MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous Programme
Bachelor of Engineering

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING

SYLLABUS

VII Semester & VIII Semester

(2021-22 Admitted Batch)

Academic Year 2024-2025

VISION

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns.

MISSION

1. Impart world class engineering education to produce technically competent engineers.
2. Provide facilities and expertise in advanced computer technology to promote research.
3. Enhance Industry readiness and entrepreneurial abilities through innovative skills
4. Nurture ethical values and social responsibilities

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1 : Graduates will be efficient software developers in diverse fields and will be successful professionals and/or pursue higher studies.

PEO 2 : Graduates will be capable to adapt to new computing technology for professional excellence and Research and will be lifelong learners.

PEO 3 : Graduates will work productively exhibiting ethical qualities for the betterment of society.

PEO 4 : Graduates will possess leadership qualities, work harmoniously in a team with effective communication skills

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, andengineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information toprovide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports anddesign documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering andmanagement principles and apply these to one's own work, as a member and leader in a team, to manageprojects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon graduation, students with a degree B.E. in Computer Science & Engineering will be able to:

PSO – 1: To make the students industry ready by facilitating them with software tools in recent technologies

PSO – 2: To develop IT based solutions for problems in diverse domains

Admitted Batch: 2021-22
Academic Year : 2024-25
Scheme & Syllabus for IV Year

SEVENTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P (hrs)**	**Credits**	**Contact Hours**
PCC	21CS701	System Software and Compiler Design	3-1-0	3	4
PCC	21CS702	Cloud Computing	3-0-0	3	3
PCC	21CS703	Network Security and Cyber Law	3-0-0	3	3
PI	21CS704	Main Project Phase - I	0-0-4	2	4
PEC	21CS77X	Elective - III	3-0-0	3	3
PEC	21CS78X	Elective - IV	3-0-0	3	3
OEC	21OECSXX	Open Elective -II	3-0-0	3	3
AEC	21RMIP	Research Methodology & Intellectual Property Rights (Mandate Non-Credit)	2-2-0	AUDIT	4
			Total	**20**	**27**

Sl. No.	**Elective - III**		**Sl. No.**	**Elective - IV**	
	Course Code	**Course Title**		**Course Code**	**Course Title**
1.	21CS771	Deep Learning	1.	21CS781	Digital Image Analysis
2.	21CS772	Data Science	2.	21CS782	Big Data Analytics
3.	21CS773	Mobile Communications	3.	21CS783	Storage Area Networks
4.	21CS774	Software Testing	4.	21CS784	Green Computing
5.	21CS775	Principles of User Interface Design	5.	21CS785	Advanced Web Technology
6.	21CS776	Project Management and Finance	6.	21CS786	Software Metrics

Sl. No.	**Open Electives**	
	Course Code	**Course Title**
1.	21OECS71	Introduction to Python Programming
2.	21OECS72	IOT and its Applications
3.	21OECS73	Big Data Analytics
4.	21OECS74	Web Technology

EIGHTH SEMESTER					
Course Category	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
PI	21CS801	Main Project Phase - II	0-0-8	4	8
PI	21INT3	Research / Industry Internship - III	0-0-24	12	24
			Total	**16**	**32**

Course Title	SYSTEM SOFTWARE AND COMPILER DESIGN		
Course Code	21CS701	L-T-P-C	(3-1-0) 3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40L+10T

Course Objective:	To get acquainted with the features of system software and the various phases of compiler design.
Course Outcomes (COs):	Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the concepts of system software and the features of various machine architectures.	1	-
2.	Demonstrate the functions and features of an assembler used to generate the object program.	2,3	-
3.	Apply the concepts of Loaders, Linkers and Macro Processors for a given problem	2,3	-
4.	Apply Lexical and Syntactic analysis for a given grammar.	3,4,5	-

Course Contents:

MODULE – 1	10 Hrs

Machine Architecture, Assembler 1: The Simplified Instructional Computer (SIC)
Assemblers: Basic assembler functions, Machine dependent assembler features.
Assembler 2: Machine Independent Assembler Features, Assembler Design Options.

MODULE – 2	10 Hrs

Loaders and Linkers: Basic Loader Functions, Machine-Dependent Loader Features, Machine-Independent Loader Features, Loader Design Options.
Macro Processor: Basic Macro Processor Functions, Machine-Independent Macro Processor Features.

MODULE – 3	10 Hrs

Introduction: Language Processors, The structure of a Compiler, Applications of Compiler Technology, Programming Language Basics.
Lexical Analysis: Role of Lexical Analyzer, Input buffering, Specifications of tokens, Recognition of Tokens.

MODULE – 4	10 Hrs

Syntax Analysis: Introduction, Context –free Grammar and Structure of Language, Parser and its Types, Top- Down parser-Recursive descent parsing and Non-Recursive descentparsing, Predicting parsing table, Error recovering strategies.

Tutorial

1. a)Write and execute a LEX program to count the number of characters, words, spaces & no. of lines in a given input file.
   b)Write a LEX program to count the number of comment lines in a given C program.
   Also eliminate them and copy that program into separate file.
2. Write a LEX program to recognize a valid arithmetic expression and to recognize the identifiers and operators present and to print them separately.
3. a) Write a LEX program to recognize and count the number of identifiers in a given input file.
   b) Write a LEX program to find & replace String.
4. a) Write a LEX program to check the validity of a Date.
   b) Write LEX program by reading input file and copy the content with line number to another file.
5. Write YACC program to recognize a valid arithmetic expression that uses operators +, -,* & /.

6. Write YACC program to evaluate an arithmetic expression involving operators +, -, * and /.
7. Write a YACC program to convert infix to postfix.
8. a) Write YACC program to recognize the grammar ($a^n b$, n >= 10).
   b) Write a YACC Program to recognize the grammar ($a^n b^m c^k$, m,n,k >=0 and m=n+k).

Text Books:

1. Leland Beck, D. Manjula - System Software – An Introduction to Systems Programming, Third Edition, Pearson Education 2013.
2. Alfred V Aho, Ravi Sethi, Jeffrey D Ullman, Compilers- Principles, Techniques and Tools, Addison-Wesley 2013.

Reference Books:

1. Alfred V Aho, Ravi Sethi, Jeffrey D Ullman, Compilers- Principles, Techniques and Tools, Addison-Wesley 2013.
2. D. M. Dhamdhere, Systems Programming and Operating Systems, Tata McGraw Hill Company, Second Edition, 2009.
3. John J. Donovan, Systems Programming, Tata McGraw Hill Company, Second Edition, 2000.
4. John. R. Levine, Tony Mason and Doug Brown: Lex and Yacc, O'Reilly, SPD, 2012.
5. S. V. Raghavan, Principles of Compiler Design, Tat McGraw Hill Education Publication, 2010.

MOOC:

https://in.udacity.com/course/compilers-theory-and-practice--ud168

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	2	2	-	-	-	-	-	-	-	-	-

Course Title	CLOUD COMPUTING		
Course Code	21CS702	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: To expose students to frontier areas of cloud computing service models and applications.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain concepts of cloud computing	1	-
2.	Recognize the different virtualization techniques, architecture andtypes of clouds	2	-
3.	Determine the cloud platforms and adopt Cloud Computing services and tools in real life scenarios.	2,7	-
4.	Integrate new standards for access management, security and privacyat different levels of cloud services	6,8	-
5.	Develop and deploy an application for cloud platform	5,9,10,12	1,2

Course Contents:

MODULE – 1	10 Hrs

Introduction: Cloud computing at a glance, historical developments, building cloud computing environments, computing platforms and technologies. **Principles of parallel and Distributed computing:** Eras of computing, parallel vs. Distributed computing, elements of parallel computing, elements of distributed computing, technologies for distributed computing.

