

# UNIVERSITY OF THE PUNJAB

## NOTIFICATION

It is hereby notified that the Vice-Chancellor has, in exercise of the powers vested in him under Section 15(3) of the University of the Punjab, Act 1973 and in anticipation of the approval of other relevant bodies, approved the recommendations made by the Board of Faculty of Science at its meeting dated 19-11-2020 regarding approval of Syllabi & Courses of Reading for M.Sc. Information Technology (IT) Program under Semester System for Affiliated Colleges with effect from the Academic Session, 2020 and onward.

The Syllabi & Courses of Reading M.Sc. Information Technology (IT) is attached herewith as Annexure A.

**Admin. Block,  
Quaid-i-Azam Campus,  
Lahore.**

**Sd/-  
Dr. Muhammad Khalid Khan  
Registrar**

No. D/ 859 /Acad.,

Dated: 25-01 /2021.

Copy of the above is forwarded to the following for information and necessary action:-

1. Members of the Syndicate
2. Dean, Faculty of Computing & Information Technology
3. Principal, Punjab University College of Information Technology
4. Principal of all Affiliated Colleges
5. Controller of Examinations
6. Director, IT
7. Deputy Registrar (Affiliation)
8. Admin. Officer (Syndicate with File)
9. Secretary to the Vice-Chancellor
10. Private Secretary to the Registrar
11. Assistant Syllabus

  
**Assistant Registrar (Academic)  
for Registrar**

<b>Course Title</b>	<b>Introduction to Computing</b>
<b>Course Code</b>	<b>CMP-300</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow Up</b>	None
<b>Syllabus</b>	<b>Topics:</b> Introduction to Information Technology, The Internet and World Wide Web, Software, Types of software, Application Software, Productivity Software, System Software, Digital Logic Design, Computer Organization, Operating System, Utility Programs, Hardware, Storage, Computer Networks, Software development, Command Line, Little Man Computer, Database Systems, Software Engineering Problem Solving, Algorithms, HTML.
<b>Text Book(s)</b>	Nell Dale and John Lewis, Computer Science Illuminated, 5 <sup>th</sup> Edition, Jones & Bartlett Learning, 2012, ISBN-10: 1449672841, ISBN-13: 978-1449672843.

<b>Title</b>	<b>Discrete Mathematics</b>
<b>Code</b>	<b>CMP-301</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics: Propositional logic:</b> Logical operators, translations between symbolic expressions and formal english expression, logical equivalences, <b>Predicate logic:</b> Quantifiers, Nested quantification, equivalences, translations between symbolic forms and formal English. <b>Rules of inference, Proof methods and strategies:</b> Direct proof, Proof by contraposition, Existence proof, Uniqueness proofs, trivial proofs, vacuous proofs, <b>Sets:</b> notations, set operations, Venn diagrams, countable and uncountable sets, <b>Functions:</b> injective, surjective, bijective, special types of functions, compositions, <b>Sequences, Summations:</b> Single summation, double summation, shifting indices, evaluating summations, formulas <b>Growth of functions:</b> Big-O notation, <b>Integers and divisibility:</b> Division theorem, modular arithmetic, lcm, gcd, Euclidean and Extended Euclidean method, finding solutions to congruences, <b>Primes:</b> Fundamental theorem of arithmetic, characterizations of primes, Mersenne primes, <b>Induction:</b> weak induction, strong induction, <b>Recursion and recurrences:</b> formulation of recurrences, closed formulas, <b>Counting:</b> product rule, sum rule, principle of inclusion-exclusion, combinations and permutations, binomial coefficients, Pascal's identity and Pascal's triangle, binomial theorem, pigeonhole principle, <b>Relations:</b> reflexive, symmetric, transitive, antisymmetric, equivalence relations and equivalence classes, partial orders, <b>Graph Theory:</b> terminologies, handshaking lemma and corollary, special families of graphs, graph representations, isomorphism, planarity, eulerian and hamiltonian graphs, trees</p>
<b>Text Book(s)</b>	Kenneth H. Rosen, Discrete Mathematics and Its Applications, 7 <sup>th</sup> Edition, McGraw Higher-Ed, 2011, ISBN: 0073383090.
<b>Reference Material</b>	None

<b>Title</b>	<b>Writing Workshop</b>
<b>Code</b>	<b>EN-301</b>
<b>Credit Hours</b>	3
<b>Category</b>	English
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Definition of Writing Skill, Techniques and Styles, Style: writing in your natural voice, Sentence length, and structures, choice of words and appropriateness, Use of capitals and first and second person pronouns, Active and passive, complete guide to style, Good usage: the split infinitive and all that General English rules and principles, Punctuation and use of capitals, A short grammar of current English: Parts of speech; nouns, pronouns, adjectives, Determiners, Verbs, Adverbs, Articles, Prepositions, conjunctions, words and suffixes, Phrases, clauses and sentences; linking phrases, transitions, coherence and unity, Genres of essays; narrative, descriptive and argumentative, short stories; understanding the basic differences, Features of a book review, How to write a bibliography and references, Idioms and figure of speech, Phrasal Verbs, Writing Assignments and Using the computer to improve writing, Reading Comprehension, Summarizing: descriptive, informative and evaluative summary, Simple application format and writing, Letter formats and writing, How to Write Effective Emails, Differences between British and American English</p>
<b>Text Book(s)</b>	George Stern, Writing in English: An Invaluable Guide to Effective Writing, Didax Educational Resources, 2004, ISBN-13: 978-1583241868
<b>Reference Material</b>	Handouts

