SYLLABUS

(With effect from 2024 -25)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2024-25)

Bachelor Degree

In

Information 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 INFORMATION SCIENCE AND ENGINEERING

About the Department

The Department of Information science and Engineering takes pride in producing quality engineers over the past 20 years. The credit for all the flowery results goes to the highly motivating staff, from whom all students draw inspiration. The Department was started in the year 2000. The present intake of the undergraduate program is 60. The department has well equipped classrooms, computer laboratories with high-end systems, department library. We are proud to produce the first PhD student in our college. Faculty members of the department are involved in research activities in different fields such as Medical Image Processing, Pattern Recognition, and Data Mining etc. The department is using Outcome-based education (OBE), which is a recurring education reform model, and it is affiliated to Visvesvaraya Technological University (VTU). The department has achieved good Placement, conducted International Conferences and other sponsored short-term courses, workshops, National seminars and symposia. The laboratory facilities and the Internet access are available to the staff and students of the Information Science and Engineering

Vision

"The department strives to equip our graduates with Knowledge and Skills to contribute significantly to Information Science & Engineering and enhance quality research for the benefit of society".

Mission

M1: To provide students with state of art facilities and tools of Information Science & Engineering to become productive, global citizens and life-long learners.

M2: To prepare students for careers in IT industry, Higher education and Research.

M3: To inculcate leadership qualities among students to make them competent Information Science & Engineering professionals or entrepreneurs.

1.2. State the Program Educational Objectives (PEOs)

Graduates of the program will be able to

PEO1: Establish a productive Information Science & Engineering career in industry, government or academia.

PEO2: Interact with their peers in other disciplines by exhibiting professionalism and team work to contribute to the economic growth of the country.

PEO3: Promote the development of solutions to the problems in Information Science using hardware and software integration.

PEO4: Pursue higher studies in Engineering, Management or Research.

A. List of Program Outcomes (POs)

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. **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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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 and design documentation, make effective presentations, and give and receive clear instructions.

PO11. 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.

PO12. 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.

B. List of Program Specific Outcomes (PSOs)

Information Science & Engineering Graduates will have

PSO1- The Knowledge to excel in IT profession by utilizing mathematical concepts, programming paradigms and software development practices for successful career.

PSO2- The ability to continuously learn and develop solutions in IT world by applying the emerging technologies in multidisciplinary environment

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	P21IS701	Industry 4.0	IS	3	-	-	3	50	50	100
2	P21IS702X	Professional Elective Course – IV	IS	3	-	-	3	50	50	100
3	P21IS703X	Professional Elective Course – V	IS	3	-	-	3	50	50	100
4	P21IS704	Data Science (Integrated)	IS	3	-	2	4	50	50	100
5	P21RMI705	Research Methodology and IPR	IS	3	-	-	3	50	50	100
6.	P21IS706	Project Work Phase – I	IS	-	-	-	4	100	-	100
Total							**20**			

Professional Elective Course – IV (P21IS702X)	
Course Code	**Course Title**
P21IS7021	Business Analytics
P21IS7022	Big Data
P21IS7023	Pattern Recognition
P21IS7024	Management Information System

Professional Elective Course – V (P21IS703X)	
Course Code	**Course Title**
P21IS7031	Full Stack Web Development
P21IS7032	Parallel Computing
P21IS7033	Natural Language Processing
P21IS7034	Multicore Programming

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	P21IS801	Self-Study Course	IS	-	-	-	2	100	-	100
2	P21INT802	Research / Industry Internship – III	IS	-	-	-	6	-	100	100
3	P21IS803	Project Work Phase – II	IS	-	-	-	8	100	100	200
Total							**16**			

INDUSTRY 4.0 [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER VII**			
Course Code:	**P21IS701**	**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

- Student Can Understand conceptual framework for Industry 4.0 with respect to its design principle
- Student can understand set the Industry 4.0 strategies,
- Student can select the key technologies, determine the projects.
- Student can understand digital transformation in current technology

UNIT – I	**8 Hours**

Conceptual Framework for Industry 4.0:

Introduction, Main Concept & Components of Industry4.0, Proposed framework for Industry 4.0,

Smart and Connected Products Business Models: Introduction, Business Models, Key Business Models Components of Smart and Connected Products.

Self-study component:	Proposed framework

UNIT – II	**8 Hours**

Data Analytics in Manufacturing: Introduction, Methodology: Techniques used for Predictive Analytics, Forecast Accuracy Calculation.