MODULE – 2	10 Hrs

Virtualization: Introduction, characteristics of virtualized environments, Taxonomy of virtualization techniques, virtualization and cloud computing, pros and cons of virtualization technology.
Cloud Computing architecture: Introduction, Cloud reference model, types of clouds, economics of thecloud, open challenge**s.**

MODULE – 3	10 Hrs

Cloud platforms in industry: Amazon Web Services, Google AppEngine, Microsoft Azure.
Advanced topics in cloud computing: Energy efficiency in clouds, Market based management of clouds,Federated clouds/Inter clouds, Third party cloud services.

MODULE – 4	10 Hrs

Infrastructure security, IAM: Infrastructure security: network level, host level, application level**, Identity and Access management**: trust boundaries and IAM, why IAM? IAM challenges, IAM definitions, IAM architecture and practices, getting ready for cloud, IAM standards and protocols for cloudservices, IAM practices in the cloud, cloud authorization management;
Security management in the cloud: security management standards, security management in the cloud, availability management, Saas, Paas. Iaas availability management, access control, security vulnerability,patch and configuration management. **Privacy:** What is privacy?, what is data life cycle?, what are the keyprivacy concerns in cloud?, who is responsible for protecting privacy?

Text Books:

1. Mastering Cloud Computing, McGraw Hill publication, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi
2. Cloud security and privacy an enterprise perspective on risks and compliances,2013, Tin Mather,Subra Kumarswamy, Shahed Latif

Reference Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescue, first edition, MK publishers.
2. Cloud Computing- A practical approach, McGraw Hill publication, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter.

MOOCs:

1. https://www.youtube.com/watch?v=Eg4AAGCE7X4
2. https://www.coursera.org/learn/cloud-computing
3. https://www.edx.org/course/introduction-cloud-computing-microsoft-cloud200x

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-		2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	-	3	2	-	2	3	2

Course Title	NETWORK SECURITY AND CYBER LAW		
Course Code	21CS703	L-T-P-C	(3-0-0) 3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective:	Apply cryptography techniques on malicious networks andcyber law, IPR, IT Act.
Course Outcomes (COs):	Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the various types of Security attacks and Ciphers	1,12	-
2.	Encrypt/Decrypt the message by applying Traditional and Modern Block Ciphers.	3	-
3.	Apply Symmetric and Asymmetric key Cryptography Algorithms for a given problem.	3	-
4.	Describe the strategies and regulations of Cyber law and IT act	6,8	2

Course Contents:

MODULE – 1	10 Hrs

Introduction: Security goals, Cryptographic attacks, Services and Mechanisms, Techniques for security goals implementation, **Mathematics of cryptography**: Integer Arithmetic, The Extended Euclidean Algorithm; **Traditional Symmetric-Key Ciphers:** Symmetric-Key Ciphers**,** Categories of traditional ciphers.

Self-Study Component (Not included in SEE):: Modular Arithmetic, Matrices and Linear Congruence

MODULE – 2	10Hrs

Stream and Block ciphers**; Introduction to Modern Symmetric-Key Ciphers:** Modern block ciphers, Components of modern block ciphers, Two classes of Product Ciphers, Attacks designed for block ciphers.; **Data Encryption Standard**: History and Data Encryption Standard, DES Structure, DES Analysis, Security of DES, Multiple DES-Conventional Encryption Algorithm.

Self-Study Component (Not included in SEE): Mathematics of Symmetric-Key cryptography: Field and GF(2n) Fields.

MODULE – 3	10 Hrs

The CAST Block Cipher, Data Encryption Standard Blowfish, IDEA**; Advanced Encryption Algorithm:** History and Advanced Encryption Algorithm, Transformation used by AES; **Asymmetric Key cryptography:** Difference between symmetric cryptography and asymmetric Key cryptography Cryptosystem, RSA cryptosystem, Rabin Cryptosystem ;

Self-Study Component (Not included in SEE): Mathematics of Asymmetric-Key cryptography: Primes, Primality testing, Factorization, Chinese Remainder Theorem.

MODULE – 4	10 Hrs

Security and Cyber Law: INTRODUCTION: Cyberspace , Cyber security, Cyber security Policy , Cyber Crime, Nature of Threat , Enabling People, Mission and Vision of Cyber security Program , OBJECTIVES : Emerging Trends of Cyber Law , Create Awareness , Areas of Development , International Network on Cyber security; **Intellectual Property Rights**: Types of Intellectual Property Rights, Advantages of Intellectual Property Rights, Intellectual Property Rights in India, Intellectual Property in Cyber Space; **The information Technology Act -** IT act aim and objectives, Scope of the act, Major Concepts, Important provisions, Attribution, acknowledgement, and dispatch of electronic records, Secure electronic records and secure digital signatures, Regulation of certifying authorities: Digital Signature certificates, Duties of Subscribers, Penalties and adjudication.

Text Books:

1. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security" Third edition published by McGraw Hill Education-2017.
2. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition

Reference Books:

1. Hans Delfs, Helmut Knebl, "Introduction to Cryptography: Principles and Applications", Springer
2. Neal Koblitz, "Number theory and cryptography", Springer, 2007.
3. William Stallings: Cryptography and Network Security, Fifth Edition, Pearson Education-2013

MOOCs:

1. http://nptel.ac.in/courses/106105031/
2. https://www.edx.org/learn/cybersecurit
3. https://www.tutorialspoint.com/information_security_cyber_law/index.htm

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-		-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2		3	-	-	-	-	-	2

Course Title	MAIN PROJECT PHASE - I		
Course Code	21CS704	L-T-P-C	(0-0-4)2
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	-
Course Objective:	To be able to identify a relevant problem that requires technical solution and conduct survey for the same.		
Course Outcomes (COs):	Upon the completion of the course the students will be able to:		

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify a problem, through Extensive literature Survey leading to publication of a survey paper.	1,2	
2.	Plan & design the solution to the chosen problem	3	2
3.	Make oral presentation and documentation of the work carried out	9,10	

Course Contents:

During VII semester, candidates in consultation with the guides shall carry out literature survey to finalize the topic of the project. ***The same project will be continued in Eighth semester***. Students are expected to present the project synopsis, system analysis, requirements specification and **should publish a technical paper on Literature Survey. The evaluation will be carried out in three stages**

- Project Stage 1 – Team Formation , Topic Selection & Guide allotment (No marks)
- Project Stage 2 – Extensive Literature Survey , Problem Definition
- Project Stage 3 – Preliminary Design, Report Preparation and Publication

The evaluation of the project phases shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the project coordinator in consultation with the Head of the department. ***For Multidisciplinary projects guides will be allotted from each concerned branch***.

