Programme Outcomes, Programme Specific Outcomes and Course Outcomes For PG Programmes

Programme Name: *M.C.A.*

Number of Semesters: 4

Name of the Department
University of North Bengal
West Bengal, INDIA

Programme Outcomes

- Provide students with knowledge, general competence, and analytical skills in Computer Science on an advanced level.
- Prepare them for academics, industry, and research.
- Provide hands-on experience to apply computing skills in all other fields of study like Mathematics, Geography, Bio Sciences, Physics, Chemistry, Linguistics, Music, Medical Sciences etc.

Programme Specific Outcomes

Students will:

- Become technology-oriented with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society as a whole.
- Acquire some development experience within a specific field of Computer Science, through project work.
- Gain ability to apply knowledge of Computer Science to the real-world issues.
- Get familiar with current research trends in various fields of Computer Science.
- Use creativity, critical thinking, analyses and research skills.
- Get prepared for placement by developing personality and soft skills.
- Gain ability to communicate scientific information in a clear and concise manner.
- Build up programming, analytical and logical thinking abilities.
- Know the recent developments in IT, future possibilities and limitations, and understand the value of lifelong learning.
- Get an ability to participate in debates, discussions in the society constructively.
- Gain management skills to cater the corporate sector.

Course Outcomes

Bridge Course for students from non-computing background (to run in parallel with Semester I)		
Course Code	**Course Name**	**Course Outcomes**
	Bridge Course	- Prepare students from non-computing background for MCA - This course runs in parallel with MCA Semester I - Students learn the basics of Computer Application in areas like Digital Systems, Microprocessors, Numerical & Statistical Computing, Programming in C etc.

SEMESTER—I		
Course Code	**Course Name**	**Course Outcomes**
PCC-IT11	Object Oriented Programming using in C++	Knowledge gained: • an ability to incorporate exception handling in object-oriented programs

		• an ability to use template classes and the STL library in C++ • an understanding of the concepts of OOPs including inheritance and polymorphism • an ability to overload operators in C++ • an understanding of the difference between function overloading and function overriding Skills gained: • Logical thinking • C++ Programming Competency developed: • Ability to write object-oriented programs of moderate complexity in C++ • Developing real world application using C++
PCC-IT12	Database Management Systems	Knowledge gained: • Types of databases • Detailed architecture, define objects, load data, query data and performance tune databases. • Writing SQL queries for the given problem statement Skills gained: • Establish a basic understanding of the process of Database • Develop ER diagram for representing conceptual data model • Convert ER diagram into a set of relations representing logical data model Competency developed: • Gain ability to handle large volumes of structured, semi-structured, and unstructured data using database technologies. • Appreciate the need for DB approach and understand the components and roles of DBMS • Apply DB system development life cycle to business problems • Implement a set of relations in the chosen DBMS • Development and Administration using MySQL.
PCC-IT13	Data Communications and Computer Networks	Knowledge gained: • Basic networking concepts, types of networks, various topologies and application of networks • types of addresses, data communication. • wired and wireless networks, its types, functionality of layer • importance of network security and cryptography • concept of networking models, protocols, functionality of each layer Skills gained: • Learn basic networking hardware and tools. • Create hybrid topologies using the existing topologies, and check efficiency. • Apply different encoding and decoding mechanisms involved in different types of transmission media and to measure the transmission impairments. Competency developed: • Create a new protocol and test its efficiency. • Design a new network architecture using protocols and interfaces.

PCC-IT14	Discrete Mathematics	Knowledge gained: • Basics of Combinations and Permutations • Relations matrices and graphs. Skills gained: • Mathematical and logical thinking towards a real world problem solving • Mathematical modeling of real world problems • Demonstrate the working of Grammars and Languages Competency developed: • Comprehend and evaluate mathematical arguments revolving around computation • Apply the knowledge on Graphs and Trees to real world applications.
PCC-IT15	Formal Language & Automata Theory	Knowledge gained: • To have an understanding of finite state and pushdown automata. • To have a knowledge of regular languages and context free languages. • Recognize to which class in the Chomsky hierarchy the language described (by a grammar or machine) belongs Skills gained: • Define the various categories of languages and grammars in the Chomsky hierarchy • Define various categories of automata (deterministic and nondeterministic finite state automata, and variants of Turing machines) • Define the notions of computability and decidability • Recognize problems reducible to/from well-known decidable/undecidable problems • Reduce a problem to another (when possible), to develop proofs of decidability/undecidability; • Apply Rice's theorem, when appropriate Competency developed: • Derive an appropriate machine description from a grammar, and vice versa; • Design a Turing machine that accomplishes a specific task, using macros when appropriate. • A Infer properties of a language from a grammar or machine description; • Infer the equivalence of languages described using different grammars or machines.
HSMC-16	Business and Technical Communication	Knowledge gained: • Understand professional writing by studying management communication contexts and genres, researching contemporary business topics, analyzing quantifiable data discovered by researching, and constructing finished professional workplace documents. • Participate actively in writing activities (individually and in collaboration) that model effective scientific and technical communication in the workplace.

