirements: Functional & non-functional – user-systemrequirementengineeringprocess–feasibilitystudies– elicitation – validation&management–softwareprototyping–S/Wdocumentation– Analysisandmodelling Requirement Elicitation, Software requirement specification (SRS)3Ps(people,productandprocess)ProcessandProjectmetricsSoftwareProjectEstimation:LOC,FP,EmpiricalEstimationModels-COCOMOII Model	
3		DesignEngineering	07

	3.1	Design Process & quality, Design Concepts, The design Model, Pattern-basedSoftware Design. 4.2 Architectural Design :Design Decisions, Views, Patterns,ApplicationArchitectures,ModelingComponentlevelDesign: component,Designing class based components, conducting component-level design, UserInterfaceDesign:Thegolden rules, Interface Design steps & Analysis, Design Evaluation	
4		SoftwareRisk,ConfigurationManagement	05
	4.1	Risk Identification, Risk Assessment, Risk Projection, RMMM Software Configuration management, SCM repositories, SCM process Software Quality Assurance Task and Plan, Metrics, Software Reliability, Formal Technical Review (FTR), Walkthrough.	
5		Software Testing and Maintenance	05
	5.1	Testing: Software Quality, Testing: Strategic Approach, Strategic Issues-Testing: Strategies for Conventional Software, Object oriented software, Web AppsValidating Testing- System Testing- Art of Debugging. Maintenance : Software Maintenance-Software Supportability-Reengineering- Business Process Reengineering- Software Reengineering-Reverse Engineering- Restructuring- Forward Engineering.	
6		IT Project Management and Project Scheduling	08
	6.1	Introduction, 4 P's, W5HH Principle, Need for Project Management, Project Life cycle and ITPM, Project Feasibility, RFP, PMBOK Knowledge areas, Business Case, Project Planning, Project Charter and Project Scope.	
	6.2	Project Scheduling:Defining a Task Set for the Software Project, Timeline chartsWBS, Developing the Project Schedule, Network Diagrams (AON, AOA), CPM and PERT, Gantt Chart , Tracking the Schedule, Earned Value Analysis	

Textbooks:	
1	Roger S. Pressman, Software Engineering:Apractitioner's approach, McGraw Hill
2	Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India
3	JohnM.Nicholas,ProjectManagementforBusinessandTechnology,3rdedition,Pearson Education.
References:	
1	"SoftwareEngineering:APreciseApproach"Pankaj Jalote,WileyIndia
2	Ian Sommerville " Software Engineering" 9th edition Pearson Education SBN-13: 978-0- 13-703515-1, ISBN-10: 0-13-703515-2
3	PankajJalote,An integrated approach to Software Engineering, Springer/Narosa.

Assessment:	
InternalAssessment:	
Assessmentconsistsoftwoclasstestsof20markseach.Thefirst-classtestistobeconductedwhen approx.40%syllabusiscompletedandsecondclasstestwhenadditional40%syllabusiscompleted.Duratio nof each test shall be one hour.	
End SemesterTheory Examination:	
1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://onlinecourses.swayam2.ac.in/cec21_cs21/preview
2	https://nptel.ac.in/courses/106101061
3	http://www.nptelvideos.com/video.php?id=911&c=94

Course Code	Course Name	Credit
CSC604	MachineLearning	03

Pre-requisite: Data Structures, Basic Probability and Statistics,Algorithms	
Course Objectives: The course aims:	
1	TointroduceMachinelearningconcepts
2	TodevelopmathematicalconceptsrequiredforMachinelearningalgorithms
3	TounderstandvariousRegressiontechniques
4	TounderstandClusteringtechniques
5	TodevelopNeuralNetworkbasedlearningmodels
Course Outcomes: **Aftersuccessful completion of the course students will be able to:**	
1	Comprehend basics of Machine Learning
2	Build Mathematical foundation for machine learning
3	Understand various Machine learning models
4	Select suitable Machine learning models for a given problem
5	Build Neural Network based models
6	Apply Dimensionality Reduction techniques