Performance Indicators	Low (40%)	Medium(70%)	High(100%)
Literature Survey and Problem Definition (20 Marks)	Literature Survey not pertaining to the title of the project (8)	Incomplete literature survey and improper problem definition (14)	Extensive literature survey with clear state of the art problem definition (20)
Preliminary Design (10 Marks)	Has no coherent strategies for problem Solving (4)	Has some strategies for problem – solving, but does not apply them consistently (7)	Formulates strategies for solving problems (10)
Presentation (10 marks)	Disorganized and ineffective presentation (4)	Organized, but ineffective presentation (7)	Effective organized presentation (10)
Report Preparation (30 Marks)	Disorganized and contents are not sufficient	Organized but not good content wise	Effectively organized and well framed contents
Paper Publication (20 Marks)	Paper submitted & awaiting results (8)	National conference International Conference (14)	Journal (20)
Punctuality (Project Dairy Maintenance) (10 marks)	Not meeting the guide regularly (4)	Meeting regularly but doesn't document details of every session (7)	Up to date dairy maintenance(10)

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-

Course Title	DEEP LEARNING		
Course Code	21CS771	L-T-P	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective:	Introduce major deep learning algorithms and their applications to solve real world problems.
Course Outcomes (COs):	At the end of the course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the fundamentals of deep learning algorithms	1	1
2.	Apply suitable deep learning algorithms for the given problem.	3	2
3.	Use tensor-flow and keras for training the models.	3, 5	2
4.	Solve problems using Deep Neural networks, CNN and RNN.	3, 4, 5. 9. 10	1, 2

Course Contents :

MODULE-1	10 Hrs

Introduction to Artificial Neural Networks with Keras- From Biological to Artificial Neurons, Biological Neurons, Logical Computations with Neurons, Architectures of Neural Network, Learning Process in ANN, The Perceptron, MultiLayer Perceptron (MLP) and Backpropagation, Types of Activation Functions, Regression MLps, Classification MLPs.

Implementing MLP's with Keras, : Installing TensorFlow 2, Building an Image Classifier Using the Sequential API, Building a Regression MLP Using the Sequential API, Building Complex Models Using the Functional API, Saving and Restoring a Model, Using Callbacks, Visualization Using TensorBoard, Fine-Tuning Neural Network Hyperparameters

MODULE-2	10 Hrs

Training Deep Neural Networks- Vanishing/Exploding Gradients, Glorot and He Initialization, Nonsaturating Activation Functions, Batch Normalization, Gradient Clipping, Reusing Pretrained Layers, Transfer Learning With Keras, Unsupervised Pretraining, Pretraining on an Auxiliary Task. Faster Optimizers, Momentum Optimization, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam and Nadam Optimization, Learning Rate Scheduling. Avoiding Overfitting Through Regularization, $\ell 1$ and $\ell 2$ Regularization, Dropout, Monte-Carlo (MC) Dropout, Max-Norm Regularization.

MODULE-3	10 Hrs

Loading and Preprocessing Data with TensorFlow – The Data API, Chaining Transformations, Shuffling the Data, Preprocessing the Data, Putting Everything Together, Prefetching, Using the Dataset With tf.keras. The TF Record Format , Compressed TFRecord Files, A Brief Introduction to Protocol Buffers, TensorFlow Protobufs, Loading and Parsing Examples, Handling Lists of Lists Using the Sequence Example Protobuf. The Features API, TF Transform, The TensorFlow Datasets (TFDS) Project.

Deep Computer Vision Using Convolutional Neural Networks - Architecture of Visual Cortex, Convolutional Layer, Filters, Stacking Multiple Feature Maps, TensorFlow Implementation, Memory Requirements, Pooling Layer, TensorFlow Implementation.

MODULE-4	10 Hrs

Deep Computer Vision Using Convolutional Neural Networks : CNN Architectures, LeNet-5, AlexNet, GoogLeNet, VGGNet, ResNet, Xception, SENet, Implementing a ResNet-34 CNN Using Keras, Using Pretrained Models From Keras, Pretrained Models for Transfer Learning, Classification and Localization, Object Detection: Fully Convolutional Networks (FCNs), You Only Look Once (YOLO), Semantic Segmentation

Processing Sequences Using RNNs and CNNs - Recurrent Neurons and Layers , Training RNNs, Forecasting a Time Series, Baseline Metrics , Implementing a Simple RNN.

Text Book:

"Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems – September 2019: Second Edition" by Aurelien Geron.

Reference Book:

"Python Machine Learning- Third Edition" by Sebastian Raschka and Vahid Mirjalili

e-Book:

https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/

MOOCs:

1. https://www.edx.org/course/deep-learning-with-tensorflow
2. https://www.deeplearning.ai/tensorflow- in-practice/

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	2	
CO2	-	2	-	-	3	-	-	-	3	-	-	-	-	3
CO3	-	3	-	-	3	-	-	-	3	3	-	-	-	3
CO4	-	-	2	2	3	-	-	-	2	2	-	-	2	3

Course Title	DATA SCIENCE		
Course Code	21CS772	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply the data science process to real-time data.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the basic concepts of data science	1	-
2.	Apply different techniques for EDA using the R tool	2	-
3.	Apply supervised and unsupervised algorithms for a given problem	3,4	-
4.	Use data visualization tools and plot graphs.	5,9	1,2

Course Contents:

MODULE – 1	10 Hrs

Introduction: What is Data Science? Big Data and Data Science hype - and getting past the hype,Why now? –Datafication, Current landscape of perspectives, Skill sets needed.
Statistical Inference - Populations and samples, Statistical modelling, probability distributions, fitting a model.

MODULE – 2	10 Hrs

Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summarystatistics) of EDA, Philosophy of EDA.
The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms - Linear Regression.

MODULE – 3	10 Hrs

k-Nearest, Neighbors (k-NN), k-means. One More Machine Learning Algorithm and Usage in Applications -Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam Data Wrangling: APIs and other tools for scrapping the Web.

MODULE – 4	10 Hrs

Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.
Data Visualization - Data Visualization History, What Is Data Science, Redux?, A Sample of Data Visualization Projects.

Text Book:

Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2014.

Reference Books:

1. Jure Leskovek, Anand Rajaraman and Jeffery Ullman. Mining of Massive Datasets. V2.1, Cambridge University Press. 2004.
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about DataMining andData-analytic Thinking. ISBN 1449361323. 2013.

MOOCs:

1. Introduction to data Analytics nptel.ac.in/courses/110106064/E-Books: a) An Introduction toData Science. By J. Stanton, 2013.
2. Data Sciencehttps://drive.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	2	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	2	-	-	-	-	-

Course Title	MOBILE COMMUNICATIONS		
Course Code	21CS773	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective:	To apply knowledge of Mobile Communications and Technologies in real time applications.
Course Outcomes (COs):	Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the applications, marketing and reference model of Mobile communication system.	1,2,3,12	-
2.	Classify the different types of transmissions, medium access control techniques and satellite Systems.	1, 2	-
3.	Develop the suitable wireless and/or mobile network for a given scenario.	3	-
4.	Study the performance of protocols involved in mobile network layer, mobile ad-hoc networks and transport layer.	2,4	-

Course Contents:

MODULE – 1	10 Hrs

Introduction to Mobile Communications: Applications, History of Wireless Communication, A Market for Mobile Communications, Some open research Topics, A simplified reference model.
Wireless Transmission: Frequencies for Radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Cellular Systems.

MODULE – 2	10 Hrs

Medium Access Control: Motivation for a specialized MAC, TDMA, CDMA, Comparison of S/T/F/CDMA. **Satellite Systems:** History, Applications, Basics, Routing, Localizations, Handover; **Broadcast Systems:** Overview, Cyclical Repetition of data, DAB, DVB, Convergence of Broadcasting and Mobile communications.

MODULE – 3	10 Hrs

Wireless LAN: Infrared versus radio transmission, Infrastructure and Adhoc Network, IEEE-802.11-System Architecture and Protocol Architecture.
Mobile Network Layer: Mobile IP: Goals, assumptions and requirements, Entities and terminology, IP packet delivery, Agent discovery, Registration, Tunnelling and encapsulation, Optimizations; Dynamic host configuration protocol

MODULE – 4	10 Hrs

Mobile ad-hoc networks: Routing, Destination sequence distance vector, Dynamic source routing, Alternative metrics , Overview ad-hoc routing protocols

Mobile Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, Performance enhancing proxies;

Text Book:

Jochen Schiller, Mobile communications, Pearson Education, 2nd edition

Reference Books:

1. Asoke K. Talkukder, Roopa R Yavagal: Mobile Computing – Technology, Applications and Service Creation, Tata McGraw Hill, 2012
2. Reza B'Far: Mobile Computing Principles – Designing and Developing Mobile Applications with UML and XML, 5th Edition, Cambridge University press, 2013

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	2	-	-	-	-	-	-	-	-	-	-

Course Title	SOFTWARE TESTING		
Course Code	21CS774	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50Marks	Total Hours	40

Course Objective: Apply effective testing techniques for developing quality software products.