<b>Title</b>	<b>Digital Logic Design</b>
<b>Code</b>	<b>CMP-320</b>
<b>Credit hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Follow-up</b>	None
<b>Co-Requisite</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Introduction to Boolean Algebra, Basic theorems and properties of Boolean Algebra, Boolean Functions, Complement of a Function Concept of Minterms and Maxterms, Representation of Function in Sum of Minterms or Product of Maxterms, Conversion between Canonical Forms, Standard Forms, Introduction to Karnaugh Map, Two-, Three- and Four- variable Maps, Sum of Products Simplification, Product of Sum Simplification, NAND and NOR Implementation, Don't care Conditions, The Tabulation Method, Introduction to Combinational Logic, Design of Adders, Design of Subtractors, Code Convertors, Analysis Procedure of Combinational Circuits, Multilevel NAND Circuits, Multilevel NOR Circuits, Binary Parallel Adders, Decimal Adders, Magnitude Comparator, Decoders and its applications, Multiplexers, Demultiplexers, Encoders, ROM, Programmable Logic Array (PLA), Introduction to Sequential Circuits, Basic Flip Flop, Clocked RS Flip Flop, Clocked D Flip Flop, Clocked JK Flip Flop, Clocked T Flip Flop, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Flip Flop Excitation tables, Design Procedure, Design of Counters, Design with State Equations, Introduction to Registers, Shift Registers, Ripple Counters, Synchronous Counters, Timing Sequences, Memory Unit, Random Access Memory.</p>
<b>Text Book(s)</b>	M. Morris Mano, Digital Logic and Computer Design, 1 <sup>st</sup> Edition, Pearson, 1979, ISBN: 0132145103.
<b>Reference Material</b>	Thomas L. Floyd, Digital Fundamentals, 10 <sup>th</sup> Edition, Prentice Hall, 2008, ISBN: 0132359235.

<b>Title</b>	<b>Data Communication and Computer Networks</b>
<b>Code</b>	<b>CMP-330</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	Reference models: ISO/OSI and TCP/IP, introduction and protocols architecture, basic concepts of networking, network topologies, layered architecture, physical layer functionality, modulation techniques, multiplexing in time and frequency domain, digital data to digital signal encoding schemes. transmission errors, maximum data transfer rate of noiseless and noisy channels, electromagnetic spectrum, industrial-scientific band (ISM), frequency hopping spread spectrum (FHSS), data link layer functionality, multiple access techniques, circuit switching and packet switching, LAN technologies, wireless networks, MAC addressing, networking devices, network layer protocols, IPv4 and IPv6, IP addressing, sub netting, CIDR, routing protocols, transport layer protocols, ports and sockets, connection establishment, flow and congestion control, application layer protocols, latest trends in computer networks.
<b>Text Book(s)</b>	James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition, ISBN-10: 0132856204
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Andrew S. Tanenbaum, David J. Wetherall ,Computer Networks, 5<sup>th</sup> Edition, Pearson, 2102. ISBN 10: 0132126958</li> <li>2. William Stallings, Data and Computer Communications, 10<sup>th</sup> Edition, Pearson, 2013. ISBN-13: 978-0133506488ISBN-10: 0133506487</li> <li>3. Behrouz A. Forouzan, Data Communication and Computer Networks, 5<sup>th</sup> Edition, Science Engineering &amp; Math, 2012. ISBN-13: 978-0073376226</li> </ol>

<b>Title</b>	<b>Programming Fundamentals</b>
<b>Code</b>	<b>CMP-340</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	CMP-342: Object Oriented Programming CMP-343: Object Oriented Programming Lab
<b>Course Description</b>	<p><b>Topics:</b> Flowcharts/Pseudo Codes, Basic C++ Language Constructs: Data types, Variable and Constants, Operator and Expressions, Input and Output (I/O), Formatted I/O, Escape Sequences. Structured Programming in C Language: Decision making using if control structure, Repetition using for and do while, multiple selection using switch and logical operators. Procedural Programming in C Language: functions, prototype, parameter and arguments, call by value and call by reference, library and header files, scope and life time of variables (storage classes). Composite data types arrays: definition, processing, and passing of array to a function, multi-dimensional arrays, searching and sorting. Pointers: pointer definition, pointer arithmetic, constant pointers, pointer and arrays. Strings: string and characters, string conversion functions, Dynamic Memory Allocation. User Defined Data Types: structures, definition, initialization, accessing members of structures, typedef, union, enumerations. C File Processing: files and streams, Sequential Access File, Random Access File, Secondary Storage I/O. Miscellaneous Topics: Command Line Arguments.</p>
<b>Text Book(s)</b>	1. Tony Gaddis, Starting out with C++: from control structures through objects, 7th Ed., Addison-Wesley, 2012, ISBN 978-0-13-257625-3
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. D.S. Malik, C++ Programming, From Problem Analysis to Program Design, 5<sup>th</sup> Ed., ISBN-13: 978-0-538-79813-6</li> <li>2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2<sup>nd</sup> Ed., Prentice Hall, ISBN 978-0131103627.</li> <li>3. Bjarne Stroustrup, The C++ Programming Language, 4th Edition, Addison-Wesley, 2013, ISBN 978-0321563842.</li> <li>4. Reference from different books, some web-link or lecture notes for reading will be provided.</li> </ol>

<b>Title</b>	<b>Programming Fundamentals Lab</b>
<b>Code</b>	<b>CMP-341</b>
<b>Credit Hours</b>	1
<b>Category</b>	Computing core
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Implementation of the concepts studied in "CMP140-Programming Fundamentals" Flowcharts/Pseudo Codes, Data types, Variable and Constants, Operator and Expressions, Input and Output (I/O), Formatted I/O, Escape Sequences, Decision making using if/switch control structure, Repetition using for and do while, functions, prototype, parameter and arguments, call by value and call by reference, Library and header files. Array, Passing Arrays to function, multi-dimensional arrays, searching and sorting. Pointers: pointer definition, pointer arithmetic, constant pointers, pointer and arrays. Dynamic Memory Allocation. User Defined Data Types: structures, definition, initialization, accessing members of structures, typedef, unions. C File Processing: files and streams, Sequential Access File, Random Access File, Secondary Storage I/O. Miscellaneous Topics: Command Line Arguments.</p>
<b>Text Book(s)</b>	
<b>Reference Material</b>	