Internet of Things & New Value Proposition: Introduction, Internet of Things, Examples of IoT's Creations in Different Industries: Smart Agriculture, Smart City, Smart Life-Wearable Technologies, Smart Health.

Self-study component:	IoTs Value Creation Barriers

UNIT – III	**8 Hours**

Advances in Robotics in the Era of Industry 4.0: Introduction, Recent Technological Components of Robots, Advanced Sensor technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics, Cognitive Architecture for Cyber-Physical Robotics.

Self-study component:	Industrial Robotics Applications

UNIT – IV	**8 Hours**

The Role of Augmented Reality in the Age of Industry 4.0: Introduction, AR Hardware and Software Technology, Industrial Applications of AR.

Additive Manufacturing Technologies And Applications: Introduction, Additive Manufacturing Technologies, Application Areas of Additive Manufacturing,

Self-study component:	Impact of Additive Manufacturing Technology on society.

UNIT – V	8 Hours

Digital Traceability Through Production Value Chain: Introduction, Digital Traceability Technologies, Applications, Project Management in digital traceability.

Overview of Cyber Security in the Industry 4.0 Era: Introduction, Security threats & Vulnerabilities of IoT, Industrial Challenge, Evolution of Cyber attacks, Strategic Principals of Cyber Security,

Self-study component:	Cyber Security Measures

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 Framework for Industry 4.0	Understand	L1
CO2	Identify Importance of Data Analytics for Industry 4.0	Identify	L2
CO3	Analyze the usage & applications of Robotics in Industry 4.0	Analyze	L3
CO4	Evaluate the Digital Traceability & Cyber Security threats' in the Industry 4.0	Evaluate	L4

Text Book(s):

1. Industry 4.0: Managing The Digital Transformation, By Alp Ustundag, Emre Cevikcan, Springer Series in Advanced Manufacturing, 24 May 2019.

Reference Book(s):

1. Industry 4.0 Current Status and Future Trends Edited by Jesús Hamilton Ortiz, Edited by Jesús Hamilton Ortiz, 10 Lower Thames Street, London, EC3R 6AF, United Kingdom, 2005.
2. Industry 4.0Concepts, Processes and Systems Edited By Ravi Kant, Hema Gurung, Copyright 2024.

BUSINESS ANALYTICS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VII**			
Course Code:	**P21IS7021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Theory Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Understand the concept of correlation and its role in analytics.
- Learn to calculate correlation between two continuous variables.
- Learn how to apply the applications of predictive models to support relational marketing strategies.
- Focus on optimization models aimed at the integrated planning of the logistic chain from the perspective of a single company.

UNIT – I	**8 Hours**

Business Analytics: Why Analytics, Business Analytics: The Science of data driven decision making, Descriptive Analysis, Predictive Analytics, Prescriptive Analytics, Big Data Analytics, Web and Social Media Analytics, Machine Learning Algorithms, Framework for data driven decision making, Analytics Capability Building, Roadmap, Challenges.

Self-study component:	Types (Descriptive, Predictive and Prescriptive).

UNIT – II	**8 Hours**

Descriptive Analytics: Data Types and Scales, Types of Data Measurement Scales, Population and Sample, Measures of Central Tendency, Percentile, Decile, and Quartile, Measures of Variation, Measures of Shape −Skewness and Kurtosis.

Self-study component:	Data Visualization.

UNIT – III	**8 Hours**

Decision Support systems: Definition of system, Representation of the decision making process, Evolution of information systems, definition of Decision Support systems.

Data Warehousing: Definition of Data warehousing, Data warehousing architecture, Cubes and multidimensional analysis.

Self-study component:	Development of Decision Support systems.

UNIT – IV	**8 Hours**

Business Intelligence applications: Marketing models, Relational marketing, sales force management, Business case studies.

Self-study component:	Cross selling in retail industry.

UNIT – V	8 Hours
Logistics and production models: Supply chain optimization, optimization models for logistics planning, Revenue management systems, Business case studies. Data Envelopment Analysis: Efficiency measures, efficient frontier, the CCR model, identification of good operating practices.	
Self-study component:	Other models.

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

CO	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** various elements of analytics business context, technology and data science	Understand	L2
CO2	**Apply** the emergence of analytics in a competitive strategy.	Apply	L3
CO3	**Analyse** need of Decision Support systems.	Analyse	L4
CO4	**Analyse** various tools and techniques in analytics with business applications.	Analyse	L4
CO5	**Design** and develop techniques to solve problems from different industries.	Design	L5

Text Book(s):

1. U. Dinesh Kumar, "Business Analytical – The science of data driven decision making", Wiley 2017.
2. Carlo-Vercellis, "Business intelligence datamining and optimization for decision making", First Edition.

