SYLLABUS

(With effect from 2024-25)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ2024-25)

Bachelor Degree

In

Computer Science &Engineering

VII & VIII Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Ph : 08232- 220043, Fax: 08232 – 222075, Web: www.pescemandya.org

VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Computer Science and Engineering

The Vision of the department is:

"The Department of Computer Science and Engineering shall create professionally competent and socially responsible engineers capable of working in global environment.*"*

The mission of the department is:

DM1: Enforce best practices in teaching-learning, with dedicated faculty and supportive infrastructure to impart the knowledge in emerging technologies.

DM2: Improve Industry-Institute relationship for mutual benefit.

DM3: Inculcate ethical values, communication and entrepreneurial skills.

DM4: Sensitize social, legal, environmental and cultural diversity issues through professional training and balanced curriculum.

Program Educational Objectives (PEO's)

Graduates of the program shall

- Have Successful computer professional career in IT industry and related areas
- Pursue higher education in engineering or management with the focus on intensive research and developmental activities.
- Develop their career as entrepreneurs in a Responsible, Professional and ethical manner to serve the society

The National Board of Accreditation (NBA) has defined twelve Program Outcomes for Under Graduate (UG) engineering programs as listed below.

Program Outcomes (PO's)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problem.
2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering 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 public health and safety, and 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 to provide 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 the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects 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.

The Under Graduate (UG) of B.E Computer Science & Engineering Program has defined **Program Specific Outcomes (PSO**) which are listed below.

PSO-1: Ability to apply problem solving skills in developing solutions through fundamentals of Computer Science and Engineering.

PSO-2: Ability to apply Analytical Skills in the field of Data Processing Systems.

PSO-3: Ability to design and develop applications through Software Engineering methodologies and Networking Principles.

Bachelor of Engineering (VII–Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs/Week**			**Credits**	**Examination Marks**		
				L	**T**	**P**		**CIE**	**SEE**	**Total**
1	P21CS701	Cryptography & Network Security	CS	3	-	-	3	50	50	100
2	P21CS702X	Professional Core Course (Elective-IV)	CS	3	-	-	3	50	50	100
3	P21CS703X	Professional Core Course (Elective-V)	CS	3	-	-	3	50	50	100
4	P21CS704	Machine Learning (Integrated)	CS	3	-	2	4	50	50	100
5	P21RMI705	Research Methodology and IPR	CS	3	-	-	3	50	50	100
6.	P21CS706	Project Work Phase–I	CS	-	-	-	4	100	-	100
Total							**20**			

Professional Elective Course–IV (P21XX702X)	
Course Code	**Course Title**
P21CS7021	Introduction to Generative AI
P21CS7022	Augmented And Virtual Reality
P21CS7023	Managing Big Data
P21CS7024	Natural Language Processing

Professional Elective Course–V (P21XX703X)	
Course Code	**Course Title**
P21CS7031	Distributed Databases principles and systems
P21CS7032	Software Architecture & Design Patterns
P21CS7033	Cyber Security
P21CS7034	Robotic Process Automation

Bachelor of Engineering (VIII–Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs/Week**			**Credits**	**Examination Marks**		
				L	**T**	**P**		**CIE**	**SEE**	**Total**
1	P21CS801	Self-Study Course	CS	-	-	-	2	100	-	100
2	P21INT802	Research/Industry Internship– III	CS	-	-	-	6	-	100	100
3	P21CS803	Project Work Phase–II	CS	-	-	-	8	100	100	200
Total							**16**			

Cryptography & Network Security [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Subject Code:	**P21CS701**	**Credits**	**3**
Number of Contact Hours/Week	**3:0:0**	**CIE Marks**	**50**
Total Number of Contact Hours	**40**	**SEE Marks**	**50**

Course Learning Objectives: This course will enable students to:

CLO1: Summarize basic security concepts and apply various symmetric encryption techniques.
CLO2: Compare and contrast various asymmetric encryption techniques and Explain key exchange algorithms.
CLO3: Describe key distribution concepts and User authentication protocols.
CLO4: Describe cloud, E-mail security concepts and analyzes IPSec.

Unit–1	**8 Hours**

Computer & Network security Concepts: Computer Security concepts, security attacks, security services, Security Mechanisms.
Classical Encryption Techniques: Symmetric Cipher Model, substitution Techniques, Transposition Techniques, Steganography.
Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, The data encryption standard, A DES example, The strength of DES.

Self-Study Content:	Rotor Machine, A model for Network security.

Unit-2	**8 Hours**

Public-Key Cryptography and RSA: Principles of public-key cryptosystems. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA.
Other Public-Key Cryptosystems: Diffie-Hellman key exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic.

Self-Study Content:	Elliptic curve Cryptography

Unit-3	**8 Hours**

Key Management and Distribution: Symmetric key distribution using Symmetric encryption, Symmetric key distribution using Asymmetric encryption, Distribution of Public Keys, X-509 certificates, Public Key Infrastructure.
User Authentication: Remote user Authentication principles, Remote user Authentication Using Symmetric Encryption, Kerberos.

Self-Study Content:	Remote user Authentication using Asymmetric encryption

Unit-4	**8 Hours**

Network Access Control & Cloud Security: Network Access Control, Extensible Authentication Protocol, Cloud Security Risk and Countermeasures.
Transport Level Security: Web Security Consideration, Transport Layer security, HTTPS, Secure shell (SSH). **Wireless network security:** Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview.