<b>Title</b>	<b>Business and Technical Communication</b>
<b>Code</b>	<b>EN-302</b>
<b>Credit Hours</b>	3
<b>Category</b>	English
<b>Prerequisite</b>	EN-301: Writing Workshop
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<b>Topics:</b> Writing Basics; Sentence Structure; Process of Preparing Effective Business Messages; Effective Communication, Perspectives in Communication skills, The seven Cs of effective communication, Forms of Written Communication; Memos; Good News and Neutral Messages; Bad News Messages; Business Letters; Proposals and Business Plans; Writing Proposals and Reports; Short Reports; Long Formal Reports; Specification Documents; Review of Language; Writing Technical Research Reports; Special Topics in Business Communication; Communication and Technology; Documentation and Research Citation; Job Application and Resumes
<b>Text Book(s)</b>	<ol style="list-style-type: none"> <li>1. D. O'Hair, J. S. O'Rourke, M.J. O'Hair, Business Communication: A Framework for Success, 1<sup>st</sup> Edition, Cengage Learning, 2000, ISBN-13: 978-0324073508</li> <li>2. Herta A. Murphy, Herbert W. Hildebrandt and Jane P. Thomas, Effective Business Communication, 7<sup>th</sup> Edition, McGraw Hill India, 2008, ISBN-13: 978-0070187757</li> </ol>
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>3. Courtland L. Bovee, John V. Thill, Business Communication Today, 12<sup>th</sup> Edition, Prentice Hall, 2013, ISBN-13: 978-0132971294</li> <li>4. J. M. Penrose, R. W. Rasberry, R. J. Myers, Advance Business Communication, 4<sup>th</sup> Edition, South-Western Publishers, 2000, ISBN-13: 978-0324037395</li> <li>5. Kitty O. Locker, Business and Administrative Communication, 11<sup>th</sup> Edition, McGraw-Hill Education, 2014, ISBN-13: 978-0073403250None</li> </ol>

<b>Course Title</b>	<b>Theory of Automata and Formal Languages</b>
<b>Course Code</b>	<b>CMP-311</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow Up</b>	None
<b>Course Description</b>	<b>Topics:</b> History of computation, recursive definitions, regular expressions, deterministic finite automata, transition graphs, nondeterministic finite automata, regular languages, properties of regular languages, non-regular languages, context-free grammars, context-free languages, properties of context-free languages, push down automata, non-context free languages, Turing machines.
<b>Text Book(s)</b>	Peter Linz, An Introduction to Formal Languages and Automata, 6 <sup>th</sup> Edition, Jones & Bartlett Learning, 2016, ISBN-10: 1284077241, ISBN-13: 978-1284077247,

<b>Title</b>	<b>Object Oriented Programming</b>
<b>Code</b>	<b>CMP-342</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	CMP-340 Programming Fundamentals
<b>Co-Requisite</b>	None
<b>Follow-up</b>	CMP-410 Data Structures and Algorithms CMP-411 Data Structures and Algorithms Lab
<b>Course Description</b>	<b>Topics:</b> Object Oriented Concepts, Terminology and Features, Class/ADT/UDT, Data Abstraction and Encapsulation, Special Methods, Constructor and Destructor; Modifier const; Array and Pointer of ADT, Composition, Aggregation; this Pointer, friend Function and Class, Modifier static, Operator Overloading, Function and Class Templates, Inheritance, its types, and related Terminology, Overriding: static & dynamic/Polymorphism; Stream I/O, File Processing; Exception Handling
<b>Text Book(s)</b>	1. H. M. Deitel, P. J. Deitel, C++ How to Program, 5th Ed., Prentice Hall, 2005, ISBN 0-13-185757-6.
<b>Reference Material</b>	1. Victor Shtern, Core C++ A Software Engineering Approach, 1st Ed., Prentice Hall PTR, 2000, ISBN: 0-13-085729-7. 2. Stephen Parata, C++ Primer Plus, 5th Ed., Sams Publishing, 2005, ISBN 0-672-32697-3. 3. Bjarne Stroustrup, The C++ Programming Language, 4th Ed., Addison Wesley, 2013, ISBN-10 0-321-56384-0. 4. Handouts.

<b>Title</b>	<b>Object Oriented Programming Lab</b>
<b>Code</b>	<b>CMP-343</b>
<b>Credit Hours</b>	1
<b>Category</b>	Computing
<b>Prerequisite</b>	CMP-340: Programming Fundamentals
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<b>Topics:</b> Implementation of the concepts studied in "CMP244 - Object Oriented Programming", Review of Data Driven Programming, Defining Classes and Object Initialization: setter/getter, Constructor/Destructor, Resource Allocation/De-Allocation, const data members and function, Composition, Aggregation, Friend function/classes, Generalization, Multilevel/Multiple Inheritance, Runtime Polymorphism, Singleton/Proxy/Adapter Pattern, Adhoc Polymorphism: Templates, Stream I/O, File Processing, Exception Handling
<b>Text Book(s)</b>	
<b>Reference Material</b>	

<b>Title</b>	<b>Software Engineering</b>
<b>Code</b>	<b>CMP-390</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow Up</b>	None
<b>Course Description</b>	<p><b>The Scope of Software Engineering:</b> Motivation and need, Importance and need of Software Engineering, Definition of Software Engineering, Introduction to software engineering vocabulary. <b>Software Process Models:</b> Waterfall Model, Incremental Model, Prototyping Model, Spiral Model, RAD Model. <b>Introduction to Requirements Engineering. Analysis Model:</b> Data modeling, Functional Modeling, Behavioral Modeling. <b>Software Design:</b> Data Design, Architectural Design, Component Level Design, User Interface Design.</p>
<b>Text Book(s)</b>	Ian Sommerville, Software Engineering, 10 <sup>th</sup> Edition, Pearson, 2015, ISBN-13: 978-0133943030.
<b>Reference Material</b>	Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd Edition, Pearson, 2002, ISBN-13: 978-0133056990.