Reference Book(s):

1. Business Analytics Principles, Concepts, and Applications: What, Why, and How Paperback – 29 September Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey.

BIG DATA [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VII**			
Course Code:	**P21IS7022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Theory Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Understanding the role of data in business intelligence and Business analysis and business at large.
- To provide students with the fundamentals and essentials of Big Data.
- To discuss the challenges traditional mining algorithms face when analyzing Big Data.
- To enable the students to optimize business decisions and create competitive advantage with big data analytics.
- To impart the architectural concepts of Hadoop and Map reduce paradigm and to enable the students to make use of programming tools PIG,HIVE and Cassandra.

UNIT – I	**8 Hours**

Types of Digital Data: Classification of Digital Data. Introduction to Big Data: Introduction to Big Data, Characteristics of Data, Definition of Big Data, Challenges with Big Data, Characteristics of Data Which are not Definitional Traits of Big Data, Need of Big Data, Traditional Business Intelligence (BI) versus Big Data. Big Data Analytics: What is Big Data Analytics?, What Big Data Analytics Isn't?, Classification of Analytics, Greatest Challenges that Prevent Businesses from Capitalizing on Big Data, Top Challenges Facing Big Data, Big Data Analytics Important.

Self-study component:	Basically Available Soft State Eventual Consistency (BASE).

UNIT – II	**8 Hours**

The Big Data Technology Landscape: NoSQL (Not Only SQL), Hadoop. Introduction to Hadoop: Introducing Hadoop, Why Hadoop?, Why not RDBMS?, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet Another Resource Negotiator).

Self-study component:	Interacting with Hadoop Ecosystem.

UNIT – III	**8 Hours**

Introduction to Hive: What is Hive?, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), RCFile Implementation.

Self-study component:	User-Defined Function (UDF).

UNIT – IV	**8 Hours**

Introduction to Pig: What is Pig?, The Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use Case for Pig: ETL Processing, Pig Latin Overview, Data Types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank,

User-Defined Functions (UDF), Parameter Substitution, Diagnostic Operator, Word Count Example using Pig, When to use Pig?, When not to use Pig?, Pig at Yahoo!.	
Self-study component:	Pig versus Hive.

UNIT – V	**8 Hours**
Introduction to Cassandra: Apache Cassandra – An Introduction, Features of Cassandra, CQL Data Types, CQLSH, Keyspaces, CRUD (Create, Read, Update, and Delete) Operations, Collections, Using a Counter, Time to Live (TTL), Alter Commands, Querying System Tables, Practice Examples.	
Self-study component:	Import and Export.

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 requirements for and constraints in Big Data ecosystem.	Understand	L2
CO2	**Apply** concepts of Hadoop/Map-reduce framework for solving typical Big data problems	Apply	L3
CO3	**Apply** the Hive platforms to manage Big data.	Apply	L3
CO4	**Apply** Pig Latin for solving big data challenges	Apply	L3
CO5	**Apply** Cassandra query language in handling Big data storage.	Apply	L3

Text Book(s):

1. Big Data Analytics, Seema Acharya and Subhashini Chellappan. Wiley India Pvt. Ltd. 2nd Edition 2019.

Reference Book(s):

1. Network Data Analytics, Siddesh G M et.al., Springer, 2018

PATTERN RECOGNITION

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

SEMESTER VII

Course Code:	**P21IS7023**	**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:

- To learn about supervised and unsupervised pattern classifiers.
- To familiarize about different feature extraction techniques.
- To explore the role of Hidden Marko model and SVM in pattern recognition.
- To understand the application of Fuzzy logic and genetic algorithms for pattern classifier