		• Design a model internet with various categories of networks and test the transmission rate.

		• Recognize, explain, and use the formal elements of specific genres of organizational communication: white papers, recommendation and analytical reports, proposals, memorandums, web pages, wikis, blogs, business letters, and promotional documents. • Understand the ethical, international, social, and professional constraints of audience, style, and content for writing situations among managers or co-workers and colleagues of an organization, and between organizations, or between an organization and the public. Skills gained: • Practice the unique qualities of professional rhetoric and writing style, such as sentence conciseness, clarity, accuracy, honesty, avoiding wordiness or ambiguity, using direct order organization, readability, coherence and transitional devices. • Explore different format features in both print, multimedia and html documents, and develop document design skills. Competency developed: • Writing professional correspondence • Oral presentations
LC-IT11	C and C++ Lab	Knowledge gained: • This lab work provides hands-on experience for C++. • C++ Programming assignments based on class, inheritance, abstraction, encapsulation, dynamic binding, polymorphism, I/O systems, exception handling should be covered DS using C++ assignments should be based on Stacks, Queue, Linked List and mainly it should cover Tree , Binary Threaded Tree & Graph programs Skills gained: • Programming in C++ Competency developed: • Developing application to solve real world problem using C++
LC-IT12	DBMS Lab	Knowledge gained: • To explain basic database concepts, applications, data models, schemas and instances. • To demonstrate the use of constraints and relational algebra operations. • Describe the basics of SQL and construct queries using SQL • To emphasize the importance of normalization in databases. • To facilitate students in Database design • To familiarize issues of concurrency control and transaction management. Skills gained: • Apply the basic concepts of Database Systems and Applications. • Use the basics of SQL and construct queries using SQL in database creation and interaction.

		• Analyze and Select storage and recovery techniques of database system. Competency developed: • Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.

SEMESTER—II		
Course Code	**Course Name**	**Course Outcomes**
PCC-IT21	Java Programming	Knowledge gained: • To learn Object Oriented Programming language • To learn database programming using Java • To handle abnormal termination of a program using exception handling • To create flat files • To study web development concept using Servlet and JSP Skills gained: • To design User Interface using Swing and AWT • To learn socket programming concept Competency developed: • To develop a game application using multithreading • To develop application using multithreading
PCC-IT22	Data Structure & Algorithms	Knowledge gained: • Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms • Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs • Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs • Demonstrate different methods for traversing trees • Illustrate various technique to for searching, Sorting and hashing • Describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack • Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing. • Summarize different categories of data Structures Skills gained: • Compare alternative implementations of data structures with respect to performance • Compare and contrast the benefits of dynamic and static data structures implementations • Explain the significance of dynamic memory management Techniques • Identify different parameters to analyze the performance of an algorithm. Competency developed: • Choose appropriate data structures to solve real world problems efficiently. • Design and implement an appropriate hashing function for an application • Design algorithms to perform operations with Linear and Nonlinear data structures
PCC-IT23	Computer Organization & Architecture	Knowledge gained: • Understand the theory and architecture of hardwired and microprogram controlled central processing units

		• Learn the concepts of parallel processing, pipelining and inter-processor communication. • Define different number systems, binary addition and subtraction, 2's complement representation and operations Skills gained: • Analyze some of the design issues in terms of speed, technology, cost, performance • Design a simple CPU with applying the theoretical concepts • Understand the architecture and functionality of central processing unit Competency developed: • Use appropriate tools to design verify and test the CPU architecture. • Exemplify in a better way the I/O and memory organization.
PCC-IT24	System Software and Compiler Construction	Knowledge gained: • To understand design issues of a lexical analyzer and use of Lex tool • To understand design issues of a parser and use of YACC tool • To understand issues related to memory allocation • To understand and design code generation schemes • To understand the design structure of a simple editor. • To understand Complexity of Operating system as a software • To understand the working of linkers and loaders and other development utilities. Skills gained: • Process of designing and implementing System programs and operating system components. • Design structure of Assembler and macro processor for a hypothetical simulated computer. Competency developed: • Design and implement simulations of operating system level procedures. • Design and implement System programs with minimal features to understand their complexity.
PEC-IT25 (Anyone of the Electives)	PE21: Embedded Systems	Knowledge gained: • Understand hardware and software design requirements of embedded systems. • Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems. • Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level) • Become aware of interrupts, hyper threading and software optimization. Skills gained: • Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems. • Learn to develop the hardware for embedded system application based on the processors. • Explore the features of the microcontrollers and provide apt solutions for any embedded application.