Module		Detailed Content	Hours
1		**IntroductiontoMachineLearning**	6
	1.1	Introduction to Machine Learning, Issues in Machine Learning, ApplicationofMachineLearning,StepsofdevelopingaMachineLearningApplication.	
		SupervisedandUnsupervisedLearning:ConceptsofClassification,Clustering andprediction,Training,Testingandvalidationdataset,cross validation, overfitting and underfitting of model	
		PerformanceMeasures:MeasuringQualityofmodel-ConfusionMatrix, Accuracy,Recall,Precision,Specificity,F1Score,RMSE	
2		**Mathematical Foundation forML**	5
	2.1	SystemofLinearequations,Norms,Innerproducts,LengthofVector,Distancebetween vectors, Orthogonal vectors	
	2.2	SymmetricPositiveDefiniteMatrices,Determinant,Trace,Eigenvaluesandvectors, Orthogonal Projections, Diagonalization, SVD and its applications	
3		**LinearModels**	7
	3.1	Theleast-squaresmethod,MultivariateLinearRegression,RegularizedRegression, Using Least-Squares Regression for classification	
	3.2	SupportVectorMachines	
4		**Clustering**	4
	4.1	Hebbian Learning rule	

	4.2	Expectation -Maximization algorithm for clustering	
5		**Classification models**	10
	5.1	Introduction, Fundamental concept, Evolution of Neural Networks, BiologicalNeuron, Artificial Neural Networks, NN architecture, McCulloch-Pitts Model.Designing a simple network, Non-separable patterns, Perceptron model withBias. Activation functions, Binary, Bipolar, continuous, Ramp. Limitations ofPerceptron.	
	5.2	PerceptronLearningRule.DeltaLearningRule(LMS-WidrowHoff), Multi-layerperceptronnetwork.Adjustingweightsofhiddenlayers.Errorbackpropagation algorithm.	
	5.3	Logistic regression	
6		**Dimensionality Reduction**	07
	6.1	CurseofDimensionality.	
	6.2	Feature Selection and Feature Extraction	
	6.3	Dimensionality ReductionTechniques,Principal ComponentAnalysis.	

Textbooks:

1	Nathalie Japkowicz & Mohak Shah, "Evaluating Learning Algorithms:A Classification Perspective", Cambridge.
2	Marc Peter Deisenroth,Aldo Faisal, Cheng Soon Ong, "Mathematics for machine learning",
3	SamirRoyandChakraborty,"Introductiontosoftcomputing",PearsonEdition.
4	EthemAlpaydın, "Introduction to Machine Learning", MITPress McGraw-Hill Higher Education
5	Peter Flach, "Machine Learning", Cambridge University Press

References:

1	TomM.Mitchell,"MachineLearning",McGrawHill
2	KevinP. Murphy, "Machine Learning —AProbabilisticPerspective",MITPress
3	Stephen Marsland, "Machine Learning anAlgorithmicPerspective", CRC Press
4	Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning", Cambridge University Press
5	Peter Harrington, "Machine Learning inAction", DreamTech Press

Assessment:

InternalAssessment:

Assessmentconsistsoftwoclasstestsof20markseach.Thefirst-classtestistobeconducted whenapprox.40%syllabusiscompletedandsecondclasstestwhenadditional40%syllabusiscompleted.Duration of each test shall beone hour.

End SemesterTheory Examination:

1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful links:

1	NPTEL
2	AI and MLCertification - Enroll in PGPAI MLCourses with Purdue (simplilearn.com)
3	https://www.learndatasci.com/out/coursera-machine-learning/
4	https://www.learndatasci.com/out/google-machine-learning-crash-course/

CourseCode	Course Name	Credit
CSDLO6011	High PerformanceComputing	03

CourseObjectives: Studentswilltryto:

1. Learntheconceptsofhigh-performancecomputing.
2. Gainknowledgeofplatformsforhighperformancecomputing.
3. Designandimplementalgorithmsforparallelprogrammingapplications.
4. AnalyzetheperformancemetricsofHighPerformanceComputing.
5. Understandtheparallelprogrammingparadigm,algorithmsandapplications.
6. Demonstratetheunderstandingofdifferent HighPerformanceComputingtools.

CourseOutcomes: Studentswillbeableto:

1. UnderstandthefundamentalsofparallelComputing.
2. DescribedifferentparallelprocessingplatformsinvolvedinachievingHighPerformanceCom puting.
3. DemonstratetheprinciplesofParallelAlgorithmsandtheirexecution.
4. EvaluatetheperformanceofHPCsystems.
5. ApplyHPCprogrammingparadigmtoparallelapplications
6. DiscussdifferentcurrentHPCPlatforms.

Prerequisite: ComputerOrganization,CProgramming,DatastructuresandAlgorithmAnalysis.