Course Outcomes(COs): Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the concepts of software testing and its documentation.	1,2	-
2.	Analyze various software testing methods and strategies	2,3	2
3.	Apply suitable test case generation techniques	3,5,9	2
4.	Ensure criteria for final certification of the software product	1,8	2

Course Contents:

MODULE–1	10Hrs

Basics of Software Testing: Human Errors and Testing; Software Quality; Requirements, Behavior and Correctness; Correctness versus Reliability; Testing and Debugging; Test Metrics.
Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test-generation Strategies, Static Testing. Model-Based Testing and Model Checking; Control-Flow Graph; Types of Testing; The Saturation Effect.

MODULE–2	10Hrs

Test Generation from Requirements: Introduction; The Test-Selection Problem; Equivalence Partitioning; Boundary Value Analysis; Category-Partition Method.
Test Generation from Requirements: Cause-Effect Graphing, Test Generation from Predicates.

MODULE–3	10Hrs

Structural Testing: Overview; Statement testing; Branch testing; Condition testing, Path testing; Procedure call testing; Comparing structural testing criteria; The infeasibility problem.
Dependence, Data Flow Models, and Data Flow Testing: Definition-Use pairs; Data flow analysis; Classic analyses; From execution to conservative flow analysis; Data flow analysis with arrays and pointers; Inter-procedural analysis; Overview of data flow testing; Definition-Use associations; Data flow testing criteria; Data flow coverage with complex structures; The infeasibility problem.

MODULE–4	10Hrs

Test Case Selection and Adequacy, Test Execution: Overview; Test specification and cases; Adequacy criteria; Comparing criteria; Overview of test execution; From test case specification to test cases; Scaffolding; Generic versus specific scaffolding; Test oracles; Self-checks as oracles; Capture and replay. Process: Test and analysis activities within a software process: The quality process; Planning and monitoring; Quality goals; Dependability properties; Analysis; Testing; Improving the process; Organizational factors. Integration and component-based software testing: Overview; Integration testing strategies; Testing components and assemblies. System, Acceptance and Regression Testing:
Overview; System testing; Acceptance testing; Usability; Regression testing; Regression test selection techniques; Test case prioritization and selective execution.

Text books :

1. Aditya P Mathur: Foundations of Software Testing, 2nd Edition, Pearson Education, 2014 (Chapters 1 excluding 1.15, 1.16, 1.17, 2, 6).
2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, John Wiley & Sons, 2008 (Chapters 4, 6, 9, 12, 13, 17, 21, 22).

Reference Books:

1. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, 2nd Edition, Pearson, 2007.
2. Ron Patton: Software Testing, 2nd edition, Pearson, 2004.

MOOC:
http://nptel.ac.in/courses/106105150

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	3	-	3	-	-	-	2	-	-	-	-	3
CO4	2	-	-	-	-	-	-	2	-	-	-	-	-	1

Course Title	PRINCIPLES OF USER INTERFACE DESIGN		
Course Code	21CS775	(L-T-P)C	(3-0-0)3
Exam	3Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply the concepts and principles of User Interface Design and evaluate User Interfaces.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Demonstrate the theories and design processes of interactive systems	1	-
2.	Apply the principles of user interface design to improve visualization.	3	-
3.	Analyze different types of user interfaces, devices and quality of service issues	2	2
4.	Design appropriate user interface for the given application	3,5	2

MODULE – 1 **10Hrs.**

The User Interface-Introduction, Overview, the importance of user interface – Defining the user interface, The importance of Good design, Characteristics of graphical and web user interfaces, Principles of user interface design

The User Interface Design process- Obstacles, Usability, Human characteristics in Design.

MODULE – 2 **10Hrs.**

Human Interaction speeds, Business Functions-Business definition and requirement analysis, Basic business functions, Design standards. System menus and navigation schemes- Structures of menus, Functions of menus, Contents of menus.

MODULE -3 **10Hrs.**

Formatting of menus, Phrasing the menu**,** selecting menu choices, Navigating menus, Kinds of graphical menus.

Windows - Characteristics, Components of window, Window presentation styles, Types of window, Window management.

MODULE -4 **10Hrs.**

Organizing window functions, Window operations, Web systems, Characteristics of device-based controls.

Screen based controls- Operable control, Text control, Selection control, Custom control, Presentation control, Windows Tests-prototypes, kinds of tests.

Text Books:

Wilbert O. Galitz, "The Essential Guide to User Interface Design", John Wiley & Sons, Second Edition 2002.

Reference Books:

1. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.
2. Alan Cooper, "The Essential of User Interface Design", Wiley- Dream Tech Ltd.,2002

MOOC Course:

User Interface Design https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-		-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3		-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	2		3	-	-	-	-	-	-	-	-	2

Course Title	PROJECT MANAGEMENT AND FINANCE		
Course Code	21CS776	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective:	Understand the techniques of Project Management.
Course Outcomes (COs)	At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe the role, importance and Concepts of Project Management.	1	-
2.	Explore project organization structures.	1	-
3.	Elucidate management functions to handle the team.	1	-
4.	Estimate the project cost.	3	2

Course Contents:

MODULE – 1	10 Hrs.

Introduction: Understanding Project Management, The Project Manager–Line Manager Interface, Defining the Project Manager's Role, Defining the Functional Manager's Role, Defining the Functional Employee's Role, Defining the Executive's Role, Working with Executives, The Project Manager as the Planning Agent, Project-Driven versus Non–Project-Driven Organizations, Marketing in the Project-Driven Organization; **PROJECT MANAGEMENT GROWTH: CONCEPTS AND DEFINITIONS:** General Systems Management, Resistance to Change, Systems, Programs, and Projects: A Definition, Product versus Project Management: A Definition, Maturity and Excellence: A Definition, Informal Project Management: A Definition, The Many Faces of Success, The Many Faces of Failure, The Stage-Gate Process, Project Life Cycles, Project Management Methodologies: A Definition, Organizational Change Management and Corporate Cultures, Project Management Intellectual Property, Systems Thinking;

MODULE – 2	10 Hrs.

ORGANIZATIONAL STRUCTURES: Introduction, Organizational Work Flow, Traditional (Classical) Organization, Developing Work Integration Positions, Line–Staff Organization (Project Coordinator), Pure Product (Projectized) Organization, Matrix Organizational Form, Modification of Matrix Structures, Selecting the Organizational Form, Structuring the Small Company; **ORGANIZING AND STAFFING THE PROJECT OFFICE AND TEAM**: Introduction, The Staffing Environment, Selecting the Project Manager: An Executive Decision, Skill Requirements for Project and Program Managers, Special Cases in Project Manager Selection, Selecting the Wrong Project Manager, Duties and Job Descriptions, The Organizational Staffing Process, The Project Office;

MODULE -3	10 Hrs.

MANAGEMENT FUNCTIONS: Introduction, Controlling, Directing, Project Authority, Interpersonal Influences, Barriers to Project Team Development, Suggestions for Handling the Newly Formed Team, Team Building as an Ongoing Process, Dysfunctions of a Team, Leadership in a Project Environment, Life-Cycle Leadership, Organizational Impact, Employee–Manager Problems, Management Pitfalls, **MANAGEMENT OF YOUR TIME AND STRESS**: Introduction, Understanding Time Management, Time Robbers, Time Management Forms, Effective Time Management, Stress and Burnout.