		• Analyze various examples of embedded systems based on ATOM processor. Competency developed: • Analyze the embedded systems' specification and develop software programs. • Incorporate suitable microcontroller along with appropriate interfacing circuits and implement the same for an application with software programs. • Design real time embedded systems using the concepts of RTOS.
	PE22: Mobile Application Development	Knowledge gained: • Pass data between fragments • To gain knowledge of installing Android Studio and Cross Platform Integrated Development Environment. • An ability to use the techniques, skills, and modern technology. Skills gained: • Debug android apps and create UI fragments • Create database and communicate with mobile apps Competency developed: • Design apps with audio play back. • To develop the different applications that mobile computing offers to people, employees, and businesses • To develop high levels of technical competence in the field of mobile technology
	PE23: Computer Graphics	Knowledge gained: • Learn the concepts of projections, viewing and graphics pipeline Skills gained: • Develop line and circle generation algorithms Competency developed: • Apply 2D and 3D transformations • Develop clipping algorithms for point, line and polygons
	PE24: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
HSMEC-26	HE21: Accounting and Management Control	Knowledge gained: • Obtaining knowledge and understanding of models and methods in management accounting and control • Obtaining the ability to apply a range of models and methods in different contexts and in order to analyze an organization's activities Skills gained: • Being able to communicate findings • To identify and analyze problems and solutions in real-life situations

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		Competency developed: • The ability to analyze and critically discuss the reasons to and consequences of management accounting and control
	HE22: Organizational Behaviour	Knowledge gained: • Understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories. • Understand group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations. • Understand the organizational system, including organizational structures, culture, human resources, and change. • Analyze the complexities associated with management of the group behavior in the organization. Skills gained: • Demonstrate the applicability of the concept of organizational behavior to understand the behavior of people in the organization. • Demonstrate the applicability of analyzing the complexities associated with management of individual behavior in the organization. Competency developed: • Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization.
	HE23: Human Computer Interaction	Knowledge gained: • Explain the main principles of a user-centered approach. • Explain how to do usability testing through examples. • Understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces. • Understand the important aspects of implementation of human-computer interfaces. • Discuss the conceptual, practical, and ethical issues involved in evaluation. • Explain what cognition is and why it is important for interaction design. Skills gained: • Analyze and discuss HCI issues in groupware, ubiquitous computing, virtual reality, multimedia, and Word Wide Web-related environments. • Explain the capabilities of both humans and computers from the viewpoint of human information processing. • Describe typical human–computer interaction (HCI) models and styles, as well as various historic HCI paradigms. • Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems. • Identify some of the common pitfalls in data analysis, interpretation, and presentation. • Identify the importance of working in teams and the role of each member within an interface development phase. • Identify the various tools and techniques for interface analysis, design, and evaluation. • Identify the impact of usable interfaces in the acceptance and performance

		utilization of information systems.
		Competency developed:
		- Apply an interactive design process and universal design principles to designing HCI systems. - Evaluation of interface for a given application or activity.
	HE24: Introduction to Management Functions	Knowledge gained:
		- Understand the concepts related to Business. - Define management, its four basic functions and skills. - Recognize the role of a manager and how it relates to the organization's mission. - Know critical management theories and philosophies and how to apply them. - Explain the relationship between strategic, tactical, and operational plans. - Identify the stages of team development and the skills a team must acquire to become effective. - Explain the concept of continuous change and its impact on change management. - Analyze effective application of PPM knowledge to diagnose and solve organizational problems and develop optimal managerial decisions. - Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
		Skills gained:
		- Gain understanding of the functions and responsibilities of managers. - To provide tools and techniques to be used in the performance of the managerial job. - To enable to analyze and understand the environment of the organization.
		Competency developed:
		- Demonstrate the roles, skills and functions of management. - Develop cognizance of the importance of management principles.
	HE25: Management Information Systems	Knowledge gained:
		- Understand the leadership role of Management Information Systems in achieving business competitive advantage through informed decision making. - To describe the role of information technology and decision support systems in business and record the current issues with those of the firm to solve business problems - Managing the digital firm - Compare the processes of developing and implementing information systems - Illustrate redesigning the organization with information systems - Debate infrastructure of information technology - Explain relationships between concepts of information systems, organization, management and strategy.
		Skills gained:
		To provide the theoretical models used in database management systems to answer business questions.