Self-Study Content:	Cloud Security as a Service

Unit-5			8 Hours
Electronic Mail Security: Internet Mail Architecture, Email Formats, Email threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy, DNSSEC. **IP Security:** IP Security overview, IP Security Policy, Encapsulating Security payload, Combining Security Associations, Internet Key Exchange.			
Self-Study Content:.	Cartographic Suits		
Course Outcomes: On completion of this course, students are able to:			
CO's		**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the concept of network security and encryption techniques.	L2	Understand
CO2	Apply Public-key cryptography, RSA and other public-key cryptosystems.	L3	Apply
CO3	Understand key management and distribution schemes, Authentication applications and cloud security.	L2	Understand
CO4	Understand the issues and structure of Electronic Mail Security and IPSec.	L2	Understand

Textbooks:

1. Cryptography and Network Security, William Stallings, 7th edition, 2014, Pearson.

Reference Books:

1. Cryptography and Information Security, V K Pachghare, 2nd Edition. PHI, 2015.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs16/preview
2. https://www.cs.vsb.cz/ochodkova/courses/kpb/cryptography-and-network-security_-principles-and-practice-7th-global-edition.pdf

Introduction to Generative AI

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VII

Course Code:	**P21CS7021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to

CLO1: Understand the core principles and functionalities of Generative AI compared to traditional AI approaches.

CLO2: Explore the various techniques used in GAI, including Generative Adversarial Networks (GANs), Variational Auto encoders (VAEs), Large Language Models (LLMs), and Prompt Engineering.

CLO3: Grasp the data requirements and evaluation metrics used in generative models.

CLO4: Identify real-world applications of Generative AI across different industries, including the potential of multimodal
models combining text, image, audio, and video data.

CLO5: Gain practical experience by implementing a simple Generative AI application using Python libraries like TensorFlow or PyTorch.

UNIT – I	**8 Hours**

Introduction to Generative AI: What and why is Generative AI? , Definition and core principles of GAI, Traditional AI/ML vs. Generative AI, Differences between traditional AI (discriminative) and GAI (generative) approaches, How Generative AI Works, Content creation by models, integration into machine learning and development processes, Generative AI Workflows, Data requirements and evaluation metrics for generative models, Applications of GAI, Real-world applications across various industries.

Self-study component:	Applications on traditional AI and Generative AI.

UNIT – II	**8 Hours**

Large Language Models: Transformer Architecture, Foundational aspects of transformer models in LLMs, Training Techniques for LLMs ,Pre-training and fine-tuning methods, Case Studies of LLMs, Prominent LLMs like GPT-3, BERT, and their applications, Introduction to Multimodal Generative Models, Definition and processing of multimodal GAI models, Challenges and advantages of multimodal versus unimodal models, Applications like generating video descriptions, creating music from images, and interactive storytelling.

Self-study component:	Open sources on LLMs, Commercial LLMs.

UNIT – III	**8 Hours**

Generative Models: Generative Adversarial Networks (GANs): Fundamental concepts including generators, discriminators, and training processes, Types of GANs, Various GAN architectures like DCGAN, WGAN, and their functionalities, Variational Auto encoders (VAEs)**,** Role in probabilistic generative modelling and differences from GANs.

Self-study component:	Case studies on DCGAN,WGAN

UNIT – IV	8 Hours
Prompt Engineering and Retrieval-Augmented Generation: Prompt Engineering, Effective prompts for achieving desired outputs from GAI models, Embedding Techniques, Types of embeddings (word, sentence) and their use in vector databases, Vector Databases, Importance in efficient retrieval and search operations for GAI applications, Retrieval-Augmented Generation (RAG) , Concept of RAG and enhancement of GAI model performance through vector databases	
Self-study component:	Prompt Engineering Challenges, Challenges in RAG implementation and potential solutions.
UNIT – V	**8 Hours**
Hands-on Python Implementation of GenAI Application, Essential Python Libraries for GAI: Libraries like TensorFlow, PyTorch, and other GAI frame works **Building a Simple Chatbot:** Development of a practical chatbot application using GAI techniques learned throughout the course, **Project Presentations:** Showcase of chatbot projects, fostering learning exchange and creative exploration	
Self-study component:	Case studies on Real time examples

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Summarize** the basics of Generative AI.	Understand	L2
CO2	**Analyze** Large Language Models and Generative Models.	Analyze	L4
CO3	**Apply** Prompt Engineering and Retrieval-Augmented Generation.	Apply	L3
CO4	Gain practical experience by developing GenAI Applications.	Apply	L3

Text Book(s):

1. Engler, Numa Dhamani, Introduction to Generative AI, Released November 2023, Manning Publication
2. *Amit Bahree*, Generative AI in Action, Released November 2023, Manning Publication
3. Jakub Langr and Vladimir Bok, GANs in Action, September 9, 2019 SBN13: 9781638354239, Manning Publication.
4. Joseph Babcock, Raghav Bali, Generative AI with Python and TensorFlow 2, April 2021,Packt Publishing

Reference Book(s):

1. Hughes, O, Generative AI Defined: How it Works, Benefits and Dangers, August 7, 2023, TechRepublic.
2. Kyle Stratis, What Is Generative AI?, Released December 2023, O'Reilly Media inc.,
3. Ben Auffarth, Generative AI with LangChainm, Released December 2023,Packt Publishing.