MODULE -4	10 Hrs.

PRICING AND ESTIMATING: Introduction, Global Pricing Strategies, Types of Estimates, Pricing Process, Organizational Input Requirements, Labor Distributions, Overhead Rates, Materials/Support Costs, Pricing Out the Work, Smoothing Out Department Man-Hours, The Pricing Review Procedure, Systems Pricing, Developing the Supporting/Backup Costs, The Low-Bidder Dilemma, Estimating High-Risk Projects, Project Risks, The Disaster of Applying the 10 Percent Solution to Project Estimates; **COST CONTROL**: Introduction, Understanding Control, The Operating Cycle, Cost Account Codes, Budgets, The Earned Value Measurement System (EVMS), The Cost Baseline, Justifying the Costs, The Cost Overrun Dilemma;

Text Book:

Project Management: A System approach to planning Scheduling & Controlling, Harold Kerzner, 10th edition 2009, John Wiley &sons

Reference Books:

1. A management guide to PERT and CPM Wesit & Levy Eastern economy edition of PHL,2011
2. Project planning, scheduling & control James P lewis Meo publishing company,2010.

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	2

Course Title	DIGITAL IMAGE ANALYSIS		
Course Code	**21CS781**	**L-T-P-C**	**(3-0-0)3**
Exam Hrs.	**3**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**

Course Objective: To study the mathematical transforms necessary for image processing along with data handling techniques.

Course Outcomes(COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Explain the mathematical methods used for Image Analysis	1, 2	-
2	Apply the concepts of shape theory in a Digital Image Processing	1, 2	-
3	Analyze various data handling techniques used in Image Analysis.	2, 3	-
4	Represent image in the form of a graph.	3	-

Course Contents:

MODULE–1	10 Hrs

Numerical Harmonic Analysis and Image Processing: Gabor Analysis and Digital Signal Processing - From Fourier to Gabor Expansions, Local Time-Frequency Analysis and STFT, Fundamental Properties of Gabor Frames, Commutation Relations of the Gabor Frame Operator, Critical Sampling, Oversampling, and the Balian-Low Theorem, Wexler-Raz Duality Condition, Gabor Analysis on LCA Groups, Numerical Gabor Analysis, Image Representation and Gabor Analysis, Signal and Image Reconstruction – Notation, Signal Reconstruction and Frames, Numerical Methods for Signal Reconstruction, Examples and Applications - Object Boundary Recovery in Echocardiography, Image Reconstruction in Exploration Geophysics, Reconstruction of Missing Pixels in Images

MODULE–2	10 Hrs

Stochastic Shape Theory: Shape Analysis, Contour Line Parameterization, Deformable Templates - Stochastic Planar Deformation Processes, Gaussian Isotropic Random Planar Deformations, The Deformable Templates Model, Maximum Likelihood Classification, The Wavelet Transform - Atomic Decompositions and Group Theory, Discrete Wavelets and Multiscale Analysis, Wavelet Packets, Wavelet Packet Descriptors, Global Nonlinear Optimization - Multilevel Single-Linkage Global Optimization, Implementation

MODULE–3	10 Hrs

Data Handling: Parallel and Distributed Processing - Dealing with Large Remote Sensing Image Data Sets - , Parallel Radar Signal Processing, Parallel Radar Image Processing, Distributed Processing

MODULE–4	10 Hrs

Robust and Adaptive Image Understanding: Graphs in Image Analysis - From Pixels to Graphs, Graphs in the Square Grid, Run Graphs, Area Voronoi Diagram, Graph Transformations in Image Analysis - Arrangements of Image Elements, Dual Graph Contraction, **Hierarchies:** Regular Image Pyramids, Structure, Contents, Processing, Fuzzy Curve Pyramid, Irregular Graph Pyramids - Computational Complexity, Irregular Pyramids by Hopfield Networks, Equivalent Contraction Kernels, Extensions to 3D

Text Book:

Digital Image Analysis Selected Techniques and Applications, Walter G. Kropatsch, Horst Bischof.

Reference Books:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, 4th Edition, Pearson publications, 2018
2. A.K. Jain, “Fundamentals of Digital Image Processing”, Pearson 2nd Edition, 2018.
3. Scott E Umbaugh “DIGITAL IMAGE PROCESSING AND ANALYSIS - Human and Computer Vision Applications with CVIPtools” CRC Press 2nd Edition 2011

MOOCs:

https://www.edx.org/learn/image-analysis/ecole-polytechnique-federale-de-lausanne-image-processing-and-analysis-for-life

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-

Course Title	BIG DATA ANALYTICS		
Course Code	21CS782	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Acquire the knowledge to handle Big Data.

Course Outcomes(COs): Upon completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe basic concepts of Big data analytics	1	-
2.	Apply Big data framework for data analysis	2,3	-
3.	Use Big data tools and techniques in processing of data	3,5,9,10	1,2

Course Contents:

MODULE – 1	10Hrs

Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization.

Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.

MODULE – 2	10Hrs

Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines.

Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.

MODULE – 3	10Hrs

Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels.

Map-Reduce and the New Software Stack 1: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.

MODULE – 4	10Hrs

Map-Reduce and the New Software Stack 2: Algorithms Using Map-Reduce for Matrix multiplication, Relational Algebra operations, Workflow Systems. Recursive Extensions to Map-Reduce.

Communication Cost Models: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate.

Mining Data Streams: Stream Data Model and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, A press, e-book of 2012.
2. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC:

https://nptel.ac.in/courses/106/104/106104189

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	2	-	-	-	2	2	-	-	2	1

Course Title	STORAGE AREA NETWORKS		
Course Code	21CS783	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective:	Analyze various Storage Area Networks.
Course Outcomes(COs):	Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate different RAID levels.	1	-
2.	Explain the components of Storage Area Network (SAN).	1	2
3.	Explore Storage Area Network.	1	2
4.	Explain the concepts of Network Attached Storage(NAS).	1	2

Course Contents:

MODULE – 1	10 Hrs

Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages, Case study: Replacing a server with Storage Networks, Architecture of Intelligent Disk Subsystems, Hard disks and Internal I/O Channels.

Intelligent Disk Subsystem: JBOD, Storage virtualization using RAID, different RAID levels; Caching: Acceleration of Hard Disk Access; Instant copies, Remote mirroring, LUN masking, Availability of disk subsystems.

MODULE – 2	10 Hrs

I/O Technique: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel **Protocol** Stack-links, ports, topologies, FC-0,FC-1,FC-2,FC-3, link services, FC-4.

Fiber channel SAN, Network Attached Storage: Fiber Channel SAN-point-to-point topology, fabric **topology**, arbitrated loop topology, hardware components, IP Storage-IP storage standards: iscsi, iFCP, Mfcp, FCIP. The NAS hardware Architecture, The NAS Software Architecture, Network connectivity.

MODULE – 3	10 Hrs

File System: Local File Systems; Network file Systems and file servers: basic principle, NAS, **performance** bottle necks, acceleration of network file systems, case study-DAFS; Shared Disk file systems; Comparison: NAS, fiber Channel SAN and iSCSI SAN.

Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.

MODULE – 4	10 Hrs

SAN Architecture and Hardware devices: Creating a Network for storage-The network part, The software `-fabric OS services, The connectivity part- connecting server, connecting the storage, SAN Hardware devices- The fiber channel switch, Host Bus adaptors. **Software Components of SAN:** The switch's operating system, Device Drivers, The Supporting components.