<b>Title</b>	<b>Project Management</b>
<b>Code</b>	<b>CMP-392</b>
<b>Credit Hours</b>	3
<b>Category</b>	IT (Core)
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow Up</b>	None
<b>Course Description</b>	<p>Topics: Definition of a project, Scope triangle, The S curve, Definition of project management, Five phases of project management life cycle: Defining, planning, executing, controlling, closing, Scope of project, Project Work Breakdown Structure (WBS), Estimate activity duration: Causes of variation in activity duration, five methods of Estimating Activity Duration, Project Networks: Critical Path Method (CPM), Build the project network, Analysis of the project network, Project Evaluation Review Technique (PERT), Activity on Arrow, Activity on Node, GANTT Chart, Using MS-Project to draw GANTT chart and project Networks, Prepare project Proposal: Purpose of the project proposal, Contents of the project proposal, Format of the Project Proposal, Staffing and Personnel Planning: Personnel Plan, Team structures: Democratic decentralized, Controlled Decentralized, Controlled Centralized, Coordination and communication issues, Maslow's need theory of motivation, Software Project Team Roles and Responsibilities, Risk Identification, Analysis and Management, Configuration Management: Change Management and Control, baselines, Version Control, Earned Value Analysis for Project Monitoring and Control. Examples of Earned Value Analysis, Project Quality Assurance Plans, SQA Process Project Quality Standards, Project Documents</p>
<b>Text Book(s)</b>	Guide to the Project Management Body of Knowledge (PMBOK® Guide), 6 <sup>th</sup> Edition, Project Management Institute, 2017, ISBN-10: 1628251840.
<b>Reference Material</b>	Teresa Luckey, Joseph Phillips, Software Project Management For Dummies, 1st Edition, For Dummies Publisher, 2006, ISBN 0471749346.

<b>Title</b>	<b>Database Systems</b>
<b>Code</b>	<b>CMP-370</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	CMP-473: Database Administration
<b>Course Description</b>	<p><b>Topics: File Systems and Databases:</b> Introduction, A File system Critique, Database Systems, Database Models. <b>Introduction to RDBMS:</b> Logical view of Data; Entities and Attributes, Tables and their Characteristics, Keys; Integrity Rules. <b>Relational Algebra:</b> Relational Database Operators, System Catalog. <b>Entity Relationship (E-R) Modeling:</b> Basic Modeling Concepts, Data Models, The Entity Relationship (E-R) Model. <b>Normalization of Database Tables:</b> Objectives, Forms, Normalization and Database Design, Denormalization, <b>Structured Query Language (SQL):</b> Introduction, DDL Commands, DML Commands, DCL Commands, Complex Queries and SQL Functions, Procedural SQL; Triggers, Stored procedures. <b>Database Design:</b> The System Development Life Cycle (SDLC), The Database Life Cycle (DBLC), Database Design Strategies, <b>Transaction Management and Concurrency Control:</b> Introduction, Transaction Properties and Types, Concurrency Control Issues, Database Recovery Management. <b>DDBMS:</b> Evolution, Components, Distributed processing and distributed databases, Distributed database transparency features. Distributed database design, Data fragmentation, Data replication, Data allocation, Client-server versus DDBMS, C.J. Date's 12 commandments for distributed databases.</p>
<b>Text Book(s)</b>	Carlos Coronel, Steven Morris, Database Systems: Design, Implementation & Management, 12 <sup>th</sup> Ed., Cengage Learning, 2016. ISBN-10: 1305866797
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Jeffrey A. Hoffer, Ramesh Venkataraman, Heikki Topi, Modern Database Management, 12<sup>th</sup> Edition, Pearson, 2015. ISBN-10: 0133544613</li> <li>2. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management, 6<sup>th</sup> Edition, Pearson, 2015. ISBN-10: 1292061189</li> <li>3. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7<sup>th</sup> Edition, Pearson, 2016. ISBN-10: 1292097612</li> <li>4. C. J. Date, An Introduction to Database Systems, 8<sup>th</sup> Edition, Pearson, 2004. ISBN-10: 0321189566</li> <li>5. Michael McLaughlin, Oracle Database 11g PL/SQL Programming (Oracle Press) 1<sup>st</sup> Edition, McGraw-Hill Education, 2008, ISBN: 0071494456</li> </ol>

<b>Title</b>	<b>Data Structures and Algorithms</b>
<b>Code</b>	<b>CMP-410</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	CMP-342: Object Oriented Programming
<b>Co-Requisite</b>	None
<b>Follow-up</b>	CMP-412: Analysis of Algorithms
<b>Course Description</b>	<p><b>Topics:</b> Introduction: Introduction to Course, Review of Object Oriented Programming Concepts. Algorithm Specification: Properties of Algorithm, examples, performance, analysis, measurement, and Big Oh notation. Introduction to ADTs: Array and Polynomial as an ADT, Sparse Matrices, and Representation of Arrays, The Stack ADT, Expressions, Postfix Notation, and Infix to postfix conversion. Recursion: Recursive Definition and Processes, Writing Recursive Programs. Queue: The Queue ADT, Circular and Double Ended Queue. Self-Referencing Classes and Dynamic Memory Allocation. Linked List: Singly Linked Lists, Circular Lists, Linked Stacks and Queues (Double Ended List), Doubly Linked Lists. Trees: Introduction to Trees, Logical construction and Traversing of Binary Trees, Implementation of Binary Trees (Insertion and Traversing), Searching and deletion in Binary Trees, Binary Search Tree, Introduction to Balanced and AVL Trees. Heaps: Heaps and Heaps as Priority Queues, Double Ended Priority Queue. Searching: Linear Search, Binary Search, and Types of Indexing. Hashing: Hash Functions: Division; Overflow Handling: Chaining; Introduction to other advanced topics like:, B-Trees, Generalized List, etc. Sorting types and Techniques: Logical and Algorithmic Implementation of Selection, Bubble, Insertion, Shell, Radix, Merge, Quick, Heap, and Tree sorts. Graphs: Graph terminology, Adjacency List and Adjacency Matrix and Adjacency list representation of Graph; Elementary Graph Operations: Breadth First Search and Depth First Search, Spanning Trees (BFSST, DFSST).</p>
<b>Text Book(s)</b>	<ol style="list-style-type: none"> <li>1. Ellis Horowitz, Sartaj Sahni, D. Mehta, Fundamentals of Data Structures in C++, 2<sup>nd</sup> Ed., Computer Science Press, 1995. ISBN 81-7808-792-8</li> <li>2. Adam B. Drozdek, Data Structure and Algorithm in C++, 4<sup>th</sup> Ed., Cengage Learning, ISBN 978-1133608424</li> </ol>
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. D. Samanta, Classic Data Structures, Prentice Hall, 2001, ISBN: 812033731X.</li> <li>2. Mark Allen Weiss, Data Structure and Algorithms in C++, 2<sup>nd</sup> Ed., Pearson Education, ISBN 81-7758-943-1.</li> <li>3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, 2<sup>nd</sup> Ed, MIT Press, 2001, ISBN 0-07-013151-1.</li> <li>4. Reference from different books enlisted in reference material will be given as required or lecture notes for reading will be provided.</li> </ol>