DETAILEDSYLLABUS:

Sr. No.	Module	DetailedCo ntent	Hours
0	Prerequisite	ComputerOrganization,CProgramming,Datastructuresan dAlgorithmAnalysis.	**02**
I	Introduction	**Introduction to Parallel Computing:** Motivating Parallelism,Scope of Parallel Computing, Levels of parallelism (instruction,transaction,task,thread,memory,function),Mod els(SIMD, MIMD,SIMT,SPMD,DataflowModels,Demand-drivenComputation). **Self-learning Topics:** Parallel Architectures: Interconnectionnetwork,ProcessorArray,Multiprocessor.	**05**

II	ParallelProgrammingPlatforms	**ParallelProgrammingPlatforms:**ImplicitParallelism:Dichotomy of Parallel Computing Platforms, Physical OrganizationofParallelPlatforms,CommunicationCostsinParallel Machines. **Self-learning Topics:** Trends in Microprocessor & Architectures,Limitations of Memory System Performance.	**04**
III	Parallel Algorithm And Concurrency	**Principles of Parallel Algorithm Design:** Preliminaries,Decomposition Techniques, Characteristics of Tasks andInteractions,MappingTechniquesforLoadBalancing, Basic Communication operations: Broadcast and ReductionCommunication types. **Self-learningTopics: ParallelAlgorithmModels**	**09**
IV	Performance Measures forHPC	**PerformanceMeasures:**Speedup,executiontime,efficiency,cost, scalability, Effect of granularity on performance,Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law. **Self-learningTopics:**PerformanceBottlenecks.	**05**
V	ProgrammingParadigms forHPC	**Programming Using the Message-Passing Paradigm :**PrinciplesofMessagePassingProgramming,TheBuildingBlocks: Send and Receive Operations, MPI: the MessagePassingInterface,Topology andEmbedding. **ParallelAlgorithms andApplications :**	**09**
		One-DimensionalMatrix-VectorMultiplication,Graph Algorithms,SampleSort,Two-DimensionalMatrixVectorMultiplication. **Self-learningTopics:**IntroductiontoOpenMP.	
VI	GeneralPurposeGraphics Processing Unit(GPGPU) Architecturean dProgramming	OpenCLDeviceArchitectures,IntroductiontoOpenCLProgramming. **Self-learning Topics:** Introduction to CUDA architecture, andIntroduction to CUDAProgramming.	**05**

TextBooks:

1. AnanthGrama,AnshulGupta,GeorgeKarypis,VipinKumar,“IntroductiontoParallelComputing”, Pearson Education, Second Edition, 2007.
2. Kai Hwang, Naresh Jotwani, “Advanced Computer Architecture: Parallelism,Scalability,Programmability”,McGraw Hill,Second Edition, 2010.
3. EdwardKandrotandJasonSanders,“CUDAbyExample–AnIntroductiontoGeneralPurposeGPUProgramming”,Addison-WesleyProfessional ©,2010.
4. GeorgHager,GerhardWellein,“IntroductiontoHighPerformanceComputingforScientistsandEngineers",Chapman &Hall/ CRCComputationalScienceseries, 2011.
5. Benedict Gaster, Lee Howes, David Kaeli, Perhaad Mistry, Dana Schaa ,“HeterogeneousComputingwithOpenCL”,2ndEdition,Elsevier,2012.

Reference Books:

1. MichaelJ.Quinn,“ParallelProgramminginCwithMPIandOpenMP”,McGraw-HillInternational Editions, Computer Science Series, 2008.
2. KaiHwang,ZhiweiXu,“ScalableParallelComputing:Technology,Architecture,Programming”, McGraw Hill, 1998.
3. LaurenceT.Yang,MinyiGuo,“High-PerformanceComputing:ParadigmandInfrastructure”Wiley, 2006.
4. FayezGebali,“AlgorithmsandParallelComputing”,JohnWiley&Sons,Inc.,2011.

OnlineReferences:

Sr.No.	WebsiteName
1.	https://onlinecourses.nptel.ac.in/noc21_cs46/preview
2.	https://onlinecourses.nptel.ac.in/noc22_cs21/preview

Assessment:

InternalAssessment(IA)for20marks:

- IAwillconsistofTwoCompulsoryInternalAssessmentTests.Approximately40% to 50% of syllabus content must be covered in First IA Test andremaining 40% to 50% of syllabus content must be covered in Second IATest.