		Competency developed: • Analyze and synthesize business information and systems to facilitate evaluation of strategic alternatives
	HE26: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
LC-IT21	Java Programming Lab	Knowledge gained: • This lab work provides hands-on for Java. • Java Programming assignments based on class, inheritance, abstraction, encapsulation, dynamic binding, polymorphism, I/O systems, exception handling Skills gained: • Programming in Java Competency developed: • Developing application to solve real world problem using Java • Implement core Java programs to solve simple problems • Implement Client and Server end Java programs Knowledge gained:
LC-IT22	Data Structure Using C++ Lab	Knowledge gained: • Write C programs using structures, unions, dynamic memory allocation functions and command line arguments • Implement C/C++ linear data structures like stacks, queues, linked lists using static and dynamic allocation and their applications • Implement C/C++ program for binary search tree using nonlinear data structure. • Gain knowledge in concepts of C++ like classes, operator overloading, friend functions, constructor overloading. • Write C programs using arrays, strings, dynamic memory allocation functions • Implement C linear data structures like stacks, queues, linked lists using static and dynamic allocation and their applications • Implement C program for binary search tree and Graphs using nonlinear data structure. Skills gained: • Programming real life application in C++ Competency developed: • Understand and choose the appropriate data structure for solving real world problems.

		SEMESTER—III
Course Code	**Course Name**	**Course Outcomes**
PCC-IT31	Python Programming	Knowledge gained: • To understand why Python is a useful scripting language for developers. • To learn how to use lists, tuples, and dictionaries in Python programs. • To learn how to identify Python object types. • To learn how to use indexing and slicing to access data in Python programs. • To define the structure and components of a Python program. • To learn how to write loops and decision statements in Python. • To learn how to write functions and pass arguments in Python. • To learn how to build and package Python modules for reusability. • To learn how to read and write files in Python. • To learn how to design object-oriented programs with Python classes. • To learn how to use class inheritance in Python for reusability. • To learn how to use exception handling in Python applications for error handling. • To acquire programming skills in core Python. • To acquire Object Oriented Skills in Python Skills gained: • To learn how to design and program Python applications. Competency developed: • To develop the ability to write database applications in Python • To develop the skill of designing Graphical user Interfaces in Python
PCC-IT32	Internet and Web Technologies	Knowledge gained: • Learn Core-PHP, Server Side Scripting Language • Learn PHP-Database handling. • Learn different technologies used at client Side Scripting Language • Learn XML, CSS and XML parsers. • One PHP framework for effective design of web application. • Learn JavaScript to program the behavior of web pages. • Learn AJAX to make our application more dynamic. Skills gained: • Design and Develop Web Applications using Node.js, Express.js, AngularJS • Create and connect MongoDB to web application • Connect Mongoose to MongoDB • Create a MEAN CRUD Module for web application Competency developed: • Developing application to solve real world problems
PCC-IT33	Optimization Techniques	Knowledge gained: • Gets a thorough knowledge on optimization of electrical and electronic engineering problems through classical optimization techniques

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		• Gets a thorough knowledge on constrained non linear programming and dynamic programming Skills gained: • Optimized application development for efficiency Competency developed: • Able to apply conceptual things to real-world electrical and electronics problems and applications
PCC-IT34	Operating Systems	Knowledge gained: • To understand Complexity of Operating system as a software • To understand design issues related to process management and various related algorithms • To understand design issues related to memory management and various related algorithms • To understand design issues related to File management and various related algorithms • Allocate Main Memory based on various memory management techniques • Compare Memory allocation using Best fit, Worst fit, and first fit policies • Apply page replacement policies for dynamic memory management • Schedule CPU time using scheduling algorithm for processors • Compare various device scheduling algorithms Skills gained: • To evaluate, and compare OS components through instrumentation for performance analysis. • To analyze the various device and resource management techniques for timesharing and distributed systems Competency developed: • To design and understand the following OS components: System calls, Schedulers, Memory management systems, Virtual Memory and Paging systems. • To develop and analyze simple concurrent programs using transactional memory and message passing, and to understand the trade-offs and implementation decisions
PCC-IT35 (Anyone)	PE 31: Cloud Computing	Knowledge gained: • To understand the principles and paradigm of Cloud Computing • Ability to design and deploy Cloud Infrastructure • Understand cloud security issues and solutions • Analyze the virtualization and cloud computing concepts. • Learn the architecture, deployment models, and infrastructure models of Cloud Computing. Skills gained: • Ability to understand role of Virtualization Technologies • Demonstrate knowledge on the cloud computing security, federation, presence, identity, and privacy Competency developed:

			• Design & develop backup strategies for cloud data based on features • Familiarity with open source cloud computing software, and free/commercial cloud services. • Learn the privacy policy of cloud providers
	PE32: Mobile and Pervasive Computing		Knowledge gained: • Get familiar with various generations of mobile communications. • Understand the concept of cellular communication • Understand the basics of wireless communication • Get the Knowledge of GSM mobile communication standard, its architecture, logical channels, advantages and limitations. • Understand the GSM architecture • Understand the issues relating to Wireless applications Skills gained: • To familiarize the students with the buzz words and technology of mobile communication Competency developed: • Develop ability to develop Android Application
	PE33: Soft Computing		Knowledge gained: • Understand the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms. • Provide the mathematical background for carrying out the optimization associated with neural network learning. • To discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience • To relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems • To describe with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations Skills gained: • Familiar with current research problems and research methods in Soft Computing by working on a research or design project. • Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory. Competency developed: • To understand the concepts of how an intelligent system work and its brief development process. • This course exposes learners to Neural Network, Fuzzy Logic and Genetic Algorithms, which are the major building blocks of Intelligent Systems.
	PE34:Open Course/Swaya m Courses		Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
PEC-IT36 (Anyone)	PE35: Data Warehousing and Data Mining		Knowledge gained: • Understand Data Warehouse fundamentals, Data Mining Principles • Design data warehouse with dimensional modeling and apply OLAP

		operations.
		- Identify appropriate data mining algorithms to solve real world problems - Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining - Describe complex data types with respect to spatial and web mining. - Benefit the user experiences towards research and innovation, integration. - To introduce the fundamental concepts of data mining and recognize various types of data mining tasks. - To introduce mathematical and statistical models used in data Classification. - To define, understand and interpret association rules. - Discuss the clustering algorithms to solve real-world problems Skills gained: - To identify the scope and essentiality of Data Warehousing and Mining. - To analyze data, choose relevant models and algorithms for respective applications. - To study spatial and web data mining. Competency developed: - To develop research interest towards advances in data mining.
	PE36: Design and Analysis of Algorithms	Knowledge gained: - Analyze the running time and space complexity of algorithms. - Describe, apply and analyze the complexity of divide and conquer strategy. - Describe, apply and analyze the complexity of greedy strategy. - Describe, apply and analyze the complexity of dynamic programming strategy. - Explain and apply backtracking, branch and bound and string matching techniques to deal with some hard problems. - Describe the classes P, NP, and NPComplete and be able to prove that a certain problem is NP-Complete. - Describe analysis techniques for algorithms. - Identify appropriate data structure and design techniques for different problems - Identify appropriate algorithm to be applied for the various application like geometric modeling, robotics, networking, etc. - Appreciate the role of probability and randomization in the analysis of algorithm - Differentiate polynomial and non-deterministic polynomial algorithms. Skills gained: - To provide mathematical approach for Analysis of Algorithms - To solve problems using various strategies - To provide mathematical approach for Analysis of Algorithms. - To teach advanced data structures. - To solve complex problems in real life applications. Competency developed: - To analyze strategies for solving problems not solvable in polynomial time - Analyze various algorithms.

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	PE37: Principal of Programming Languages	Knowledge gained: • Knowledge of, and ability to use, language features used in current programming languages. • An ability to program in different language paradigms and evaluate their relative benefits. • An understanding of the key concepts in the implementation of common features of programming languages. Skills gained: • Investigate semantic issues in programming languages by studying implementations in an interpreter • Define the semantics of a programming language using a definitional interpreter. Competency developed: • Solve problems using a range of programming paradigms and assess the effectiveness of each paradigm for a particular problem.
	PE38: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
LC-IT31	Python and Socket Programming Lab	Knowledge gained: • Programming in Python Skills gained: • Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language • Developing adequate skills in programming • Implementation of various applications using Python. Competency developed: • Developing the Python programming to do a variety of programming tasks. • Develop application using Python.
LC-IT32	Web Technology Lab	Knowledge gained: • Implement Simple PHP programs to solve simple problems • Provides knowledge of code optimization • To understand concept of interoperability. Skills gained: • Apply the knowledge of different web technologies to develop web-based applications • Understand the process of designing and implementing Web applications, using PHP. Competency developed: • Ability to perform hands-on NoSql database lab assignments that will allow students to use the four NoSQL database types via products such as Cassendra, MongoDB,Neo4J and Riak

		• Build and maintain the databases handling in real life applications and daily needs.