<b>Title</b>	<b>Data Structures and Algorithms Lab</b>
<b>Code</b>	<b>CMP-411</b>
<b>Credit Hours</b>	1
<b>Category</b>	Computing
<b>Prerequisite</b>	CMP-342: Object Oriented Programming
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Implementation of the concepts studied in "CMP210-Data Structures and Algorithms"</p> <p>Performance Analysis/Measurement</p> <p>Sparse Matrices</p> <p>N-Dimensional Arrays</p> <p>Stack ADT, Expressions Evaluation</p> <p>Recursion: Backtracking</p> <p>Queue: Double Ended Queue.</p> <p>Self-Referencing Classes and Dynamic Memory Allocation.</p> <p>Linked List: Singly Linked Lists, Circular Lists, Linked Stacks and Queues (Double Ended List),</p> <p>Doubly Linked Lists.</p> <p>Trees: Binary Trees</p> <p>Binary Search Tree</p> <p>Introduction to Height Balanced and AVL Trees.</p> <p>Heaps and Heaps as Priority Queues, Double Ended Priority Queue.</p> <p>Searching: Linear Search, Binary Search, and Types of Indexing.</p> <p>Hashing: Hash Functions, Collision Resolution: Open Hashing, Chaining</p> <p>Sorting types and Techniques: Logical and Algorithmic Implementation of Selection, Bubble, Insertion, Shell, Radix, Merge, Quick, Heap Sort</p> <p>Graphs: Graph terminology, Adjacency List and Adjacency Matrix and Adjacency list representation of Graph; Elementary Graph Operations: Breadth First Search and Depth First Search, Spanning Trees (BFSST, DFSST).</p>
<b>Text Book(s)</b>	
<b>Reference Material</b>	

<b>Title</b>	<b>Operating Systems</b>
<b>Code</b>	<b>CMP-421</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	Operating systems basics, system calls, process concept and scheduling, inter-process communication, multithreaded programming, multithreading models, threading issues, process scheduling algorithms, thread scheduling, multiple-processor scheduling, synchronization, critical section, synchronization hardware, synchronization problems, deadlocks, detecting and recovering from deadlocks, memory management, swapping, contiguous memory allocation, segmentation & paging, virtual memory management, demand paging, thrashing, memory-mapped files, file systems, file concept, directory and disk structure, directory implementation, free space management, disk structure and scheduling, swap space management, system protection, virtual machines, operating system security
<b>Text Book(s)</b>	A. Silberschatz, P. B. Galvin, G. Gagne, Operating Systems Concepts, 9 <sup>th</sup> Edition, Wiley, 2012, ISBN: 1118063333.
<b>Reference Material</b>	Andrew S. Tanenbaum, Herbert Bos, Modern Operating Systems, 4 <sup>th</sup> Edition, Pearson, 2014, ISBN: 013359162X. William Stallings, Operating Systems: Internals and Design Principles, 9 <sup>th</sup> Edition, Pearson, 2017, ISBN: 0134670957.

<b>Title</b>	<b>Enterprise Application Development</b>
<b>Code</b>	<b>CMP-442</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Introduction to Course, Overview of Enterprise Application Development, Microsoft technology history, Intro to .net and its architecture, Concept of MSIL, CLR, CLS, CTS, .NET Managed and Unmanaged Code, .Net Assembly, Introduction to C# fundamentals, Boxing and Un-Boxing, Implementing multi-tier architecture, Introduction to ADO.Net, Sql Injection, parameterized queries, Usage of Data Set, Data Adapter and Command Builder in disconnected Model, Delegate, Multicast delegates, introduction to windows forms, Html, Introduction to java script, data types, variables, functions, Debugging js using Firebug, Introduction to the Browser's Object (BOM), Document Object Model, Introduction to JQuery, JQuery Effects, Introducing LINQ, LINQ to Objects, LINQ to Sql, Query Syntax, Projection, Filtering and Join In Linq Queries, Introduction to ADO.NET Entity Framework, The Entity Data Model, CSDL, Eager vs Lazy Loading, POCO Classes, DbContext API, Querying Entity Data Models, Introduction to ASP.NET MVC, MVC Application Structure, Controllers overview, Action Methods, parameterized action methods, Introduction to Razor Syntax, Code Expressions, , Code Blocks, Implicit Vs Explicit Code Expression, Data Annotations, Client + Server Side Validation, Validation and Model Binding, Validation and Model State, MVC Membership, Authorization and Security, Introduction to Service Oriented Architecture, SOAP, WSDL, Service Contract, Data Contract, XML, WCF Bindings, ABC of WCF, Restful Services, Consuming rest services (CRUD operations) using JQuery AJAX and JSON, Introduction to Web API, Example of Web API using CRUD Example, MVC Routing.</p>
<b>Text Book(s)</b>	<ol style="list-style-type: none"> <li>1. Herbert Schildt, C# 4.0 The Complete Reference, McGraw-Hill, 2010, ISBN: 007174116X.</li> <li>2. A. Freeman, S. Sanderson, Pro ASP.NET MVC 4, 4<sup>th</sup> Edition, Apress, 2012, ISBN: 1430242361.</li> </ol>
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Julia Lerman, Programming Entity Framework, 2<sup>nd</sup> Edition, O'Reilly, 2010, ISBN: 0596807260.</li> <li>2. Fabrice Marguerie, Steve Eichert, Jim Wooley, LINQ in Action, Manning Publications, 2008, ISBN: 1933988169.</li> <li>3. Jeremy McPeak, Beginning JavaScript, 5<sup>th</sup> Edition, Wiley, 2015, ISBN: 978-1-118-90333-9.</li> <li>4. Pablo Cibraro, Kurt Claey's, Fabio Cozzolino, Johann Grabner, Professional WCF 4: Windows Communication Foundation with .NET 4, Wiley, 2010, ISBN: 978-0-470-56314-4.</li> <li>5. Handouts and Internet references</li> </ol>