Text Books :

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Second Edition Wiley India, 2009
2. Robert Spalding: Storage Networks, The Complete Reference, Tata McGraw Hill, 2003. (Ch. 9, 13, 14, 15)

Reference Book:

Richard Barker and Paul Massiglia: Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs, John Wiley India, 2002

MOOC:

https://onlinecourses.nptel.ac.in/noc18_cs50/preview

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	2

Course Title	GREEN COMPUTING		
Course Code	21CS784	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: To enable students to design, manufacture, and dispose computing devices in a way that reduces their environmental impact.

Course Outcomes(COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore fundamentals of Green Computing	1,7	-
2.	Analyze various sustainability challenges and strategies that can reduce the environmental impact of usage of computers	2,7	-
3.	Relate the green computing practices to make business more energy efficient and Green compliant.	6,11	-
4.	Document and present the technical paper with proposed sustainable solution for Green Computing.	3,4,7,8,9,10	-

Course Contents:

MODULE – 1 **10 Hrs**

Green IT: An Overview, Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green IT, Holistic Approach to Greening IT, Greening IT, Applying IT for enhancing Environmental sustainability, Green IT Standards and Eco-Labelling of IT, Enterprise Green IT strategy, Green IT: Burden or Opportunity, Green Devices and Hardware: Introduction, Life Cycle of a device or hardware, Reuse, Recycle and Dispose.

Green Software: Introduction, Energy-saving software techniques, Evaluating and Measuring software Impact to platform power. Sustainable Software Development: Introduction, Current Practices, Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics

MODULE – 2 **10 Hrs**

Green Data Centres: Data Centres and associated energy challenges, Data centre IT infrastructure, Data Centre facility infrastructure: Implications for energy efficiency, IT infrastructure management.

Green Networks and Communications: Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards. Enterprise Green IT Strategy: Introduction, Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Organizational Considerations in a Green IT Strategy, Steps in Developing a Green IT Strategy. Green Enterprises and Role of IT: Introduction, Organization and Enterprise Greening, Information systems in Greening Enterprises, Greening Enterprise: IT Usage and Hardware, Inter-Organizational Enterprise activities and Green Issues.

MODULE – 3 **10 Hrs**

Managing Green IT: Introduction, Strategizing Green Initiatives, Implementation of Green IT, Information Assurance. Regulating Green IT: Laws, Standards and Protocols: Introduction, The regulatory environment and IT manufacturers, Non regulatory government initiatives, Industry associations and standards bodies, Green building standards, Green data centres, Social movements and Greenpeace

Green Cloud Computing and Environmental Sustainability: Introduction, what is Cloud Computing? Cloud Computing and Energy Usage Model: A Typical Example, Features of Clouds Enabling Green Computing, Towards Energy Efficiency of Cloud Computing, Green Cloud Architecture

MODULE – 4	10 Hrs
Harnessing Semantic Web Technologies for the Environmental: Introduction, Information Management for Environmental Sustainability, Ecosystem of Software Tools, Examples of Managing Data. **Green IT-An Outlook**: Introduction, Awareness to implementations, Greening by IT, Green IT: A megatrend, A seven-step approach to creating green IT strategy, Research and Development directions.	
Text Book: Harnessing Green IT: Principles and Practices , San Murugesan, G. R. Gangadharan. ,1 st Edition ,Wiley& IEEE 2017.	
Reference Books: 1. Green IT Strategies and Applications-Using Environmental Intelligence, BhuvanUnhelkar ,1 st Edition, CRC Press 2011 2. Green Communications: Principles, Concepts and Practice Konstantinos Samdanis, Peter Rost, Andreas Maeder, Michela Meo, Christos Verikoukis ,1 st Edition, Wiley 2015.	

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	-	-	-	-	2	-	-	-
CO4	-	-	2	2	-	-	2	3	3	3	-	-	-	-

Course Title	ADVANCED WEB TECHNOLOGY		
Course Code	21CS785	(L-T-P) C	(3-0-0)3
Exam. Hrs	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: To apply the concepts of Full stack web development with Django framework for real world applications.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping To PO's	Mapping to PSO's
1.	Explore the working of MVT based full stack web development with Django.	1	-
2.	Design Models and Forms for rapid development of web pages.	3	2
3.	Demonstrate the role of Template Inheritance and Generic views	1	-
4.	Apply the Django framework to create web applications	3,5,9,12	1,2

Course Contents

MODULE– 1	10Hrs.

MVC based Web Designing: Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.

MODULE– 2	10Hrs.

Django Templates and Models: emplate System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern. Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution

MODULE-3	10Hrs.

F**Django Admin Interfaces and Model Forms:** Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.
Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs.

MODULE-4	10Hrs.

Generic Views and Django State Persistence: Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.
MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.

Text Book:

Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009

ReferenceBooks:

1. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
2. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
3. Antonio Mele, Django3 by Example, 3rd Edition, Pack Publishers, 2020
4. Arun Ravindran, Django Design Patterns and Best Practices, 2nd Edition, Pack Publishers, 2020.
5. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1st Edition, Oreily Publications,

2014 .

Weblinks and Video Lectures (e-Resources):

1. MVT architecture with Django: https://freevideolectures.com/course/3700/django-tutorials
2. Using Python in Django: https://www.youtube.com/watch?v=2BqoLiMT3Ao
3. Model Forms with Django: https://www.youtube.com/watch?v=gMM1rtTwKxE
4. Real time Interactions in Django: https://www.youtube.com/watch?v=3gHmfoeZ45k
5. AJAX with Django for beginners: https://www.youtube.com/watch?v=3VaKNyjlxAU

Course Articulation matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-		-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	2	-	-	-	2	-	-	2	2	2

Course Title	SOFTWARE METRICS		
Course Code	21CS786	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Acquire the knowledge to measure the quality and health of software development process

Course Outcomes (COs) : Upon Completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain fundamentals of measurement and software metrics	1	-
2.	Apply frame work and analysis techniques for software measurement.	2	-
3.	Estimate efforts involved in software product development using internal attributes	2	2

Course Contents:

MODULE – 1	10 Hrs

Fundamentals of Measurement: Measurement: what is it and why do it?: Measurement in Software Engineering, Scope of Software Metrics,

The Basics of measurement: The representational theory of measurement, Measurement and models, Measurement scales and scale types,meaningfulness in measurement.

MODULE – 2	10 Hrs

A Goal-Based Framework For Software Measurement: Classifying software measures, Determining what to Measure, Applying the framework, Software measurement validation, Performing Software Measurementvalidation

Empirical investigation: Principles of Empirical Studies, Planning Experiments, Planning case studies as quasi-experiments ,Relevant and Meaningful Studies

MODULE – 3	10 Hrs

Software Metrics Data Collection: Defining good data ,Data collection for incident reports, How to collect data, Reliability of data collection Procedures

Analyzing software measurement data: Statistical distributions and hypothesis testing, Classical data analysis techniques, Examples of simple analysis techniques

MODULE – 4	10 Hrs

Measuring internal product attributes: Size Properties of Software Size, Code size, Design size, Requirements analysis and Specification size, Functional size measures and estimators, Applications of size measures **Measuring internal product attributes: Structure:** Aspects of Structural Measures, Control flow structure of program units, Design-level Attributes, Object-oriented Structural attributes and measures

Text Book:

Software Metrics A Rigorous and Practical Approach, Norman Fenton, James Bieman , Third Edition, 2014.

Reference Books:

1. Software metrics, Norman E, Fenton and Shari Lawrence Pfleeger, International Thomson Computer Press, 1997
2. Metric and models in software quality engineering, Stephen H.Kan, Second edition, 2002, Addison-

Wesley Professional.