SEMESTER—IV		
Course Code	**Course Name**	**Course Outcomes**
PEC-IT41 (Anyone)	PE41: Parallel Computing	Knowledge gained: • Critical methods and techniques related to parallel computing. Particularly • Focuses on hardware, algorithm, and programming of parallel systems, providing students a complete picture to understand pervasive parallel computing. • Deep understanding of how parallel systems are designed and what are the fundamental methods to program and analyze them. • An ability to apply knowledge of computing and mathematics appropriate to the discipline • Extensive use of the PMU technology infrastructure Skills gained: • Explain how large-scale parallel systems are architecture and how massive parallelism are implemented in accelerator architectures • Write parallel programs for large-scale parallel systems, shared address space platforms, and heterogeneous platforms • Design efficient parallel algorithms and applications • An ability to analyze a problem and identify the computing requirements appropriate for its solution; an ability to design, implement and evaluate a computer- based system, process, component or program to meet desired needs • An ability to apply mathematical foundations, algorithmic principles and computer science theory to the modeling and design of computer based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices • An ability to apply design and development principles in the construction of software systems of varying complexity. • An ability to function effectively as a member of a team in order to accomplish a common goal; • Parallel Computing develop skills necessary for understanding the design of parallel computing applications so as to appreciate the strengths and limitations of parallel computing approaches to problem solving. • Encourages the development of professional communication skills and provides opportunities for collaborative project development. Competency developed: • Be conversant with performance analyze and modeling of parallel programs • Complete significant projects outside of class time.
	PE42: Adhoc and Sensor Networks	Knowledge gained: • To understand the principles of sensor networks and mobile ad hoc networks, and their impact on protocol design • To understand and develop information dissemination protocols for sensor and mobile networks • Discuss and demonstrate about sensor networks

			Skills gained:
			- To develop MAC and routing protocols for sensor and mobile networks - Demonstrate the Knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid - Explain about the energy management in adhoc networks. Competency developed: - To develop efficient protocols for sensor and mobile networks - Identify the issues and challenges in providing QoS. - Demonstrate various types of mesh networks.
	PE43: Digital Image Processing & Steganography		Knowledge gained: - Analyze general terminology of digital image processing. - Describe and explain basic principles of digital image processing. - To study the image fundamentals and mathematical transforms necessary for image processing. - Examine various types of images, intensity transformations and spatial filtering. - Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression. - Evaluate the methodologies for image segmentation, restoration etc. - Learn the signal processing algorithms and techniques in image enhancement and image restoration, and image compression procedures. - Implement image process and analysis algorithms. - Understand the rapid advances in Machine vision. - Learn different causes for image degradation and overview of image restoration techniques. - Learn different feature extraction techniques for image analysis and recognition - Understand and analyze image processing problems - Understand the role of alternative color spaces, and the design requirements leading to choices of color space. Skills gained: - Get broad exposure to and understanding of various applications of image processing in industry, medicine, and defence. - Design algorithms to solve image processing problems and meet design specifications. - Be able to conduct independent study and analysis of image processing problems and techniques. - Apply image processing algorithms in practical applications. - Review the fundamental concepts of a digital image processing system. Competency developed: - Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems. - Design and implement algorithms that perform basic image processing and image analysis - Assess the performance of image processing algorithms and

		systems. • Interpret Image compression standards, image segmentation and representation techniques. • Develop any image processing application.
	PE44: Internet of Things	Knowledge gained: • Understand the definition and significance of the Internet of Things • Describe what IoT is and how it works • Recognize the factors that contributed to the emergence of IoT • Secure the elements of an IoT device • Define the infrastructure for supporting IoT deployments • Discuss the architecture, operation, and business benefits of an IoT solution • Able to understand the application areas of IOT • Able to realize the revolution of Internet in Mobile Devices, Sensor Networks • Able to understand building blocks of Internet of Things and characteristics. Skills gained: • Examine the potential business opportunities that IoT can uncover • Identify how IoT differs from traditional data collection systems • Use real IoT protocols for communication • Determine the right sensors and communication protocols to use in a particular IoT system. • Establish data migration techniques from IoT devices to the cloud • Implement security features to protect data stored in the cloud. • Use visualisation techniques to show data generated from the IoT device. Competency developed: • After the completion of the course, the students will be able design some IOT based prototypes • Design and program IoT devices
	PE45: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
PCC-IT42	Software Engineering	Knowledge gained: • Learn the phases of software development • Develop process models and process system models • Gather, understand, analyze and specify requirements • Elicit, analyze and model requirements • Schedule projects, identify risk strategies and manage risks. • Understanding importance of Object Orientation in Software engineering • Understand the components of Unified Modeling Language • Develop architectural diagram, and implement by following coding principles

		• Estimate software scope feasibility and resources • Identify and apply SQA tasks, goals, and metrics Skills gained: • To develop strategies to calculate risk factors involved in IT projects • To use project management software to control the design, implementation, closure, and evaluation of IT projects • To estimate, plan, calculate, and adjust project variables. • To identify the impact of IT projects on the performance of the organizations • To understand, manage and develop IT infrastructure in different projects Competency developed: • Apply project management practices to launch new programs, initiatives, products, services, and events relative to the needs of stakeholders. • Apply Agile process model for Software Development • Apply testing strategies and handle software product maintenance issues
PCC-IT43	Artificial Intelligence	Knowledge gained: • Understand concept of knowledge representation and predicate logic and transform the real life information in different representation. • Understand state space and its searching strategies. • Understand machine learning concepts and range of problems that can be handled by machine learning. • Understand the numerous applications and huge possibilities in the field of AI Skills gained: • To analyze and formalize the problem as a state space, graph, design heuristics • Ability to represent solutions for various real-life problem domains using logic based techniques • Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques • Apply these techniques in applications which involve perception, reasoning and learning • Use different machine learning techniques to design AI machine and enveloping applications for real world problems. • Develop knowledge of decision making and learning methods. Competency developed: • Analyze and design a real world problem for implementation and understand the dynamic behavior of a system • Ability to express the ideas in AI research and programming language related to emerging technology. • Apply the machine learning concepts in real life problems.