<b>Title</b>	<b>Artificial Intelligence</b>
<b>Code</b>	<b>CMP-460</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Introduction: What's AI, types of problems addressed, Symbolic AI: the physical symbol system hypothesis, Search: exhaustive &amp; heuristic search techniques. Logic programming: knowledge representation &amp; search in the context of logic programming, reasoning in logic programming: unification, horn clause logic, and resolution, Prolog as example logic programming formalism, Knowledge Representation Schemas: Logic, frames, semantic nets, scripts; problems in knowledge representation. Expert systems. Selected Topics in AI: Game playing, Genetic algorithms, Introduction to Machine Learning for AI, Decision Trees, Bayesian classification, Artificial Neural Networks, Computer Vision, Natural language processing</p>
<b>Text Book(s)</b>	George F. Luger, Artificial Intelligence - Structures and Strategies for Complex Problem Solving, 6 <sup>th</sup> Edition, Pearson, 2008, ISBN-13: 978-0321545893
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3<sup>rd</sup> Edition, Pearson, 2009, ISBN-13: 978-0136042594</li> <li>2. Ivan Bratko, Prolog: Programming for Artificial Intelligence, 4<sup>th</sup> Edition, Pearson, 2011, ISBN-13: 978-0321417466</li> <li>3. P. Winston, Artificial Intelligence, 3<sup>rd</sup> Edition, Pearson, 1992, ISBN-13: 978-0201533774</li> </ol>

<b>Title</b>	<b>Database Administration</b>
<b>Code</b>	<b>CS-473</b>
<b>Credit Hours</b>	3
<b>Category</b>	CS Technical Elective
<b>Prerequisite</b>	CMP-370: Database Systems
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	Introduction to advance data models such as object relational, object oriented. File organizations concepts, Transactional processing and Concurrency control techniques, Recovery techniques, Query processing and optimization, Database Programming, Integrity and security, Database Administration, Physical database design and tuning, Distributed database systems, Emerging research trends in database systems.
<b>Text Book(s)</b>	Ramez Elmasri, Shamkant Navathe, Fundamentals of Database Systems, 6 <sup>th</sup> Edition, Addison Wesley, 2010, ISBN: 0136086209.
<b>Reference Material</b>	Henry F. Korth, Abraham Silberschatz, Database System Concepts, 6 <sup>th</sup> Edition, McGraw Hill, 2010, ISBN: 0073523321.

<b>Title</b>	<b>Object Oriented Analysis and Design</b>
<b>Code</b>	<b>CMP-492</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow Up</b>	None
<b>Course Description</b>	<p><b>Object Oriented Analysis and Design Basics.</b> Introduction to UML, UML Diagrams. Use Case Modeling, Rational Rose overview, Use case modeling in Rational Rose. Introduction of Interaction Diagrams, System Sequence Diagram; <b>Domain Model:</b> Identifying business classes, Domain Model Associations, Domain Model Attributes, Implementation of Sequence Diagram and Domain model in Rational Rose; <b>Interaction Diagram:</b> Sequence diagrams, Collaboration Diagrams, Implementation of Sequence and Collaboration diagrams in Rational Rose; <b>Design Class Diagram,</b> Mapping Design to Code. <b>Object Oriented software engineering:</b> Introduction to design patterns, GRASP, Information Expert, Creator, GRASP: Cohesion, Coupling, Controller, Introduction to Design Class Diagram, Mapping data model to Domain model, Mapping Design to Code.</p>
<b>Text Book(s)</b>	Grady Booch, James Rumbaugh, Ivar Jacobson, The Unified Modeling Language User Guide, 2nd Edition, Addison-Wesley, 2005, ISBN-13: 978-0321267979.
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. Simon Bennett, Ray Farmer, Object-Oriented Systems Analysis and Design Using UML, 4th Edition, McGraw-Hill Education, 2010, ISBN: 0077125363</li> <li>2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Grady Booch, Design Patterns: Elements of Reusable Object-Oriented Software 1st Edition, Addison-Wesley Professional, 1994, ISBN-10: 0201633612</li> </ol>

<b>Course Title</b>	<b>Analysis of Algorithms</b>
<b>Course Code</b>	<b>CMP-412</b>
<b>Credit Hours</b>	3
<b>Category</b>	Computing
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	CMP-410: Data Structures and Algorithms
<b>Follow Up</b>	None
<b>Syllabus</b>	<b>Topics:</b> Role of Algorithm in Computing, Analyzing Algorithms, Designing Algorithms, Growth of Functions, Asymptotic Notations, Sorting Algorithms, Time Complexity of Recursive Algorithms, Dynamic Programming, Greedy Algorithms, String Matching, Graphs, DFS, BFS, Minimum Spanning Trees, Shortest Path Algorithms, NP Completeness, Polynomial Time Algorithm, Polynomial Time verification.
<b>Text Book(s)</b>	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, 3 <sup>rd</sup> Edition, The MIT Press, 2009, ISBN-10: 0262033844, ISBN-13: 978-0262033848