3. Measuring the Software Process, William A. Florac and Areitor D. Carletow, 1995, Addison – Wesley.
4. Practical Software Metrics for Project Management and Process Improvement, Robert B.Grady, 1992, Prentice Hall.

MOOCs:

1. https://nptel.ac.in/courses/106106212
2. https://nptel.ac.in/courses/106106145

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	3

Course Title	INTRODUCTION TO PYTHON PROGRAMMING		
Course Code	**21OECS71**	**L-T-P-C**	**(3-0-0)3**
SEE duration	**3 hours**	**Hours / Week**	**3**
SEE marks	**50**	**Total hours**	**40**

Course Objective: Student's will be able to write a python program to solve the given problem

Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe and apply python language construct for writing a program	1,3,5	-
2.	Analyze the codes snippet for its correctness	2,5	-
3.	Design a GUI/python program for the given problem	3,5	1,2

Course Contents:

MODULE 1	10 Hours

Python Basics: The way of Programming. Variables, Expression and Entering Expressions into the Interactive Shell. The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program,
Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(). Loops for iteration.

MODULE 2	10 Hours

Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Argument sandprint(). Local and Global Scope, The global Statement. Exception Handling, A Short Program: Guess the Number.
Manipulating Strings: Working with Strings, Useful String Methods.

MODULE 3	10 Hours

Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List. List-like Types: Strings and Tuples.
Dictionaries: The Dictionary Data Type, Pretty Printing.

MODULE 4	10 Hours

GUI Programming: Tkinter Introduction, Tkinter and Python programming, Widgets Label, Button, Entry, Scaling, Menu, Check Box, Radio button. Tkinter examples

Text Books :

1. Al Sweigart,"Automate the Boring Stuff with Python",1st Edition. No Starch Press, 2015.
2. Wesley J Chun, "Core Python Application Programming", 3rd Edition, Pearson Publication, 2016.

Reference Book:

R. Nageswara Rao, "Core Python Programming", 3rd Edition, Dream tech Press

MOOC:

https://onlinecourses.nptel.ac.in/noc21_cs32/

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	3	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	3	-	-	-	-	-	-	-	2	2

Course Title	IOT AND ITS APPLICATIONS		
Course Code	21OECS72	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Explore the interconnection and integration of the physical world and design IOT applications.

Course Outcomes (COs) : Upon the completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the impact and challenges posed by IoT networks, compare IoT architectures	1	-
2.	Illustrate smart objects and IoT Access Technologies to leverage connectivity.	1	-
3.	Design IoT interface module using RaspberryPi for a given problem.	2,3	2

Course Contents:

MODULE – 1	10 Hrs

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack.

MODULE – 2	10 Hrs

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, **Connecting Smart Objects:** Communications Criteria, **IoT Access Technologies:** IEEE 802.15.4, IEEE 802.15.4g and IEEE 802.15.4e.

MODULE – 3	10 Hrs

IP as the IoT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances. **Application Protocols for IoT:** The Transport Layer, IoT Application Transport Methods.

MODULE – 4	10 Hrs

IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, Exploring the RaspberryPi Board; Operating System setup on RaspberryPi, RaspberryPi commands, Programming RaspberryPi with Python. **Securing IoT:** A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743).
2. Srinivasa K G, Siddesh G M Hanumantha Raju R "Internet of Things",CENGAGE Leaning India, 2017.

Reference Books:

1. Internet of Things - A Hands on Approach, Arshdeep Bahga and Vijay Madisetti Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	2

Course Title	BIG DATA ANALYTICS		
Course Code	21OECS73	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Acquire the knowledge to handle Big Data.

Course Outcomes(COs): Upon completion of the course the students will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe basic Concepts of Big data Analytics	1	-
2.	Apply Big data framework for data analysis	2,3	-
3.	Use Big Data tools and techniques in processing of data	3,5,9,10	1,2

Course Contents:

MODULE–1	10Hrs

Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization.

Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.

MODULE–2	10Hrs

Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines.

Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.

MODULE–3	10Hrs

Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels.

Map-Reduce and the New Software Stack: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.

MODULE–4	10Hrs

Communication Cost Models: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate.

Mining Data Streams, Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, A press, e-book of 2012.
2. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC:

https://nptel.ac.in/courses/106/104/106104189

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	3	-	-	-	2	2	-	-	2	1

Course Title	WEB TECHNOLOGY		
Course Code	21OECS74	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective:	Create web pages with client side and server-side scripting.
Course Outcomes (COs):	Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the concepts of HTML and scripting languages	1	-
2.	Develop dynamic web pages using JavaScript	3	-
3.	Develop client-side script to design webpage	3	-
4.	Design server-side script using PHP and MySQL	3,5	-

Course Contents:

MODULE – 1	10 Hrs

Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

MODULE – 2	10 Hrs

HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

MODULE – 3	10 Hrs

JavaScript and HTML Documents: The JavaScript execution environment; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The navigator object.

Dynamic Documents with JavaScript: Introduction to dynamic documents; Element positioning; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor.

MODULE – 4	10 Hrs

XML: Introduction; Syntax; Document structure; Namespaces, XML schemas, Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets.

PHP: Origins and uses of PHP; Overview of PHP; General syntactic characteristics; Primitives, operations and expressions; Output; Control statements; Arrays; Functions; Pattern matching; Form handling; Files; Cookies; Session tracking; Database Access using PHP and MySQL.

Text Book:

Robert W. Sebesta: Programming the World Wide Web, 8th Edition, Pearson Education, 2014.

Reference Books:

1. Deitel H.M. and Deitel P.J., "Internet and World Wide Web How to program", Pearson International, 2012, 4th Edition.
2. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson, 2015.
3. ISRD Group: Internet Technology and Web Design, Tata McGraw Hill Publishing Ltd, 2011

MOOCs:

1. https://www.mooc-list.com/course/programming-and-web-beginners-coursera
2. http://nptel.ac.in/courses/117105080/3
3. https://www.coursera.org/specializations/web-design
4. http://www.w3c.org

Course Articulation matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	-	-	-	-	-	-	-	-	-

Course Title	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS		
Course Code	**21RMIP**	**LTPC**	**(2-2-0)Audit**
CIE	**100 marks**	**Hours / Week**	**4**
SEE	**--**	**Total hours**	**28**

Course objective: Understand research methodology, design, data collection, and analysis techniques and gain knowledge of Intellectual Property Rights (IPR) with a focus on patents, designs, trademarks, and copyrights, including their registration and protection procedures.

Course Outcomes (COs) Upon completion of the course, students shall be able to:

#	Statement	Mapping to POs	Mapping to PSOs
1.	Acquire research skills and conduct comprehensive literature reviews	8,10, 12	-
2.	Apply research design knowledge to create prototype	3,4, 8, 10, 12	-
3.	Evaluate methods for data collection, analysis, and sampling design	4, 8, 10, 12	-
4.	Understand global and Indian patent scenarios, as well as registration requirements, infringements and protections related to trademarks, copyrights, and designs	6,8, 10, 12	-

Course Contents:

MODULE - I	7 Hrs.

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct. Literature Review and Technical Reading. **Citations:** Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge flow through Citations, Acknowledgments.

MODULE - II	7 Hrs.

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis. **Experimental Designs:** Introduction to Randomized Block Design, Complete Randomized Design, Latin Square Design, and Factorial Design.

MODULE - III	7 Hrs.

Method of Data Collection: Primary and Secondary Data Collection. **Sampling Design:** Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design. **Data Analysis:** Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors. Procedure for Hypothesis Testing: Mean, Variance, and Chi-square Test.

MODULE - IV	7 Hrs.

Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. **Patents:** Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for Obtaining a Patent. **Design:** What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design. **Trademarks:** Essentials of a Trademark, Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements. **Copyrights:** Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights.