	PE46: Information Security and Cyber Forensics	Knowledge gained: • Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization. • Practice with an expertise in academics to design and implement security solutions. • Understand key terms and concepts in Cryptography, Governance and Compliance. • Develop cyber security strategies and policies • Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools. Skills gained: • Analyze and evaluate the cyber security needs of an organization. • Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation. • Measure the performance and troubleshoot cyber security systems. Competency developed: • Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools. • Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators • Design and develop security architecture for an organization. • Design operational and strategic cyber security strategies and policies.
PEC- IT44(Anyone)	PE47: Cryptography & Network Security	Knowledge gained: • Learn fundamentals of cryptography and its application to network security. • Understand network security threats, security services, and countermeasures. • Acquire background on well known network security protocols such as IPSec, SSL, and WEP. • Acquire background on hash functions; authentication; firewalls; intrusion detection techniques. • Classify the symmetric encryption techniques • Illustrate various Public key cryptographic techniques • Evaluate the authentication and hash algorithms. • Discuss authentication applications Skills gained: • Understand various Cryptographic Techniques • Understand vulnerability analysis of network security. • Summarize the intrusion detection and its solutions to overcome the attacks. • Basic concepts of system level security Competency developed: • Apply various public key cryptography techniques • Implement Hashing and Digital Signature techniques • Implement system level security applications

	PE48: Software Project Management & SQA	Knowledge gained: • Get good knowledge of the issues and challenges faced while doing the Software project Management. • Explain software quality, the factors that impact quality, and the metrics used to assess product quality. • Explain software quality assurance (SQA) and how it can be implemented. • Describe how to conduct formal technical reviews and why they are the most important SQA activity. • To understand why majority of the software projects fails and how that failure probability can be reduced effectively. • To develop awareness regarding the theoretical and methodological issues related to software project management. • To develop software projects based on current technologies. Skills gained: • Create and maintain appropriate metrics to measure and maintain quality • Apply a software quality assurance program in an agile environment involving iterative and incremental development Competency developed: • To do the Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques. • Create and apply a software quality assurance plan for all software projects • Create and manage a software quality assurance team • Conduct and facilitate inspections, product reviews, walk-throughs, and audits
	PE49: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
PEC-IT45 (Any one)	PE50: Big Data Analytics	Knowledge gained: • To Understand the Big Data challenges & opportunities ,its applications • Gain conceptual understanding of NOSQL Database. • Understanding of concepts of map and reduce and functional programming • Gain conceptual understanding of Hadoop Distributed File System. • Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications. • Understand the Big Data Platform and its Use cases • Provide an overview of Apache Hadoop • Provide HDFS Concepts and Interfacing with HDFS • Understand Map Reduce Jobs • Provide hands on Hadoop Eco System • Apply analytics on Structured, Unstructured Data.

		• Exposure to Data Analytics with R. Skills gained: • Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies. • Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration. • List the components of Hadoop and Hadoop Eco-System • Access and Process Data on Distributed File System • Manage Job Execution in Hadoop Environment • Develop Big Data Solutions using Hadoop Eco System • Analyze InfosphereBigInsights Big Data Recommendations. • Apply Machine Learning Techniques using R. Competency developed: • Identify Big Data and its Business Implications. • Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues. • Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques. • Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies like Hadoop and Mapreduce.
	PE51: Data Science	Knowledge gained: • Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modelling, and statistics. • Practice problem analysis and decision-making. • Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences. Skills gained: • Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy. • Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions. • Apply principles of Data Science to the analysis of business problems. • Employ cutting edge tools and technologies to analyze Big Data. • Apply algorithms to build machine intelligence. Competency developed: • Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques. • Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.