Web and Video link(s):

1. Introduction to Generative AI https://youtu.be/cZaNf2rA30k
2. Introduction to large language models https://youtu.be/G2fqAlgmoPo
3. What is Retrieval-Augmented Generation (RAG)? https://youtu.be/T-D1OfcDW1M
4. Lawton, G. (2023, September) What is Generative AI? Everything you need to know, Enterprise AI

Augmented and Virtual Reality [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS7022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the importance of Augmented reality and Virtual reality
CLO2: Describe the history and recent developments of AR
CLO3: Provide the need on emerging technologies AR and VR
CLO4: Discuss the revolution and impact of AR
CLO5: Understand the applications of AR and VR

UNIT – I	**8 Hours**

Introduction: Definition of VR, modern experiences, historical perspective. Virtual Reality Applications.

Birds-eye view: Hardware, Software, Human physiology and Perception

Self-study component:	Aural: world-fixed vs. user-fixed, Developer choices for VWGs

UNIT – II	**8 Hours**

Geometry of Virtual Worlds: Geometric models, Changing Position and orientation, Axis-Angle representation of rotation, Chaining the transformation.

Tracking: Tracking 2D orientation, Tracking 3D orientation, Tracking Position and orientation.

Self-study component:	Viewing Transformation, The Physiology of Human Vision, Tracking Attached Bodies, 3D Scanning of Environments.

UNIT – III	**8 Hours**

Getting started with Blender: An introduction to Blender. Features of Blender Layout workspace, Sculpt Workspace, Modelling Workspace, Animation Workspace.

Introduction to Unity, working with objects, Working with Scripts First Person Controller, Third Person Controller.

Self-study component:	Advanced concepts in Blender and Unity tools.

UNIT – IV	**8 Hours**

Introduction to Augmented Reality: Definition and scope, A brief history of augmented reality, Examples, Related fields.
Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display model, Visual Displays.

Self-study component:	Ubiquitous computing, Ergonomics, Social Acceptance

UNIT – V			8 Hours
Evaluating VR Systems and Experiences: Perceptual Training, Recommendations for developers, Comfort and VR sickness, Experiments on Human subjects. **Software Architectures:** AR Application Requirements, Software Engineering Requirements.			
Self-study component:	Peripheral problems, Sickness reduction strategies		
Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain the fundamental concepts of Virtual Reality and Augmented Reality and it's Applications.	Understand	L1
CO2	Analyze the hardware and software requirements of Augmented Reality and Virtual reality.	Analyze	L4
CO3	Apply Geometric Modeling Techniques for 2D and 3D model creation in AR/VR.	Apply	L3
CO4	Design a Virtual Environment to captivate its experiences using Blender and Unity tools.	Design	L4

Text Book(s):

1. Steven M. LaValle: Virtual Reality, 2019. Cambridge university press.
2. Dieter Schmalstieg and Tobias Höllerer: Augmented Reality Principles and Practice,Addison-Wesley, 2016, Pearson Education

Reference Book(s):

1. Kaliraj P, Devi T, (2021). Innovating with Augmented Reality: Applications in Education and Industry (P. Kaliraj, Ed.) (1st ed.). Auerbach Publications. https://doi.org/10.1201/9781003175896
2. Virtual Reality & Augmented Reality in Industry by DengzheMa,JürgenGausemeier, Xiumin Fan, Michael Grafe By : Springer publications.
3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufman n, 2013.

Web and Video link(s):

1. https://docs.google.com/presentation/d/1ghccIoncBT34OargDKABa_he2Yjy1S-P/edit?usp=sharing&ouid=105825739444009503878&rtpof=true&sd=true
2. https://drive.google.com/file/d/1Qbt7bwPmPXkQq52wOacCZ5BcBMqLUksY/view?usp=sharing
3. https://drive.google.com/file/d/1p-0Oje6zXoefCwbkxUOk49MxyVbLhYd3/view?usp=sharing
4. https://drive.google.com/file/d/1H0MSJdPfOGxDaDX6mzw8WxvM6C5GZ5Wj/view?usp=drive_link
5. https://drive.google.com/file/d/1eG3Yv-XEwEGH7-G8HTE9DOIg_hKuOSbb/view?usp=sharing

Managing Big Data [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS7023**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Explore and apply the Big Data analytic techniques for business applications.
CLO2: Discuss the overview of Apache Hadoop.
CLO3: Able to implement basic technologies that forms the foundations of Big Data.

UNIT – I	8 Hours

Introduction to Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing,Volunteer Computing, In memory Data Base.

Hadoop Distributed File system: The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, Basic File system Operation, Reading Data from a Hadoop URL.

Data Flow: Anatomy of a File Read, Anatomy of a File Write.

Self-study component:	Reading and Writing Data using File system.

UNIT – II	8 Hours

YARN: Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness.

Hadoop I/O: Data Integrity, Data Integrity in HDFS, Local File System, Checksum File System, Compression, Codecs, Compression and Input Splits, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks.

Self-study component:	File-Based Data Structures: Sequence File, Map File, Other File formats and Column – Oriented Formats.

UNIT – III	8 Hours

Developing a MapReduce Application: The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, JobControl, Apache Oozie.

How MapReduce Works: Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, Task Execution.

Self-study component:	Running on a Cluster, Hadoop Logs.

UNIT – IV	**8 Hours**

MapReduce Types and Formats: MapReduce Types, Input Formats: Input Splits and Records Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output.

Flume: Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Sink Groups, Integrating Flume with Applications, Component.

Self-study component:	Installing Flume, An Example, Distribution: Agent Tiers, Delivery Guarantees.

UNIT – V	**8 Hours**

Pig: Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, And An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data.

Spark : Installing Spark, An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution.

Self-study component:	Spark Executors and Cluster Managers: Spark on YARN.