UNIT – I	**Pattern Classifier**	**8 Hours**
Overview of Pattern recognition, Discriminate functions, Supervised learning, Parametric estimation, Maximum Likelihood Estimation, Bayesian parameter Estimation, Problems with Bayes approach		
Self-study component:	Pattern classification by distance functions, Minimum distance pattern classifier.	
UNIT – II	**Clustering**	**8 Hours**
Clustering for unsupervised learning and classification, Clustering concept Hierarchical clustering, Graph theoretic approach to pattern Clustering, Validity of Clusters.		
Self-study component:	C Means algorithm,	
UNIT – III	**Feature Extraction And Structural Pattern Recognition**	**8 Hours**
Principle component analysis, Independent component analysis, linear discriminant analysis, Feature selection through functional approximation, Elements of formal grammars, Syntactic description, stochastic grammars.		
Self-study component:	Structural Representation	
UNIT – IV	**Hidden Markov Models And Support Vector Machine**	**8 Hours**
State Machines, Hidden Markov Models, Training, Classification, Support vector Machine		
Self-study component:	Feature Selection.	
UNIT – V	**Recent Advances**	**8 Hours**
Basics of Fuzzy logic, Fuzzy logic ,Fuzzy Pattern Classifiers , Pattern Classification using Genetic Algorithms.		
Self-study component:	Case Study Using Fuzzy Pattern Classifiers and Perception	

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	**Differentiate** between supervised and unsupervised classifiers	Analyzing	L4
CO2	**Classify** the data and identify the patterns.	Understanding	L4
CO3	**Extract** feature set and select the features from given data set.	Apply	L3
CO4	**Apply** fuzzy logic and genetic algorithms for classification problems	Apply	L3

Text Book(s):

1. Andrew Webb, "Statistical Pattern Recognition", Arnold publishers, London, 2002.

Reference Book(s):

1. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press. 2009
2. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Web and Video link(s):

1. What is Pattern Recognition? A Gentle Introduction (2024) - viso.ai
2. Pattern Recognition in Machine Learning [2024 Guide] (analyticsvidhya.com)

E-Books/Resources:

1. Pattern Recognition | Journal | ScienceDirect.com by Elsevier
2. Pattern Recognition and Machine Learning | SpringerLink

MANAGEMENT INFORMATION SYSTEM [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER VII**			
Course Code:	**P21IS7024**	**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:

- To enable students evaluate the role of information systems in today's competitive business environment
- To enable students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive.
- Apply a framework for evaluating information-related ethical dilemmas commonly faced by managers.
- Enhance self-confidence, ability to make proper decisions and effective communication, and Pursue lifelong learning and continuing education.

UNIT – I	**Foundation Concepts**	**08 Hours**

Foundations of Information Systems in Business: The Real World of Information Systems, The Fundamental Roles of IS in Business, Types of Information Systems, Managerial Challenges of Information Technology, **The Components of Information Systems: System Concepts:** A Foundation, Components of Information Systems, Information System Resources, Information System Activities. **Competing with Information Technology:** Strategic IT, Strategic Uses of Information Technology, building a Customer-Focused Business, The Value Chain and Strategic IS, Reengineering Business Processes, becoming an Agile Company, creating a Virtual Company, building a Knowledge-Creating Company.

Self-study component:	The Role of e-Business in Business, Trends in Information Systems.

UNIT – II	**E-Business Systems**	**08 Hours**

Introduction, Cross-Functional Enterprise Applications, Enterprise Application Integration, Transaction Processing Systems, Enterprise Collaboration Systems. Functional Business Systems: Introduction, Marketing Systems, Targeted Marketing, Manufacturing Systems, Human Resource Systems, Accounting Systems. Enterprise Business Systems: Introduction, what is CRM? The Three Phases of CRM, Benefits and Challenges of CRM, trends in CRM. Enterprise Resource Planning: Introduction, what is ERP? Benefits and Challenges of ERP, Trends in ERP. Supply Chain Management: introduction, what is SCM? Benefits and Challenges of SCM, Trends in SCM.

Self-study component:	Sales Force Automation, Financial Management Systems

UNIT – III	**E-Commerce Fundamentals**	**08 Hours**

Introduction to e-Commerce, Scope of E-commerce, Essential e- Commerce Processes, Electronic Payment Processes, e-Commerce Trends, e-Commerce Success Factors, Web Store Requirements, Business-to-Business e-Commerce, e-Commerce Marketplaces, Clicks and Bricks in e-Commerce. **Decision Support in Business:** Introduction, Decision Support Trends, Decision Support Systems,