EndSemesterExamination: Someguidelinesforsettingthequestionpapersareas:

- Weightageofeachmoduleinendsemesterexaminationisexpectedtobe/willbeproportionaltonumberofrespectivelecturehoursmentionedinthesyllabus.
- **Questionpaperformat**
- QuestionPaperwillcompriseofatotalof**sixquestionseachcarrying20 marks. Q.1** will be **compulsory** and should **cover maximum contents ofthesyllabus**
- **Remainingquestions**willbe**mixedinnature**(part(a)andpart(b)ofeach question must be from different modules. For example, if Q.2 has part (a)from Module 3 then part (b) must be from any other Module randomlyselectedfromallthemodules)
- Atotalof**fourquestions**needtobeanswered.

- **Suggestion:Laboratoryworkbasedontheabovesyllabuscanbeincorporatedasa miniprojectinCSM601:Mini-Project.**

Course Code	Course Name	Credit
CSDLO6012	Distributed Computing	03

Pre-requisite:CProgramming	
Course Objectives: The course aims:	
1	Toprovidestudentswithcontemporaryknowledgeindistributedsystems
2	Toequipstudentswithskillstoanalyzeanddesigndistributedapplications.
3	Toprovidemasterskillstomeasuretheperformanceofdistributedsynchronization algorithms
4	Toequipstudentswithskillstoavailabilityofresources
5	Toprovidemasterskillstodistributedfilesystem
Course Outcomes:	
1	Demonstrate knowledge of the basic elements and concepts related to distributed system technologies.
2	Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3	Analyze the various techniques used for clock synchronization and mutual exclusion
4	Demonstrate the concepts of Resource and Process management and synchronization algorithms
5	Demonstrate the concepts of Consistency and Replication Management
6	Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFSandthe experiencein buildinglarge-scale distributedapplications

Module		DetailedContent	Hours
1		**IntroductiontoDistributedSystems**	
	1.1	CharacterizationofDistributedSystems:Issues,Goals,andTypesof distributed systems, Distributed System Models, Hardware concepts,Software Concept.	06
	1.2	Middleware:ModelsofMiddleware,Servicesofferedbymiddleware,ClientServer model.	
2		**Communication**	06
	2.1	LayeredProtocols,Interprocesscommunication(IPC):MPI,RemoteProcedureCall (RPC),RemoteObjectInvocation,RemoteMethodInvocation(RMI)	
	2.2	MessageOrientedCommunication,StreamOrientedCommunication,GroupCommunication	
3		**Synchronization**	09
	3.1	Clock Synchronization, Physical Clock, Logical Clocks, Election Algorithms,MutualExclusion,DistributedMutualExclusion-ClassificationofMutualExclusionAlgorithm,RequirementsofMutualExclusion Algorithms, Performance measure.	
	3.2	Non Token based Algorithms: Lamport Algorithm,Ricart–Agrawala's Algorithm,Maekawa'sAlgorithm	

	3.3	TokenBasedAlgorithms:Suzuki-Kasami'sBroadcastAlgorithms,Singhal'sHeuristic Algorithm, Raymond's Tree.based Algorithm, Comparative PerformanceAnalysis.	
4		**ResourceandProcessManagement**	06
	4.1	DesirableFeaturesofglobalSchedulingalgorithm,Taskassignmentapproach, Load balancing approach, load sharing approach	
	4.2	Introduction to process management, process migration, Threads,Virtualization,Clients, Servers, CodeMigration	
5		**Consistency,ReplicationandFaultTolerance**	06
	5.1	Introductiontoreplicationandconsistency,Data-CentricandClient-Centric ConsistencyModels,ReplicaManagement	
	5.2	FaultTolerance:Introduction,Processresilience,Reliableclient-serverandgroup communication,Recovery	
6		**DistributedFileSystemsandNameServices**	06
	6.1	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes,FileReplication,CaseStudy:DistributedFileSystems(DSF),NetworkFileSystem(NFS),AndrewFileSystem(AFS),HDFS	

Textbooks:	
1	AndrewS.TanenbaumandMaartenVanSteen,"DistributedSystems:PrinciplesandParadigms, 2nd edition, Pearson Education.
2	GeorgeCoulouris,JeanDollimore,TimKindberg,,"DistributedSystems:ConceptsandDesign", 4th Edition, Pearson Education, 2005.
References:	
1	A.S.TanenbaumandM.V.Steen,"DistributedSystems:PrinciplesandParadigms",Second Edition, Prentice Hall, 2006.
2	M. L. Liu,"Distributed Computing PrinciplesandApplications", PearsonAddisonWesley,2004.
3	Learn to Master Distributed Computing by ScriptDemics, StarEdu Solutions