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understanding big data concepts and Hadoop Distributed File System	L1	Understand
CO2	Design big data applications using the comprehensive concepts of YARN and Hadoop I/O operations.	L4	Design
CO3	Develop, debug, and optimize MapReduce applications to understand the mechanisms of MapReduce job execution.	L3	Apply
CO4	A comprehensive understanding of Apache Flume, Apache Pig, and Apache Spark to process and analyze large datasets effectively.	L4	Analyze

Text Book(s):

1. Hadoop: The Definitive Guide, Tom White, O'Reilley, Third Edition, 2012.

Reference Book(s):

1. SPARK: The Definitive Guide, MateiZaharia and Bill Chambers, Oreilly, 2018
2. Apache Flume: Distributed Log Collection for Hadoop, D'Souza and Steve Hoffman Oreilly, 2014

Web and Video link(s):

1. https:// www.tutorialspoint.com/big_data_tutorials.html
2. https:// www.digimat.in/nptel/courses/video/106104189/L01.html

Natural Language Processing

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VII

Course Code:	**P21CS7024**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: Understand the basic concepts and basic algorithms of Natural language processing.
CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using Computers.
CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.
CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.

UNIT – I	**8 Hours**

Overview and Language Modelling: Origins and Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications, Information Retrieval, Language Modelling, Various Grammar- based Language Models.

Self-study component:	Statistical Language Model.

UNIT – II	**8 Hours**

Word Level Analysis: Regular Expressions, Finite State-Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word Classes, Part of Speech Tagging.

Syntactic Analysis: Context Free Grammar, Constituency, Parsing.

Self-study component:	Probabilistic Parsing.

UNIT – III	**8 Hours**

Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.

Discourage Processing: Cohesion, Reference Resolution

Self-study component:	Demonstrate semantic parsing using Stanford parser

UNIT – IV	**8 Hours**

Natural Language Generation: Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG.
Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, LLM model and ChatGPT

Self-study component:	Translation Involving Indian Languages

UNIT – V	8 Hours

Information Retrieval: Design features of Information Retrieval Systems, Information Retrieval Models, Classical Information Retrieval Models, Non-Classical Models of IR, Alternative Models of IR, Evaluation of the IR System.

Lexical Resources: Word Net, Frame Net, Stemmers

Self-study component:	Part-of-Speech Tagger, Research Corpora

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the concepts of Natural Language Processing	L2	Understand
CO2	Apply various Natural language processing techniques.	L3	Apply
CO3	Analyse the different Natural language processing techniques.	L4	Analyze
CO4	Design and develop an application using Natural Language Processing tools.	L4	Design

Text Book(s):

1. Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U S Tiwary, 1st Edition, 2008, Oxford University Press

Reference Book(s):

1. Practical Natural Language Processing, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, June 2020, O'Reilly Media, Inc. ISBN: 9781492054054
2. Natural Language Processing Recipes, Akshay Kulkarni, Adarsha Shivananda, 1st Edition, JAN 2019.

Web and Video link(s):

1. Natural Language processing with python – Analyze text with the natural language toolkit
   URL: www.nltk.org/book_1e d/

Distributed Databases principles and systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS7031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40hrs**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students:

CLO1: To enrich the previous knowledge of database systems and exposing the need for distributed database technology to confront with the deficiencies of the centralized database systems

CLO2: To introduce basic principles and techniques of distributed database including architecture and design.

CLO3: To familiarize with fragmentation techniques for query processing and query optimization.

CLO4: To understand the management of distributed transactions and concurrency control.

CLO5: To understand the technique of Reliability.

UNIT – I	**8 Hours**

Distributed Databases: An Overview, Features of Distributed versus Centralized Databases, Why Distributed Databases, Distributed Data Base Management Systems (DDBMS).

Levels of Distribution Transparency: Reference Architecture for Distributed Databases, Types of Data Fragmentation, Distribution Transparency for Read Only Applications, Integrity Constraints in Distributed Databases.

Self-study component:	Distribution Transparency for Update Applications, Distributed Databases Access Primitives

UNIT – II	**8 Hours**

Distributed Database Design: A Framework for Distributed database Design, The Design of Database Fragmentation, The Allocation of Fragments.

Translation of Global Queries to Fragment Queries: Equivalence Transformations for Queries, Transforming Global Queries into Fragment Queries.

Self-study component:	Simplification of vertically fragmented relations, Semi join programs.

UNIT – III	**8 Hours**

Translation of Global Queries to Fragment Queries Contd.: Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.

Optimization of Access Strategies: A Framework for Query Optimization, Join Queries, General Queries**.**

Self-study component:	Methods for the optimization of general queries.

UNIT – IV	**8 Hours**

The Management of Distributed Transactions: A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency control for Distributed Transactions, Architectural Aspects of Distributed Transactions.

Concurrency Control: Foundations of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control Based on Timestamps, Optimistic Methods for Distributed Concurrency Control.			
Self-study component:	Validation using only transaction timestamps		
UNIT – V			**8 Hours**
Reliability: Basic Concepts, Non-blocking Commitment Protocols, Reliability and Concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart. **Distributed database Administration:** Catalog management in distributed databases			
Self-study component:	Authorization and protection		
Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain basic principles and techniques of distributed database architecture and design.	L2	Understand
CO2	Identify different types of data fragmentation techniques for query processing.	L3	Analyze
CO3	Optimize queries for optimal performance across a distributed database.	L4	Evaluate
CO4	Analyze distributed transaction management control, concurrency control and the techniques of Reliability	L4	Analyze

Text Book(s):

1. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti (TMH), seventh reprint 2010, Tata McGraw-Hill Edition.