Management Information Systems, Online Analytical Processing, Using Design Support Systems, Executive Information Systems, Enterprise Portals and DecisionSupport, Knowledge management system.		
Self-study component:	Business and AI, The Domains of Artificial Intelligence	
UNIT – IV	**Development Processes**	**08 Hours**
Developing Business/IT Strategies: Planning Fundamentals: Introduction, Organizational Planning, the Scenario Approach, Planning for Competitive Advantage, Business Models and Planning , Business/IT Architecture Planning, Identifying Business/IT Strategies, Business Application Planning. Implementation Challenges: Implementation, Implementing Information Technology, End-User Resistance and Involvement, Change Management. Developing Business/IT Solutions: IS Development, the Systems Approach, Systems Analysis and Design, Starting the Systems Development Process, Systems Analysis, system design, End user development.		
Self-study component:	Implementing Business Systems	
UNIT – V	**Management Challenges**	**08 Hours**
Security, Ethical, and Societal Challenges of IT: Introduction, Ethical Responsibility of Business Professionals, Computer Crime, Privacy Issues, the Current State of Cyber Law and other Challenges. Security Management of Information Technology: Introduction, Tools of Security Management, Inter-Networked Security Defenses, Other Security Measures, System Controls and Audits. Managing Information Technology: Business and IT, Managing Information Technology, Business/IT Planning, Managing the IT Function, Organizing IT, Outsourcing and Offshoring IT and IS, Failures in IT Management, Management Involvement.		
Self-study component:	Managing Global IT	

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 current generation of computing and information technologies for business and Apply the concepts of Management Information Systems to enhance business processes and support decision making.	Understand	L2
CO2	**Develop** a strategy to gain a competitive advantage using information technology.	Develop	L3
CO3	**Interpret** and **recommend** the use information technology to solve business problems.	Interpret	L2
CO4	**Apply** a framework and process for aligning organization's IT objectives with business strategy	Apply	L3

Text Book(s):

1. James A. O' Brien, George M. Marakas: "Management Information Systems", 7th Edition, Tata McGraw Hill, Reprint 2013.

Reference Book(s):

1. Kenneth C. LaudonJone and P. Laudon, "Management Information Systems", 13 th Edition, Pearson Education Limited2014.
2. Ralph M. Stair and George W. Reynolds, "Principles of Information Systems - A Managerial Approach", 9 th edition, Course Technology2013.
3. W.S. Jawadekar: Management Information Systems, Tata McGraw Hill2008.

Web and Video link(s):

1. https://youtu.be/5JMkdGQCm4k?list=PLE04B26C87FB0C0C6
2. https://youtu.be/-18Py3sX5sM

E-Books/Resources:

1. **https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/186-Management-Information-Systems-James-A.-O%E2%80%99Brien-George-M.-Marakas-Edisi-10-2010.pdf**

FULL STACK WEB DEVELOPMENT

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

SEMESTER – VII

Course Code:	**P21IS7031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Theory Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Understand the major areas and challenges of web programming.
- Understand JavaScript runtimes for building servers.
- Understand front end framework for developing Interactive WebApp using ReactJS.
- Understand Type script language for robust code and easy maintenance of JavaScript based application.
- Understand latest Framework for fast API development.

Course Overview

The course provides fundamental understanding of full stack web development tools and techniques.

UNIT – I	**8 Hours**

Server-Side Action: Node and NPM Of JavaScript Runtimes and Building (Mostly) Servers First Baby Steps with Node: Installation More Useful: Executing JavaScript Source Files Node's Partner in Crime: NPM A Few More NPM Commands Initializing a New NPM/Node Project Adding Dependencies A Quick Aside: Semantic Versioning Fisher Price's "My First Node Web Server" Bonus Example: Advanced Node and NPM :More on package.json NPM: Other Commands Auditing Package Security Deduplication and Pruning Finding/Searching for Packages sans Browser Updating Packages Publishing/Unpublishing Packages Node: Standard Modules File System (fs)HTTP and HTTPS(http and https) OS (os) Path (path) Process Query Strings (querystring) URL (url) Utilities (util)

Textbook: Ch. 1,2

Self-study component:	The Rest of the Cast

UNIT – II	**8 Hours**

R Client-Side Adventures: React A Brief History of React Yeah, Okay, History Nerd, That's All Great, but What IS React? The Real Star of the Show: Components Need Info: Props Components (Sometimes) Need Memory: State Making Them Look Good.

Textbook: Ch. 3

Self-study component:	Style In the End Why Reach?