PEC-IT46 (Anyone)		
	PE52: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
	PE53: Natural Language Processing	Knowledge gained: • Understand approaches to syntax and semantics in NLP. • Understand approaches to discourse, generation, dialogue and summarization within NLP. • Understand current methods for statistical approaches to machine translation. • Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP • Introduce the challenges of empirical methods for natural language processing (NLP) applications. • Introduce basic mathematical models and methods used in NLP applications to formulate computational solutions. • Knowledge on designing procedures for natural language resource annotation and the use of related tools for text analysis and hands-on experience of using such tools. • Knowledge of research and development work in information retrieval, information extraction, and knowledge discovery using different natural language resources. • Overview of the major technologies in speech recognition and synthesis including tools for acoustic analysis and hands-on experience of using such tools Skills gained: • Trends and systems in natural language processing. • Understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts. • To recognize the significance of pragmatics for natural language understanding. • To give students opportunities to sharpen their programming skills for computational linguistics applications • Understanding of the fundamental mathematical models and algorithms in the field of NLP. Competency developed: • Describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing. • Apply these mathematical models and algorithms in applications in software design and implementation for NLP. • Understand the principles of language resource annotation and its use in machine learning applications and apply the above principles

The top of the table continues from the previous page:
• Use data mining software to solve real-world problems.

		in analysis of data and acquire intended information through the use of available tools. • Understand the design and implementation issues in various NLP applications such as information retrieval and information extraction. • Understand the complexity of speech and the challenges facing speech engineers. • Understand the principles of automatic speech recognition and synthesis. • Problem solving using systematic ways and learning independently.
	PE54: System Administration and Linux	Knowledge gained: • Explain the fundamental concepts of open-source operating system Linux • Understand the basic set of commands and editors in Linux operating system. • Discuss shell programming in Linux OS • Demonstrate the role and responsibilities of a Linux system administrator. • Distinguishvarious filter and server commands • Understand the role and responsibilities of a Unix system administrator • Make effective use of Unix utilities, and scripting languages • File processing, process management, IO management, queues management, networking, storage backup, account management, proper system start-up and shutting down. Skills gained: • Install and configure the Linux operating system • Configure and manage simple TCP/IP network services on a Linux system • Manage the resources and security of a computer running Linux at a basic level Competency developed: • Carry the duties of a UNIX system administer.
	PE55: Open Course/Swayam Courses	Students are given an open choice to take any course from SWAYAM of their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
LC-IT41(Anyone corresponding to the theory paper)	PE41L: Parallel Programming Lab	Knowledge gained: • Programming for Shared Memory System • Programming for Distributed Memory System • Programming for Distributed-Shared Memory System Skills gained: • Cluster Design and configuration • OpenMP programming • MPI programming

		• Multithreaded programming Competency developed: • Able to write parallel programs for scientific and industrial application
	PE42L: Adhoc and Sensor Networks Lab	Knowledge gained: • Design Adhoc and Sensor Networks useful in data acquisition and IoT systems Skills gained: • Developing New Routing Protocols • To do case study experiences for Adhoc sensor networks • Gain knowledge on Mica Motes. • Capable of model building, new protocol design and strategies simulation of the systems that include the above. Competency developed: • Appreciate the importance of Adhoc and sensor networks for applications like environment monitoring, habitat monitoring, health care and data acquisition systems. • Understanding of data transmission technologies of the Adhoc and sensor devices with focus on channel access routing and security. • Appreciate the need and importance of converged networks, ubiquitous environment and 'Internet of things' in the context of Adhoc and sensor networks.
	PE43L: Digital Image Processing & Steganography Lab	Knowledge gained: • To implement basic and advanced image processing algorithms • To learn about compression and coding schemes. Skills gained: • Programming for different operations on image Competency developed: • Programming related to image operations
	PE44L: Internet of Things Lab	Knowledge gained: • Investigate a variety of emerging devices and technologies such as smart sensing, pervasive connectivity, virtual interfaces & ubiquitous computing and their potential applications in consumer, retail, healthcare and industrial contexts • Programming IoT devices Skills gained: • Hands-on experimentation to discover and demonstrate the promise of the Internet of Things Competency developed: • Interdisciplinary learning and innovation experiences with IoT technologies • Consultancy work required by government/Private organizations
	PE45L: Open Course/	Students are given an open choice to take any course from SWAYAM of

	Swayam Courses Lab	their choice that they want to undertake to enhance their knowledge and to develop skill to cater with the industry demands. The program outcome shall be mentioned by the concerned authority/course provider accordingly.
PROJ-IT42	Minor Project Academic Institute	Knowledge gained: • Identify and define the problem statement • Define and justify scope of the proposed problem • Gather and analyze system requirements • Propose an optimized solution among the existing solutions • Practice software analysis and design techniques • Develop a functional application based on the software design • Apply coding, debugging and testing tools to enhance the quality of the software • Construct new software system based on the theory and practice gained through this exercise • Prepare the proper documentation of software projects following the standard guidelines • Develop technical report writing and oral presentation Skills gained: • Software Project Development Competency developed: • Professional Software Developer
PCS-IT43	Educational/ Industrial Tour	To get exposure to the actual real life live working environment.