<b>Title</b>	<b>Mobile Computing</b>
<b>Code</b>	<b>CS-435</b>
<b>Credit Hours</b>	3
<b>Category</b>	CS Technical Elective
<b>Prerequisite</b>	None
<b>Co-Requisite</b>	None
<b>Follow-up</b>	None
<b>Course Description</b>	<p><b>Topics:</b> Activities, Intents, Service, Content Provider, Broadcast Receiver, Views, Location Based Apps, Sensors, SQLite, Persistent data storage, Compass, GPS: Introduction to the Mobile Computing Domain, Comparison of different Mobile Platforms, Revision of Java, Intro to Android Platform, Dalvik Virtual Machine, Android Constructs (Activity, Intent, Content Provider, Service, Broadcast Receiver), Activity Lifecycle, Project Structure, Manifest File, Emulators (AVD), Debugging (DDMS), R.java, Inter Activity Communication(Intent), Event Handlers, Layout XML, @ Sign, Layouts, Adapters, Dynamic Lists, Holder Pattern, Menus and dialogs, Menu, Menu Group, Menu Item, Icon Menu, Sub Menu, Context Menu, Sub Menu, Dynamic Menu, Using XML Files for Menus, Services, Intents, Data Storage: Key Value Sets, Files; Intro to SQLite, Web Service Integration, JSON, HTTPClient, Graphics, Widgets &amp; Notifications, Multimedia and telephony API, Android Native Development Kit (NDK).</p>
<b>Text Book(s)</b>	<ol style="list-style-type: none"> <li>1. Mark L. Murphy, Beginning Android 2, Apress, ISBN 978-1-4302-2629-1</li> <li>2. Zigurd Mednieks, Laird Dornin, G. Blake Meike, and Masumi Nakamura Programming Android, 2<sup>nd</sup> Edition, O Reilly Press, ISBN: 978-1-449-31664-8</li> <li>3. Syed Hashmi, Satya Komatineni, Dave Maclean, Pro Android 2, Apress, ISBN 978-1-4302-2659-8</li> </ol>
<b>Reference Material</b>	<ol style="list-style-type: none"> <li>1. <a href="http://developer.android.com/develop/index.html">http://developer.android.com/develop/index.html</a></li> <li>2. <a href="http://developer.android.com/guide/components/services.html">http://developer.android.com/guide/components/services.html</a></li> <li>3. <a href="http://developer.android.com/guide/components/intents-filters.html">http://developer.android.com/guide/components/intents-filters.html</a></li> <li>4. <a href="http://developer.android.com/guide/topics/data/data-storage.html">http://developer.android.com/guide/topics/data/data-storage.html</a></li> <li>5. <a href="http://developer.android.com/guide/topics/graphics/index.html">http://developer.android.com/guide/topics/graphics/index.html</a></li> <li>6. <a href="http://developer.android.com/guide/topics/sensors/index.html">http://developer.android.com/guide/topics/sensors/index.html</a></li> <li>7. Handouts.</li> </ol>



<b>Title</b>	<b>Software Quality Assurance</b>
<b>Code</b>	<b>CS-474</b>
<b>Credit Hours</b>	3
<b>Category</b>	CS Technical Elective
<b>Prerequisite</b>	CMP-390: Software Engineering
<b>Co-Requisite</b>	None
<b>Follow Up</b>	None
<b>Course Description</b>	<b>Topics:</b> Introduction to Software Quality Assurance; Software Quality in Business Context; QA, QC and QE; Product Quality and Process Quality; Software Quality Measurement and Metrics; Personal Software Process; Walkthroughs and Inspections; Software Configuration Management; Quality System Documentation; Software Testing Techniques; Software Testing Strategies; Automated Testing; Capability Maturity Model; CMM-Integration, People-CMM; ISO; Six Sigma; Testing Tools, Trends and Perspectives.
<b>Text Book/s</b>	Daniel Galin, Software Quality Assurance From theory to implementation, 1 <sup>st</sup> Edition, Pearson, 2003, ISBN: 0201709457.
<b>Reference</b>	Roger S. Pressman, B. Maxim, Software Engineering: A Practitioners Approach, 8 <sup>th</sup> Edition, McGraw-Hill, 2014, ISBN: 0078022126.

## Template for Curricula/Syllabi of Degree Program

**Program Title:** MSc Information Technology  
**Department:** Punjab University College of Information  
Technology (PUCIT)  
**Faculty:** Faculty of Science

1. **Department Mission:** Our mission is to rigorously train our students in IT and affiliated fields, so that they can serve humanity with skill, knowledge and high character, and be a source of pride to the nation of Pakistan.
2. **Introduction:** Information Technology has been a key player in digitizing our lives. From daily routine jobs to the most sophisticated financial applications, information technology provides the necessary enabling environment. Information technology infrastructure in an organization is as important as its other physical infrastructure and human resource. PUCIT provides state-of-the-art training to its students so that they are considered competitive both in national and international markets.
3. **Program Introduction:** The Information Technology program at the PUCIT has been designed in accordance with the guidelines provided by the Higher Education Commission (HEC)/National Computing Education Accreditation Council (NCEAC). With the cutting-edge training imparted to the PUCIT students, the curriculum prepares PUCIT students not only for higher education but also for self-initiated ventures that may translate into successful startups.

#### 4. Program Objectives

The objectives of the MSc Information Technology program are to

1. Cultivate skills that cater to organizational needs, such as system maintenance, management of data, and secure access.
2. Hone the skills that facilitate learning and integrating new tools and technologies.

3. Nurture software development and problem-solving skills, clarity of thought, and creativity.
4. Build a strong foundation in theoretical concepts in computing and software engineering.
5. Prepare students for rigors of graduate studies, as well as for careers in the industry.
6. Provide a balanced exposure to liberal arts.
7. Prepare students for effective oral and technical communication.
8. Foster a sense of professional and ethical responsibilities.

## 5. Market Need / Rationale of the Program

**Note:** *Since it is just a revision of already approved curriculum of MSc Information Technology program, hence Market Need / Rationale of the Program is not required.*

The proposal for new program should include a market survey to address the need for introducing the program.

Program need assessment may include feedback from multiple sources such as:

- a) **Potential Students for the program.** (Career needs, subject interest etc.)
- b) **Potential Employers** (Public, private, NGOs, required skill set, industry projections, employment opportunities/estimated market demand/Number of job openings, Current and future prospects)
- c) **Academic Projections** (The national/ international universities that have launched the similar program)
- d) **Faculty** (Faculty credentials, capacity, resources sufficiency etc.)
- e) **Physical Facilities** (Lab and library facilities etc.)