UNIT – III	**8 Hours**

Advanced React A Better Way to Write React Code: JSX Yeah, Okay, So What Does ItLOOKLIKE? A Slight Detour into Babel Land Compile JSX And Now, Put It All Together Whither Props? Default Props Typing Props

Textbook: Ch. 4

Self-study component:	Component Lifecycle

UNIT – IV	**8 Hours**

Building a Strong Foundation: TypeScript What Is TypeScript? Jumping into the Deep End Beyond the Playground Configuring TypeScript Compilation The NittyGritty:Types String Number Boolean Any Arrays Tuples Enums Function Object Null, Void,and Undefined Custom Type Aliases Union Types TypeScript ES6 Features for"Free"! The let and const Keywords Block Scope Arrow Functions Template Literals Default Parameters Spread and Rest (and as an Added Bonus: Optional Arguments)

Textbook: Ch. 5

Self-study component:	Destructuring Classes

UNIT – V	**8 Hours**

Advanced TypeScript: Interfaces Argument/Object Interfaces Methods in Interfaces, Interfaces and Classes Extending Interfaces Namespaces and Modules Namespaces Modules Decorators Decorator Factories Third-Party Libraries Debugging TypeScript

Textbook: Ch. 6

Self-study component:	Apps Source Maps

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	**Explain** the role and functions of web servers and server frameworks.	Understand	L2
CO2	**Apply** intermediate and advanced web development practices, basic programming principles for the construction of websites.	Apply	L4
CO3	**Design** user interactions on web pages and front-end website architecture.	Apply	L3
CO4	**Develop** a fully functioning website and deploy on a web server meeting the objectives of a particular business/domain	Develop	L4

Text Book(s):

1. Frank Zammetti-Modern Full-Stack Development Apress 2020

Reference Book(s):

1. Basarat Ali Syed - Beginning Node.js-Apress ,2014.
2. Anthony Accomazzo, Ari Lerner, Clay Allsopp, David Guttman, Tyler Mcginnis, Nate Murray,FullStack React The Complete Guide to ReactJS& Friends, Fullstack.io, 2017

Web and Video link(s):

1. https://www.youtube.com/watch?v=EceJQ05KTf4&list=PLwoh6bBAszPrES-EOajos_E9gvRbL27wz
2. https://www.youtube.com/watch?v=bWACo_pvKxg&list=PLSDeUiTMfxW6VChKWb26Z_mPR4f6fAmMV

PARALLEL COMPUTING

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

SEMESTER VII

Course Code:	**P21IS7032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Prerequisites: Computer Organization, Operating System, Design & Analysis of Algorithms, Data Structure

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

- To learn the basics of parallel system and how parallel computers work.
- To learn how to analyze the correct designs of parallel architectures, especially within the technological constraints.
- To prepare students for a career in designing the computer systems of the future.

UNIT – I	**Introduction to Parallel Computing**	**08 Hours**

Thinking in Parallel, Parallelism Vs. Concurrency, Types and levels of parallelism, Different grains of parallelism, Introduction to parallelization and vectorization: Data dependencies, SIMD technology, Definition of thread and process, Parallel programming models, Decomposition methodologies for parallel program development, The message passing paradigm, load balancing issues for parallel programs, PRAM computational model, Flynn's Taxonomy, current issues in parallel processing, Parallel Processing speedup issues: Amdahl's law.

Self-study component:	Parallel Processing speedup issues: Gustafason's Laws.

UNIT – II	**Heterogeneous Architectures**	**08 Hours**

Motivation for Heterogeneous Computing, Introduction to heterogeneous architectures- GPU in particular Modern GPU architecture. Introduction to GPU computing, GPU architecture case studies: NVIDIA Fermi Tesla C2050/Kepler K20, languages for parallel computing: MPI Parallel Programming.

Self-study component:	Languages for parallel computing: OpenMP Parallel Programming.

UNIT – III	**Introduction to CUDA programming Compute Unified Device Architecture**	**08 Hours**

CUDA Architecture, CUDA programming model, execution model, thread organization: Concept of grid, block and thread, thread index generation, warp; memory model: Introduction to global, shared, local memories, usage of cache, texture cache, constant memory, memory banks and bank conflicts. CUDA structure, API and library.

Self-study component:	CUDA example programs

UNIT – IV	**Multicore Programming with OpenMP**	**08 Hours**

Fundamentals of Shared Memory Programming, Basic OpenMP concepts, PARALLEL directive, data scoping rules, basic OpenMP constructs/directives/calls, examples, parallelizing an existing code using OpenMP, More advanced OpenMP directives and functions.

Self-study component:	OpenMP performance issues

UNIT – V	Problem solving using GPUs and Optimizations and Tools	08 Hours

Single vs double precision, solving problems that involves Vectors, Matrices, Binomial coefficients, Bernstein coefficients.