Reference Book(s):

1. Principles of Distributed Database Systems, Tamer ¨Ozsu and Patrick Valduriez, Fourth Edition 2020, Springer

Web and Video link(s):

1. https:// www.youtube.com/playlist?list=PLduM7bkxBdOdjbMXkTRdsSlWQKR43nSmd
2. https://www.youtube.com/watch?v=HbKu1ymrv9U&list=PLLANTs44t4TVzVOXdEWCDXQLp90tFsG1G&index=1
3. https://www.youtube.com/watch?v=gt1sr6P4Rmw&list=PLK32cwTOY7L8D9GxdYR2JkEIAA1J1sKYO&index=6

Software Architecture and Design Patterns [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS7032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

CLO1: To define the scope of requirements - global versus component specific requirements
CLO2: To allocate requirements to architectural components
CLO3: Argue the importance and role of software architecture in large-scale software systems
CLO4: Design and motivate software architecture for large-scale software systems
CLO5: Recognize major software architectural styles, design patterns, and frameworks.

UNIT – I	**8 Hours**
Introduction: Introduction to design patterns, Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. A Notation for Describing Object-Oriented Systems **Analysis a System:** overview of the analysis phase, stage 1: gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain. Design and Implementation, discussions and further reading.	
Self-study component:	A Generalized Notion of Conformance

UNIT – II	**8 Hours**
Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.	
Self-study component:	Issues in storing and retrieving Objects

UNIT – III	**8 Hours**
Behavioral Patterns: Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Template Method	
Self-study component:	Singleton class

UNIT – IV	**8 Hours**
Interactive systems and the MVC architecture: Introduction, The MVC architectural pattern, analyzing a simple drawing program, designing the system, designing of the subsystems, getting into implementation, implementing undo operation, drawing incomplete items, adding a new feature, pattern-based solutions.	
Self-study component:	Employing the Command Pattern

UNIT – V	**8 Hours**
Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object-oriented system on the web (discussions and further reading) a note on input and output, selection statements, loops arrays	
Self-study component:	Structure of Servlets

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Design with higher performance and lower complexity codes.	L3	Apply
CO2	Experiment with core design principles and able to assess the quality of a design	L3	Apply
CO3	Capable of applying principles in the design	L3	Apply
CO4	Demonstrate an understanding of design patterns.	L2	Understand
CO5	Apply suitable patterns in specific contexts	L4	Apply

Text Book(s):

1 Object-oriented analysis, design and implementation, Brahma Dathan, Sarnath Rammath 2013, Universities Press

2. Design Patterns, Erich Gamma, Richard Helan, Ralph Johman, John Vlissides, 2013 , Pearson Publication

Reference Book(s):

1. Pattern Oriented Software Architecture, Frank Bachmann, ReginеMeunier, Hans Rohnert, John Wiley & Sons.

Cyber Security [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS7033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1 : To understand Cyber offenses and various attacks.
CLO 2 : To gain knowledge on tools and methods used in cybercrimes.
CLO 3 : To understand computer forensics and forensics for handheld devices.

UNIT – I	**8 Hours**

Introduction: Cybercrime and information security, who are Cyber criminals? Classification of Cybercrimes, **Cybercrime** – The Legal Perspectives and Indian Perspective.

Self-study component:	Case Study : Cybercrimes - Banking frauds, Email-phishing

UNIT – II	**8 Hours**

Cyber Offenses: How Criminals Plan Them - Introduction, Categories of Cybercrime, how criminals plan the attack, classification of social engineering, Cyber stalking, Cybercafé and Cybercrimes.

Self-study component:	Botnet – The fuel of cybercrimes

UNIT – III	**8 Hours**

Tools and Methods used in Cybercrime: Introduction, Proxy servers and anonymizers, Phishing, Password cracking, Keyloggers and Spywares, virus and worms,Trojan horses and backdoors, SQL injection

Self-study component:	DoS and DDoS attacks

UNIT – IV	**8 Hours**

Cyber Forensics: Introduction, historical background of Cyber forensics, digital forensic science, the need for computer forensics, cyber forensics and digital evidence, digital forensics life cycle, chain of custody concept, Approaching a computer forensics investigation, Relevance of the OSI 7 Layer model to computer forensics.

Self-study component:	Setting up a computer forensics laboratory: understanding the requirements

UNIT – V	**8 Hours**

Forensics of Handheld Devices: Introduction, handheld devices and digital forensics, Toolkits for Hand-held device forensics, Mobile phone evidence guidelines, organizational guidelines on cell phone forensics.

Self-study component:	An Illustration on real life use of forensics

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Explain the fundamentals of cybercrime and cyber forensics	Understand	L2
CO2	Illustrate the different types of cybercrimes	Apply	L3
CO3	Analyze the various methods associated with cyber forensics	Analyze	L4
CO4	Demonstrate real world scenarios of cybercrimes using forensic tools in a team	Apply	L3

Text Book(s):

1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2011, First Edition (Reprinted 2018)

Reference Book(s):

1. Jeetendra Pande "Introduction to cyber security" uttarkand open university ,2017
2. Computer Forensics: Computer Crime Scene Investigation by John R, Vacca, 2nd edition, Charles River Media, Inc, New Delhi, 2017
3. Guide to Computer Forensics and Investigations by Bill Nelson, Amelia Phillips, Christopher Steuart, CENGAGE Learning, 2018.
4. Cybersecurity Essentials by Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short, ISBN: 978-1-119-36239-5, 2018.