Activity Components

- Students select a research topic and perform a literature review, identifying existing knowledge, synthesizing prior art, and compiling relevant citations leading to publishing a survey paper.
- Students develop research proposals, including the formulation of research hypotheses.
- Students collect primary or secondary data, design a sampling procedure, and perform data analysis using statistical techniques.
- Students analyze real-world case study/studies for legal issues and propose solution/s to infringement cases.

e rubrics for evaluation will be set suitably as decided by the BOS and will be announced to the students at the beginning of the semester.

Text Book

1. Kothari C R. Research methodology: Methods and techniques. New Age International; 2004.
2. Pandey N, Dharni K. Intellectual property rights. PHI Learning Pvt. Ltd.; 2014 Jul 30.
3. Deb D, Dey R, Balas V E. Engineering research methodology. A Practical Insight for Researchers. 2019;153.

Reference Book:

Thiel D V. Research methods for engineers. Cambridge University Press; 2014 Sep 11.

MAIN PROJECT PHASE - II			
Course Code	**21CS801**	**L-T-P-C**	**(0-0-8) 4**
Exam Hrs.	**3**	**Hours / Week**	**8**
SEE	**50 Marks**	**Total Hours**	**-**

Course Objective: Design and implement solution for the identified real world problem in Phase I**.**
Course Outcomes (COs): Upon completion of course the students will be able to

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Implement the design with appropriate techniques, resources and contemporary tools	3,5	1,2
2.	Communicate effectively with team members and mentors, make presentations and prepare technical document	9,10,11,12	2
3.	Use ethical practices in all endeavors	8	-
4.	Share the responsibilities for carrying out the project & playing individual roles appropriately	9	-
5.	Implement the design with appropriate techniques, resources and contemporary tools	3,5	1,2

The project teams will implement the project started in their seventh semester

The project work is to be evaluated in three stages:

Stage I (30M) - First internal evaluation shall be taken up during this phase. This includes presentation on fine tuning of SRS & Design carried out in seventh semester.

Stage II (20 M) – Mid phase evaluation shall be taken up during this phase. This includes presentation, intermediate project demonstration, draft copy of the paper

Stage III (50 M) – Final project Demo, report submission and details of technical paper publication.

The evaluation of the project stages shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the project coordinator in consultation with the Head of the department. ***For Multidisciplinary projects guides will be allotted from each concerned branch***.

Rubrics for Evaluation of project

Stage I (Project Progress):

Evaluation of project phase II is carried out by evaluation committee.

Sl. No.	Performance Indicators	Needs Improvement (0-2 marks)	Average (4-6 marks)	Good (7-10 marks)	Max marks
1.	System design and development	System specification is not identified.	System specification is identified but not satisfactory.	System specification is identified correctly.	10

2.	Identification of appropriate tool for application	Application tools are not identified.	Application tools identified but notused.	Application tools identified and used.	10
3.	Oral presentation	Entire contents not delivered.	Contents not delivered clearly.	Contents delivered clearly with confidence.	10
				Total	**30**

Stage II (Mid Phase Project Demonstration with Draft paper):

Evaluation of this phase is done by evaluation committee.

Sl. No.	Performance Indicator	Needs Improvement (0-1 marks)	Average (2-3 marks)	Good (4-5 marks)	Total marks allocated
1.	Design and Implementation	Design not complete	Design partially completed	Design completed	5
2.	Demonstration	Incomplete.	Complete but not satisfactory.	Complete and satisfactory	5
3.	Technical paper Draft	Organization and technical content not relevant	Organization and technical content of paper complete but needs improvement	Organization and technical content of report are complete and satisfactory	5
4.	Oral presentation	Presentation slides are not clear.	Presentation slides are clear, but not satisfactory.	Presentation slides are clear and satisfactory.	5
				Total	**20**

Stage III (Final Project Demonstration):

Evaluation of this phase is done by evaluation committee.

Sl. No.	Performance Indicator	Needs Improvement	Average	Good	Total marks allocated
1.	Final project demonstration	Project incomplete (4)	Project complete but needs improvement in interface design/ functionality, etc. (7)	Project completed (10)	10
2.	Oral Presentation	Disorganized and ineffective presentation (4)	Organized, but ineffective presentation (7)	Effective organized presentation (10)	10

3.	Report submission	Disorganized and contents are not sufficient (10)	Organized but not good content wise (16)	Effectively organized and well framed contents (20)	20
4.	Technical paper publication	Paper submitted for National Conference (8)	Paper submitted / published in an International Conference (9)	Paper submitted / published in a Journal (10)	10
				Total	**50**

Course Articulation matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	-	-	-	2	2	-	-	-	-	-	-	-
CO2	3	-	3	3	-	-	-	-	-	3	-	-	3	3
CO3	-	-	3	-	3	-	-	2	3	-	2	-	3	3
CO4	3	-	-	-	3	-	-	-	3	3	-	-	3	3
CO5	3	-	-	-	-	-	-	2	-	3	-	3	-	-

Course Title	RESEARCH / INDUSTRY INTERNSHIP - III		
Course Code	21INT3	L-T-P-C	(0-0-24)12
Exam Hrs.	3	Hours / Week	-
CIE	100 Marks	Total Hours	-

Course Objective: To gain the perspective of work environment in Research organization/Industry.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the domain knowledge in solving the real world problems.	1,2	1,2
2.	Work as a team member towards the chosen problem	9	1,2
3.	Work with industry professionals and practice ethics in work environment.	8, 10,12	1,2
4.	Document, publish and present the work carried out.	9,10,11,12	1,2

Guideline: Students shall undergo In-house/ Research organization/Industry internship for a duration of ***one*** semester. At the end of the semester internal evaluation will be conducted for 100 marks according to the following rubrics.

Rubrics:

Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (20M)	Apply domain knowledge for design and development of allissues (20M)	Apply domain knowledge for design and development of most issues (15M)	Apply domain knowledge for design and development of specific issues (10M)	Unable to apply complete domain knowledge for design and development issues (5M)
Ability to develop / implement the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/implement all the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/ implement most of the solutions with appropriate techniques, resources and contemporary tools (15M)	Able to develop/implement specific solutions with appropriate techniques, resources and contemporary tools (10M)	Not confident to develop/implement solutions with appropriate techniques, resources and contemporary tools (5M)
Ability to work independently and in collaboration / multidisciplinary environment.	Able to work independently and in collaboration/ multidisciplinary environment. (20M)	Able to work independently with minimal guidance and in collaboration/ multidisciplinary environment. (15 M)	Able to work independently with more guidance and in collaboration/ multidisciplinary environment. (10M)	Unable to work independently without guide support and in collaboration/ multidisciplinary environment. (5M)

(20M)				
Ability to allocate time effectively and manage to complete the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete all the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete most of the work allotted within appropriate time. (10M)	Able to allocate time effectively and manage to complete the work allotted (5M)	Unable to use time effectively and complete the work allotted.(3M)
Ability to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (15M)	Able to effectively exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report.(15M)	Able to moderately exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (10M)	Able to partially exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (6M)	Unable to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (3M)
Ability to demonstrate effective oral and written communicatio n skills (10M)	Able to demonstrate effective oral and written communication skills (10M)	Able to demonstrate oral and written communication skills moderately. (7M)	Able to demonstrate oral and written communication skills minimally. (5M)	Unable to demonstrate effective verbal and written communication skills (2M)

Course Articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	-	-	-	-	-	-	-	-	3	-	-	-	3	2
CO3	-	-	-	-	-	-	-	3	-	3	-	3	3	2
CO4	-	-	-	-	-	-	-	-	3	3	3	3	3	2