Memory coalescing, Reduction operation using prefix sum example. Usage of shared memory optimally, Performance issues in algorithms- deciding parallelization of a part of algorithm and selecting the highest parallelism, Need of profilers and analyzers.

Self-study component:	Introduction to CUDA Tools: MemCheck, Command line and Visual Profilers.

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** fundamentals of parallel computing.	Understand	L2
CO2	**Design** parallel programs for GPU.	Design	L3
CO3	**Design** OpenMP and CUDA programs.	Design	L3
CO4	**Develop** parallel algorithms using Pthreads/OpenMP/MPI.	Develop	L4
CO5	**Analyse** the performance and design the parallel programs.	Analyse	L4

Text Book(s):

1. AnanthGrama, Anshal Gupta, GreogeKarypis, Vipin Kumar, "Introduction to Parallel Computing", Second Edition.
2. Parallel Programming in C with MPI and OpenMP by Michael J. Quinn, Tata McGrawHill Edition.

Reference Book(s):

1. Jason Sanders and Edward Kandrot,"CUDA by Example: An Introduction to General-Purpose GPU Programming",2010.
2. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-On Approach", Second Edition(MK-Morgan Kaufmann Publication)
3. Advanced computer architecture by Kai Hwong, Tata McGraw-Hill Edition, 2001

Web and Video link(s):

1. https://archive.nptel.ac.in/courses/106/102/106102114/
2. https://www.youtube.com/watch?v=RpT-fRbQeuM

NATURAL LANGUAGE PROCESSING
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VII

Course Code:	**P21IS7033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Theory Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Student Can Understand Grammar-Processing
- Student Can analyze Syntactic Analysis
- Student Can explore Relation Extraction
- Student can implement Information Retrieval & valuation Lexical Resources.

UNIT – I	**8 Hours**

Overview and language modelling:

Overview: 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 and syntactic analysis:

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..

Self-study component:	Constituency- Parsing-Probabilistic Parsing

UNIT – III	**8 Hours**

Extracting Relations from Text: From Word Sequences to Dependency Paths:

Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.

Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles:

Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling.

Self-study component:	Learning to Annotate Cases with Knowledge Roles and Evaluations.

UNIT – IV	**8 Hours**

Evaluating Self-Explanations in iSTART:
Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems,

Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures:
Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions.

Self-study component:	Results of Experiments.

UNIT – V			8 Hours
INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net Stemmers-POS Tagger.			
Self-study component:	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	**Define** the importance of natural language	Define	L1
CO2	**Understand** the concepts Text mining.	Understand	L2
CO3	**Analyze** the natural language text carpus.	Analyze	L3
CO4	**Illustrate** information retrieval techniques	Illustrate	L3

Text Book(s):

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

Reference Book(s):

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.

2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.

3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

MULTICORE PROGRAMMING [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VII**			
Course Code:	**P21IS7034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Theory Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Identify the limitations of ILP and the need for multicore architectures.
- Solve the issues related to multiprocessing and suggest solutions.
- Make out the salient features of different multicore architectures and how they exploit parallelism.

UNIT – I	**8 Hours**

Introduction: The ERA of multicore machines, a taxonomy of parallel machines, a glimpse of contemporary computing machines: the cell be processor, nvidia's kepler, amd's apus, multicore to many-core: tilera's tile-gx8072 and intel's xeon phi. Performance metrics, predicting and measuring parallel program performance.

Ch 01

Self-study component:	Amdahl's Law, Gustafson-Barsis's Rebuttal

UNIT – II	**8 Hours**

Multicore and parallel program design: The Pcam Methodology, Decomposition Patterns: Task Parallelism, Divide-And-Conquer Decomposition, Geometric Decomposition, Recursive Data Decomposition, Pipeline Decomposition, Event-Based Coordination Decomposition

Ch 02

Self-study component:	Program Structure Patterns

UNIT – III	**8 Hours**

Shared-memory programming: OpenMP : your first openmp program, variable scope: openmp integration v.0: manual partitioning, openmp integration v.1: manual partitioning without a race condition, openmp integration v.2: implicit partitioning with locking, openmp integration v.3: implicit partitioning with reduction.

Ch 04

Self-study component:	Loop-Level Parallelism

UNIT – IV	**8 Hours**

Distributed memory programming: Communicating processes, mpi, core concepts, your first mpi program, program architecture: spmd, mpmd. Point-to-point communication.