Web and Video link(s):

1. https://www.youtube.com/watch?v=KqSqyKwVuA8
2. https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_

Robotic Process Automation [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS7034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1: Understand the basic concepts of RPA platform.
CLO 2: Describe the different types of variables, control flow and data manipulation techniques.
CLO 3: Understand various control techniques, plugins and extensions in RPA.
CLO 4: Describe various types and strategies to handle events and exceptions.

UNIT – I	**8 Hours**

What is Robotic Process Automation? Scope and techniques of automation Robotic process automation, About UiPath, The future of automation.

Record and Play: Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder.

Self-study component:	Step-by-step examples using the recorder.

UNIT – II	**8 Hours**

Sequence, Flowchart, and Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-bystep example using Sequence and Flowchart.

Data Manipulation: Data Manipulation, Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-bystep example

Self-study component:	Step-by-step example, using Sequence and Control flow.

UNIT – III	**8 Hours**

Taking Control of the Controls: Taking Control of the Controls, Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, Avoiding typical failure points.

Self-study component:	How to use OCR

UNIT – IV	**8 Hours**

Tame that Application with Plugins and Extensions: Tame that Application with Plugins and Extensions, Java plugin, Mail plugin, PDF plugin, Excel and Word plugins.

Handling User Events and Assistant Bots: Handling User Events and Assistant Bots, What are assistant bots? Monitoring system event triggers, monitoring image and element triggers, Launching

an assistant bot on a keyboard event.	
Self-study component:	Credential management

UNIT – V	**8 Hours**
Exception Handling, Debugging, and Logging: Exception Handling, Debugging, and Logging, Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps.	
Self-study component:	Error reporting.

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Demonstrate Robotic Process Automation & Record and Play feature of UiPath Studio.	Understand	L2
CO2	Create different types of variables, control flow and data manipulation techniques.	Apply	L3
CO3	Apply various control techniques, plugins and extensions in RPA	Apply	L3
CO4	Illustrate various types and strategies to handle events and exceptions	Apply	L3

Text Book(s):

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Packtpub, March 2018.

Reference Book(s):

1. Learning ServiceNow by Tim Woodruff, Packtpub, March 2017.
2. ServiceNow Automation by Ashish Rudra Srivastava, Packtpub.

Web and Video link(s):

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

Machine Learning (Integrated) [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS704**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours: **Total Laboratory Hours:**	**40** **24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO1: To understand the fundamental concepts behind machine learning

CLO2: To be capable of defining machine learning problems for various applications.

CLO3: To have the capability to use machine learning algorithms to address problems of moderate difficulty.

UNIT – I	**8 Hours**

Introduction to Machine Learning: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.
Concept learning: Concept learning task, Concept learning as search, Find-S, Version Spaces and Candidate Elimination Algorithm.

Self-study component:	Problems on Find –S algorithm and Candidate Elimination Algorithm
Textbook Map:	Text book 1- Chapter 2 Text book 2- Chapter 1
Laboratory Exercise:	Implementation of Find-S and Candidate Elimination algorithms

UNIT – II	**8 Hours**

Decision Tree Learning: Introduction to Decision Tree Learning Model (Structure of a Decision Tree, Fundamentals of Entropy), Decision Tree Induction Algorithms (ID3 Tree Construction, C4.5 Construction, Classification and Regression Trees Construction, Regression Trees), Validating and Pruning of Decision Trees.

Self-study component:	Problems on ID3 and C4.5
Textbook Map:	Text Book 2: Chapter 6
Laboratory Exercise:	Implementation of ID3 and C4.5 Algorithms

UNIT – III	**8 Hours**

Artificial Neural Networks: Introduction, Biological Neurons, Artificial Neurons (Simple Model of an Artificial Neuron, Artificial Neural Network Structure, Activation Functions), Perceptron and Learning Theory (XOR Problem, Delta Learning Rule and Gradient Descent), Types of Artificial Neural Networks (Feed Forward Neural Network, Fully Connected Neural Network, Multi-Layer Perceptron (MLP), Feedback Neural Network), Learning in a Multi-Layer Perceptron, Radial Basis Function Neural Network, Applications, Advantages and Disadvantages, Challenges.

Self-study component:	Self-Organising Feature map
Text Book:	Text book 2: Chapter 10

Laboratory Exercise:	Implementation of ANN
UNIT – IV	**8 Hours**
Bayesian learning: Introduction, Bayes Theorem, Concept Learning, Maximum Likelihood and Least-Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier.	
Self-study component:	Problems on Naïve Bayes Classifier
Textbook Map:	Text Book 1: Chapter 6
Laboratory Exercise:	Implementation of Naïve Bayes Classifier
UNIT – V	**8 Hours**
Ensemble Learning: Introduction (Ensembling Techniques), Parallel Ensemble Models (Voting, Bootstrap Resampling, Bagging, Random Forest), Incremental Ensemble Models (Stacking, Cascading), Sequential Ensemble Models (AdaBoost). **Reinforcement Learning:** Introduction, The Learning task, Q Learning (Function, Algorithm, Example, Convergence, Experimentation strategies, Updating Sequence).	
Self-study component:	Temporal Difference Learning
Textbook Map:	Text book 1: Chapter 13 Text book 2: Chapter 12
Laboratory Exercise:	Implementation of Random Forest and AdaBoost

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the concepts of machine learning techniques.	L1	Understand
CO2	Analyse the given problem and associate with suitable machine learning algorithms to solve it.	L2	Analyse
CO3	Implement various applications using suitable machine learning techniques.	L3	Apply

Text Book(s):

1."Machine Learning", Tom M Mitchell, McGraw Hill, 2013.