Assessment:	
InternalAssessment:	
Assessment consists of two class tests of 20 marks each.The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional40% syllabus is completed.Durationof each test shall be one hour.	
End SemesterTheory Examination:	
1	Question paper will consist of 6 questions, each carrying 20 marks.
2	The students need to solve a total of 4 questions.
3	Question No.1 will be compulsory and based on the entire syllabus.
4	Remaining question (Q.2 to Q.6) will be selected from all the modules.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs87/
2	https://nptel.ac.in/courses/106106168

*** Suggestion:Laboratoryworkbasedontheabovesyllabuscanbeincorporatedasaminiprojectin CSM601 :Mini-Project.**

Course Code:	CourseTitle	Credit
CSDLO6013	ImageandVideoProcessing	3

Prerequisite: EngineeringMathematics,Algorithms	
Course Objectives:	
1	Tointroducestudentstothebasicconceptsofimageprocessing,fileformats.
2	Toacquireanin-depthunderstandingofimageenhancementtechnqiues.
3	Togainknowledgeofimagesegmentationandcompressiontechniques.
4	Toacquirefundamentalsofimagetransformtechniques.
Course Outcomes	
1	TogainfundamentalknowledgeofImageprocessing.
2	Toapplyimageenhancementtechniques.
3	Toapplyimagesegmentationandcompressiontechniques.
4	Togainanin-depthunderstandingofimagetransforms.
5	Togainfundamentalunderstandingofvideoprocessing.

Module		Content	Hrs
1		**DigitalImageFundamentals**	**04**
	1.1	IntroductiontoDigitalImage,DigitalImageProcessingSystem,Samplingand Quantization,	
	1.2	RepresentationofDigitalImage,Connectivity,ImageFileFormats:BMP,TIF F and JPEG.	
2		**ImageEnhancement inSpatial domain**	**08**
	2.1	IntroductiontoImageEnhancement:GrayLevelTransformations,ZeroMe moryPoint Operations,	
	2.2	HistogramProcessing,.	
	2.3	NeighbourhoodProcessing,SpatialFiltering,SmoothingandSharpeningFil ters	
3		**Image Segmentation**	**06**
	3.1	Segmentation based on Discontinuities (point, Line, Edge)	
	3.2	ImageEdgedetectionusingRobert,Sobel,Previttmasks,ImageEdgedetection using Laplacian Mask.	

	3.3	RegionOrientedSegmentation:RegiongrowingbypixelAggregation,Split and Merge	
4		**ImageTransforms**	**09**
	4.1	IntroductiontoUnitaryTransforms	
	4.2	DiscreteFourierTransform(DFT),InverseDFT,PropertiesofDFT,FastFourierTransform(FFT),	
	4.3	DiscreteHadamardTransform(DHT),InverseDHT,FastHadamardTransform(FHT),DiscreteCosineTransform(DCT),InverseDCT	
5		**ImageCompression**	**08**
	5.1	Introduction,Redundancy,FidelityCriteria	
	5.2	LosslessCompressionTechniques:RunlengthCoding,ArithmeticCoding, Huffman Coding	
	5.3	LossyCompressionTechniques:ImprovedGrayScaleQuantization,VectorQuantization	
6		**DigitalVideoProcessing**	**04**
	6.1	IntroductiontoDigitalVideoProcessing,SampledVideo	
	6.2	CompositeandComponentVideo,Digitalvideoformatsandapplications	
		Total	**39**

Textbooks:	
1	RafaelC.GonzalezandRichardE.Woods,'DigitalImageProcessing',PearsonEducationAsia, Third Edition, 2009
2	S.Jayaraman,E.EsakkirajanandT.Veerkumar,"DigitalImageProcessing"TataMcGrawHill Education Private Ltd, 2009
3	Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India PrivateLtd,Third Edition
4	S.Sridhar,"DigitalImageProcessing",OxfordUniversityPress,Second Edition,2012.
5.	Alan C. Bovik,"The Essential GuideToVideoProcessing"AcademicPress,
6	YaoWang,JornOstermann,Ya-QinZang,"VideoProcessingandCommunications",Prentice Hall, Signal Processing series.