Ch 05

Self-study component:	Alternative Point-To-Point Communication Modes

UNIT – V	8 Hours

GPU programming: Gpu Programming, Cuda's Programming Model: Threads, Blocks, And Grids, Cuda's Execution Model: Streaming Multiprocessors And Warps, Memory Hierarchy: Local Memory/Registers, Shared Memory, Constant Memory.

Ch 06

Self-study component:	Optimization Techniques: Block And Grid Design

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	**Explain** the current trends in computing machine design and how these trends influence software development	Understand	L2
CO2	**Define** fundamental concepts of parallel programming and its design issues	Understand	L2
CO3	**Demonstrate** the role of OpenMP and programming concept	Apply	L3

Text Book(s):

1. Gerassimos Barlas, "Multicore and GPU Programming: An Integrated Approach Paperback", 1st Edition, Morgan Kaufmann, 2014.

Reference Book(s):

1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006
2. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", 1st Edition, CRC Press/Taylor and Francis, 2015.

Web and Video link(s):

1. https://www.youtube.com/watch?v=vhIwuNJzVG4&list=PLE638294EA3288272
2. https://www.youtube.com/watch?v=pPStdjuYzSI
3. https://www.youtube.com/watch?v=fYJP9F_y4rI&list=PL1VUG29jR5kkA2eze4U4ngLcf7U7HCqGh

DATA SCIENCE (Integrated) [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VII**			
Course Code:	**P21IS704**	**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:

- Describe the fundamentals of Data Science.
- Carry out EDA on a given dataset.
- Use basic machine learning algorithms on a given dataset by considering ethical issues using R.

UNIT – I	**Introduction to Data Science**	**08 Hours**

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 modeling, probability distributions, fitting a model.

Self-study component:	Intro to R.
Practical Topics: (06 Hours)	Programs to implement the following statistical tests: i) Correlation test between two variables ii) Correlation Matrix between multiple variables iii) Comparing the means of two groups iv) Comparing the means of more than two groups

UNIT – II	**Data Science Process**	**08 Hours**

Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: RealDirect (online real estate firm).

Three Basic Machine Learning Algorithms - Linear Regression, k-Nearest Neighbors(k-NN), k-means.

Self-study component:	Exercise: Basic Machine Learning Algorithms.
Practical Topics: (06 Hours)	Program to perform data exploration and pre-processing on a given dataset. Program to implement linear regression for a given dataset.

UNIT – III	**Applications of Machine Learning Algorithms**	**08 Hours**

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.

Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention, Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms, Filters; Wrappers.

Self-study component:	Data Wrangling: APIs and other tools for scraping the Web.
Practical Topics:	Program to implement Multiple Linear regression for a given dataset.

(04 Hours)	Program to implement K-NN algorithm on a given dataset.	
UNIT – IV	**Recommendation Systems and Mining Social-Network Graphs**	**08 Hours**
Building a User-Facing Data Product – Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis. Mining Social-Network Graphs – Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs.		
Self-study component:	Neighborhood properties in graphs.	
Practical Topics: (04 Hours)	Build a recommendation system using; i) Item Based Collaborative Filtering ii) User Based Collaborative Filtering	
UNIT – V	**Data Visualization**	**08 Hours**
Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects, Exercise: create your own visualization of a complex dataset. Data Science and Ethical Issues – Discussions on privacy, security, ethics, A look back at Data Science.		
Self-study component:	Next-generation data scientists.	
Practical Topics: (04 Hours)	The United States has resettled more than 600,000 refugees from 60 different countries since 2006. Download the department of Homeland Security's annual count of people granted refugee status between2006-2015. Use ggplot, Illustrator, Inkscape, or Gravit Designer to explore where these refugees have come from by handling Personal Identifiable Information (PII), if any.	

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	Explain data science process and statistical inference.	Understand	L2
CO2	Illustrate EDA and feature engineering.	Apply	L3
CO3	Identify basic machine learning algorithms to use in applications.	Apply	L3
CO4	Illustrate mining social-network graphs.	Apply	L3
CO5	Create effective visualization of a given data (to communicate or persuade ethically).	Apply	L3

Text Book(s):

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

Reference Book(s):

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. V2.1, Cambridge University Press. 2014.
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 Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

Web and Video link(s):

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094438031630336256 6_shared/overview

E-Books/Resources:

- **https://sites.google.com/view/brameshsm**

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:	**P21IS706**	**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:	**P21IS801**	**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:	**P21IS803**	**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.