2."Machine Learning", S Sridhar and M Vijayalakshmi, Oxford University Press India, 2021.

Reference Book(s):

1. "Hands-on Machine Learning with Scikit- Learn & TensorFlow", Aurelien Geron, O'Reilly Publication, 2nd, 2019.
2. "Introduction to Machine Learning", Ethem Alpaydin, 2nd ,2013, PHI Learning Pvt. Ltd.

Web and Video link(s):

1. Introduction to Machine Learning ,NPTEL video - https://nptel.ac.in/courses/106106139

Research Methodology and IPR [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21RMI705**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CO1. Gain comprehensive understanding of research methodology & IPR importance

CO2. Create a framework for literature review and data sample collection

CO3. Interpret and write research reports

CO4. Understand the life cycle of IPR and its related legal aspects

UNIT – I	**8 Hours**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Research Problem: Introduction, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Self-study component:	Case study to define research problem in the area of your interest.

UNIT – II	**8 Hours**

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs,.

Self-study component:	Know about Important Experimental Designs

UNIT – III	**8 Hours**

Design of Sampling: Introduction, Steps in Sample Design, Criteria of Selecting a Sampling Procedure, Characteristics of Good Sample Design.

Measurement Technique: Introduction, Measurement Scales, Sources of Error in Measurement, Technique of Developing Measurement Tools.

Data Collection: Collection of Primary Data, Difference between Questionnaires and Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Experiment and Survey.	
Self-study component:	Case Study on Method of data collection

UNIT – IV	**8 Hours**
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. **Intellectual Property:** Introduction, Intellectual Property Regime in India, Copyrights, Trademarks, Patents, Designs, Trade Secrets, Geographical Indications and their Salient Features, Berne Convention, Paris Convention, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Issues Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Paris Convention for the Protection of Industrial Property, Berne Convention for the Protection of Literary and Artistic Works.	
Self-study component:	Patent Cooperation Treaty (PCT)

UNIT – V	**8 Hours**
Indian Patent Law: Introduction, Concept of Patent, Product/Process Patents and Terminology, Patents Act 1970, Amendments to the Patent Act 1970, Patent Rules, Patentable Subject Matter and Patentability Critria, Duration of Patents - Law and Policy Consideration, Elements of Patentability, Procedure for Filing Patent applications and Types of Applications.	
Self-study component:	Ownership and Maintenance of Patents

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	To know the meaning of Research Methodology and the technique of defining the Research Problem.	Understand	L2
CO2	Describe the framework of Literature Review, research design and report writing.	Understand	L2
CO3	Illustrate the Sampling Design and Data Collection and Procedure of Report Writing	Understand	L2
CO4	Understand the fundamentals of Intellectual Property, Patent and Drafting Procedure.	Understand	L2

Text Book(s):

1. C.R. Kothari and Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International 4th Edition, 2018.
2. Ranjit Kumar, "Research Methodology a step by-step guide for beginners", SAGE Publications, 3rd Edition, 2011.
3. Study Material, "Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament (e-book)

Reference Book(s):

1. Trochim, "Research Methods: the concise knowledge base", Trochim Atomic Dog Publishing 2005.
2. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.

Project Work Phase – I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII			
Course Code:	**P21CS706**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**0:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Project Work: The Project Work (Phase I + Phase II) carries 12 credits (4 credits+8 credits) and spreads over TWO semesters, i.e. during 7th and 8th semesters.

I. Project Phase – I and Project seminar Comprises of Literature Survey, Problem identification, Objectives and Methodology. CIE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and seminar presentation skill.

II. The Assessment marks (CIE) in the case of Project Work - Phase I, shall be based on the evaluation at the end of the 7th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department, one of them may be the internal guide. The work may be evaluated by the committee for award of Assessment marks (CIE) based on a Report [comprising of synopsis, Introduction, Literature survey, Objective and Methodology], presentation and viva voce.

III. The project work shall be carried out by candidate(s) independently/in a group (maximum of four) during the seventh and eighth semester under the guidance of one of the faculty members of the Department of study. If the project work is of inter-disciplinary nature, a co-guide shall be taken from the same or any other relevant Department. If a project work has to be carried out in any industry / factory / organization, outside the campus, the permission for the same and the name of co-guide at any of these organizations shall be intimated to the authorities at the beginning of seventh semester by the Head of the Department.

Self-Study Course [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VIII			
Course Code:	**P21CS801**	**Credits:**	**02**
Total Number of Teaching Hours:	**-**	**CIE Marks:**	**100**
		SEE Marks:	**-**

The student has to choose and study the course related to the program discipline with her / his own efforts under the guidance of Course Instructor / Project guide, using study materials available in Open Sources i.e., Massive Open Online Courses (MOOCs) – NPTEL Courses. The intention of the course is to encourage the habit of self-learning. In this regard, the department has to release the pool of courses from the list of available 8 weeks NPTEL online courses according to NPTEL calendar of events. The student has to register for the course from the available pool during VII / VIII Semester and the same will be reflected in the Grade Card of VIII Semester. The 100 marks CIE assessment is based on the final NPTEL score (i.e. Online assignments: 25% + Proctored exam: 75%). The NPTEL score will be mapped directly to the CIE marks as per the calculation below only if he /she has completed the NPTEL course (i.e. Certification).