## 6. Admission Eligibility Criteria

- Years of Study completed: 14 Years
- Study Program/Subject: B.Com / BA / B.Sc with Elective Mathematics Computer Science or Statistics or equivalent.
- Percentage/CGPA: Academic Record 70%
- Entry Test (if applicable) with minimum requirement: There is no compulsory entry test requirement. However, owing to large number of applicants PUCIT conducts an entry test to select students as per number of available seats.

- Any other (if applicable): Hafiz-e-Quran: 20 Marks

## 7. Duration of the Program

4 Semesters, 2 Years, 72 Credit hours

## 8. Categorization of Courses as per HEC Recommendation and Difference

*Note: Basics courses represent Math and Science Foundation course as per HEC/NCEAC approved curriculum.*

Semester	Courses	Category(Credit Hours)					Semester Load
		Core Courses (Computing)	Basic Courses (English)	Major Electives (Tech. Elective)	Minor Electives	Any Other	
1	7	16	3	0			19
2	7	13	3	3			19
3	7	13	0	6			19
4	4	9	0	6			15
PU	25	51	6	15			72
HEC Guidelines	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Difference (HEC &) PU	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

*\*Core: Compulsory, Basic: Foundation, Major Electives: Professional Minor Electives: Specialization*

*Note: The course/column heads are customizable according to nature and level of the program.*

## 9. Scheme of Studies / Semester-wise workload

#	Code	Course Title	Course Type	Prerequisite	Credit hours
<b>Semester I</b>					
1.	CMP-300	Introduction to Computing	Computing		3
2.	CMP-301	Discrete Mathematics	Computing		3
3.	EN-301	Writing Workshop	English		3
4.	CMP-320	Digital Logic Design	Computing		3
5.	CMP-330	Data Communication and Computer Networks	Computing		3
6.	CMP-340	Programming Fundamentals	Computing		3
7.	CMP-341	Programming Fundamentals Lab	Computing		1
<b>Total Credit Hours: 19</b>					
<b>Semester II</b>					
1.	EN-302	Business and Technical Communication	English	Writing Workshop	3
2.	CMP-311	Theory of Automata and Formal Languages	Computing		3
3.	CMP-342	Object Oriented Programming	Computing	Programming Fundamentals	3
4.	CMP-343	Object Oriented Programming Lab	Computing	Programming Fundamentals	1
5.	CMP-370	Database Systems	Computing		3
6.	CMP-390	Software Engineering	Computing		3
7.	CMP-392	Project Management	Tech. Elec.		3
<b>Total Credit Hours: 19</b>					
<b>Semester III</b>					
1.	CMP-410	Data Structures and Algorithms	Computing	Object Oriented Programming	3
2.	CMP-411	Data Structures and Algorithms Lab	Computing	Object Oriented Programming	1
3.	CMP-421	Operating Systems	Computing		3
4.	CMP-442	Enterprise Application Development	Tech. Elec.		3
5.	CMP-460	Artificial Intelligence	Computing		3
6.	CS-474	Software Quality Assurance	Tech. Elec.		3
7.	CMP-492	Object Oriented Analysis and Design	Computing		3
<b>Total Credit Hours: 19</b>					
<b>Semester IV</b>					
1.	CMP-412	Analysis of Algorithms	Computing	Data Structures and Algorithms	3
2.	CS-435	Mobile Computing	Tech. Elec.		3

3.	CS-494	Cloud Computing	Tech. Elec.		3
4.	CMP-491	Capstone Project I and II	Computing		6
<b>Total Credit Hours: 15</b>					

1. Type of course may be core (compulsory), basic (foundation), major elective (professional), minor elective (specialization) etc.

### **Research Thesis / Project /Internship**

Capstone Project I & II (6 credit hours, IV semester)

## **10. Award of Degree**

Degree awarding criteria stating:

CGPA percentage required to Qualify: 2.0

Thesis /Project/Internship: Capstone Project Required

Any other requirement, e.g. Comprehensive examination (if applicable)

## **11. NOC from Professional Councils (if applicable)**

**Not applicable**

## **12. Faculty Strength**

Degree	Area/Specialization	Total
PhD	1. Computing: 25 2. Mathematics: 3 3. Physics: 1	29
MS/MPhil	1. Computing: 24 2. Mathematics: 1 3. Physics: 1 4. English: 1	27
<b>Total</b>		<b>56</b>

## **13. Present Student Teacher Ratio in the Department**

Total Number of Students: 2,500

Total fulltime permanent faculty: 66

Total fulltime permanent faculty on duty: 56

Student Teacher ratio:  $2500 / 56 = 44.64$

**14. Course Outlines separately for each course.** The course outline has following elements:

- Basic Information. Title and Code Number, Semester, and Credit Hours
- Pre-requisites course requirements/ skills
- Learning Outcomes
- Contents
- Teaching-learning Strategies
- Assignments- Types and Number with calendar
- Assessment and Examinations:

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

- Textbooks. In the detail course outline, one may mention chapters of the textbook with the content topics
- Suggested Readings
  - Books
  - Journal Articles/ Reports

Note:

1. It is preferable to use latest available editions of books. Mention the publisher & year of publication.

2.The References/ bibliography may be in accordance with the typing manual of the concerned faculty/subject



## Checklist for a New Academic Program

### Parameters

- |   |   |
|---|---|
| 1. Department Mission and Introduction              | ✓ |
| 2. Program Introduction                             | ✓ |
| 3. Program Alignment with University Mission        | ✓ |
| 4. Program Objectives                               | ✓ |
| 5. Market Need/ Rationale                           | ✓ |
| 6. Admission Eligibility Criteria                   | ✓ |
| 7. Duration of the Program                          | ✓ |
| 8. Assessment Criteria                              | ✓ |
| 9. Courses Categorization as per HEC Recommendation | ✓ |
| 10. Curriculum Difference                           | ✓ |
| 11. Study Scheme / Semester-wise Workload           | ✓ |
| 12. Award of Degree                                 | ✓ |
| 13. Faculty Strength                                | ✓ |
| 14. NOC from Professional Councils (if applicable)  | ✓ |

---

**Program Coordinator**

---

**Chairperson**