CIE = (NPTEL Score X 1.5) = [Maximum CIE should be 100 Marks]

[Ex. – 1: If NPTEL Score is 52 then the CIE will be = 52 X 1.5 = 78

Ex. – 2: If NPTEL Score is 80 then the CIE will be = 80 X 1.5 = 100 (Subjected to a Maximum CIE Marks of 100)]

If the student fails to complete the NPTEL course at the end of the VIII Semester, then the department has to constitute a committee consisting of the Head of the department, two senior faculty members of the department, one of them may be the internal guide. The evaluation is based on a Report, Presentation, and Viva-Voce of the NPTEL chosen topic and the assessment is a relative evaluation in context to the student's completed NPTEL course Certification (i.e. the CIE Score should be less than the score of the student who cleared the NPTEL Course).

Note: The student who fails to enroll and appear for the proctored exam in NPTEL is considered to have failed.

Research / Industry Internship - III [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VIII			
Course Code:	**P21INT802**	**Credits:**	**06**
Teaching Hours/Week (L:T:P):	**0:0:0**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

Guidelines for Internship:

I. Internship is of minimum Fifteen weeks duration and to be completed between the vacation period of VI & VII semester and VII & VIII semester.

II. The internship can be carried out in any industry/ R & D Organization/ Research/ Institute/ Educational institute of repute/ Internshala (ACITE MoU Internship).

III. The Department/college shall nominate staff member/s to facilitate, guide and supervise students under internship.

IV. The Internal Guide has to visit place of internship at least once during the student's internship.

V. The students shall report the progress of the internship to the guide in regular intervals and seek his/her advice.

VI. After the completion of Internship, students shall submit a report with completion and attendance certificates to the Head of the Department with the approval of both internal and external guides.

VII. There will be 100 marks for Viva Voce conducted during Semester End Examination (SEE) of VIII Semester. For the conduction of Internship Semester End Examination following instructions are issued:

a. The Semester End Examination (SEE) for 100 marks shall be conducted similar to final semester project work / lab examination.

b. Internal & External Examiners shall be appointed by the BoE – Chairperson in consultation with HoD and approval of the same by the Principal & Controller of Examination.

c. External Examiner may be from the Industry. If the external examiner from the industry is not available, alternative arrangement shall be made by the BoE - Chairperson by appointing a faculty from out of the available faculty in the department, wherein the student is studying.

VIII. The students are permitted to carry out the internship anywhere in India or abroad. The Institution will not provide any kind of financial assistance to any student for carrying out the Internship.

IX. Failing to undergo Internship: Internship is one of the head for obtaining degree, therefore completion of internship is mandatory.

Project Work Phase – II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VIII			
Course Code:	**P21CS803**	**Credits:**	**08**
Teaching Hours/Week (L:T:P):	**0:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

Project Work: The Project Work (Phase I + Phase II) carries 12 credits (4 credits+8 credits) and spreads over TWO semesters, i.e. during 7th and 8th semesters.

I. Project Phase – I and Project seminar Comprises of Literature Survey, Problem identification, Objectives and Methodology. CIE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and seminar presentation skill.

II. The Assessment marks (CIE) in the case of Project Work - Phase I, shall be based on the evaluation at the end of the 7th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department, one of them may be the internal guide. The work may be evaluated by the committee for award of Assessment marks (CIE) based on a Report [comprising of synopsis, Introduction, Literature survey, Objective and Methodology], presentation and viva voce.

III. The project work shall be carried out by candidate(s) independently/in a group (maximum of four) during the seventh and eighth semester under the guidance of one of the faculty members of the Department of study. If the project work is of inter-disciplinary nature, a co-guide shall be taken from the same or any other relevant Department. If a project work has to be carried out in any industry / factory / organization, outside the campus, the permission for the same and the name of co-guide at any of these organizations shall be intimated to the authorities at the beginning of seventh semester by the Head of the Department.

IV. The weekly progress of the Project work shall be monitored and reviewed by the Project Guide assigned by DUGC. The method of evaluation, including intermediate assessment shall be evolved by the pertinent DUGC.

V. A candidate shall submit N+3 (No. of candidates+3) copies of the Report of the Project Work to Head, DUGC on or before the specified date. The report shall be in the format prescribed by the Institute. The candidate shall submit a report of the project work (dissertation) duly approved by the guide and co-guide. The project report shall be countersigned by the guide, co-guide (if any) and the Head of the Department

VI. The last date for the submission of Report shall be Two weeks before the closure of the semester in which the project work credits have been registered for and is expected to be completed or as announced by the COE. The date of submission of the dissertation may be extended up to a maximum of eight academic years, from the date of commencement of the first semester in which the candidate has taken admission to the course.

VII. The final evaluation (CIE & SEE) for Project Work - Phase II is done by a Project Work Evaluation Committee (PWEC) constituted by the pertinent DUGC. There shall

be an open seminar followed by a viva – voce examination as part of the final evaluation. After the final evaluation, appropriate letter grade is awarded.

VIII. If in the opinion of the PWEC, the Project Report is acceptable with minor modifications for the minimum passing grade 'E' (Fair) in the case of project, the PWEC shall value and instruct the candidate suitably to incorporate the necessary modifications and to resubmit it to the Chairman, PWEC. After such resubmission, the Chairman, PWEC will certify that the necessary modification has been incorporated.

IX. The Assessment marks in case of Project Work - Phase II and seminar shall be based on the evaluation, as per the guidelines, at the end of the 8th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department (one of them may be the internal guide).

X. The Assessment marks sheet shall bear the signature of all those concerned, along with the date and seal of the Principal.