

**M.Sc. Integrated (Computer Science/Data Science/ Decision Science/Economics)**  
Programme Structure

Semester I	Credits	Semester II	Credits
IMC 101: Management Concepts and Organisational Behaviour	4	IMC 201: Business Analytics	2
IMC 102: Environmental Studies	4	IMC 202: Microeconomics	4
IMC 103: Probability and Statistics - I	4	IMC 203: Linear Algebra	4
IMC 104: Programming in Python	6	IMC 204: Algorithms and Data Structures	6
IMC 105: Soft Skills - I	2	IMC 205: Probability and Statistics - II	4
IMC 106: Perspective Building Course - I	2	IMC 206: Soft Skills -II	2
	22		22
Semester III	Credits	Semester IV	Credits
IMC 301: Marketing Analysis	4	Machine Learning	6
IMC 302: Deductive and Inferential Mathematics	4	Data Modeling and Visualization	4
IMC 303: Macroeconomics	4	Linear Programming & Optimization	4
IMC 304: Database Management Systems	6	Econometrics - I	4
IMC 305: Soft Skills - III	2	Soft Skills - IV	2
IMC 306: Perspective Building Course - II	2	Perspective Building Course - III	2
	22		22
Semester V	Credits	Semester VI *	Credits
Computer Organization & Operating Systems	6	Domain	12
Programming in C	6	Electives	14
Data Science Toolkit	4		
Strategic Management	4		
Econometrics - II	4		
Perspective Building course - IV	2		
	26		26
Semester VII	Credits	Semester VIII	Credits
Discipline	24	Discipline	24
Semester IX *	Credits	Semester X	Credits
Discipline	16	Project/Dissertation/Optionals	16

Total Credits (5 years) =  
220

\* semester includes an audited internship .

**Course Code: IMC 101**

**Title of the Course: Management Concepts and Organisational Behaviour**

**Number of Credits: 4**

**Total Contact Hours: 48**

**Effective from AY: 2020-21**

<b><u>Prerequisites for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objective:</u></b>	At the end of the course, the student should have the ability to understand managerial processes and have the competence to deal with people at work-place	
<b><u>Content:</u></b>	<p>Management Science: basic concepts and its role in decision making: Planning, organizing, staffing, leading and controlling.</p> <p>Organization Structure and Design: Role in Individual and Interpersonal behavior at work-place</p> <p>Introduction to Determinants of Individual Behaviour: Perception, Personality, Attitudes, , learning, Self-Concepts ; Theories/ Models for understanding these determinants</p> <p>Fundamentals of Interpersonal Behaviour: Group Dynamics, Tools for Interpersonal Analysis, Fundamentals of Leadership and Motivation and their application, Theories/ Models/ Styles</p> <p>Organizational Change and Development; Models of Change; Organizational Climate and Culture; Conflict, and Negotiations. Power and Politics in Organization.</p>	<p><u>8 Hours</u></p> <p><u>4 Hours</u></p> <p><u>15 Hours</u></p> <p><u>15 Hours</u></p> <p><u>6 Hours</u></p>
<b><u>Pedagogy:</u></b>	Lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study/ Case Studies etc. or a combination of some of these. Sessions shall be interactive in nature to	

	enable peer group learning.	
<b><u>Learning Outcomes</u></b>	The participant will be able to understand people's behavior at work-place, and take managerial decisions	
<b><u>References/Readings</u></b>	<ol style="list-style-type: none"> <li>1. Wehrich, Heinz and Harold Koontz; 'Essentials of Management: An International Perspective'; McGraw-Hill, Inc.; 10<sup>th</sup> edition, 2015</li> <li>2. Robbins, Stephen and Mary Coulter; 'Fundamentals of Management'; Prentice Hall of India Pvt. Ltd.; New Delhi; 9<sup>th</sup> edition, 2018</li> <li>3. Luthans, Fred; 'Organizational Behavior'; McGraw-Hill, Inc, 12<sup>th</sup> edition, 2017</li> <li>4. Robbins, Stephen P; 'Essentials of Organizational Behavior'; Pearson Education India, 18<sup>th</sup> edition, 2018.</li> </ol>	

**Course Code: IMC 102**

**Title of the Course: Environmental Studies (as approved for other programmes)**

**Number of Credits: 4**

**Total Contact Hours: 48**

**Effective from AY: 2020-21**

Course Code: IMC 103

Title of the Course: Probability and Statistics - I

Number of Credits: 4

Total Contact Hours: 48

Effective from AY: 2020-21

<b><u>Prerequisites for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objectives:</u></b>	This course aims to introduce the basic concepts of probability theory	
<b><u>Content:</u></b>	<b>Module</b> <b>1:</b> Experiments and sample spaces, events, algebra of events, probability axioms, conditional probability, independence of events, mutually exclusive events. Bayes theorem. <b>2:</b> One dimensional random variable: discrete and continuous random variable, characteristics of distributions, cumulative distribution function, functions of one random variable. <b>3:</b> Two dimensional random variable: marginal and conditional distributions, conditional expectation independence. <b>4:</b> Covariance and correlation. Understanding linkages, visualizing <b>5.</b> Discrete distributions: Bernoulli, Binomial, Poisson	12 Hours 12 Hours 12 Hours 5 Hours 7 Hours
<b><u>Pedagogy:</u></b>	Lectures/ tutorials/assignments/self-study	
<b><u>References/Readings</u></b>	1. William W. Hines and Douglas C. Montgomery, Probability and Statistics in Engineering and Management Science, Wiley India Pvt. Ltd., 2003 2. T.Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill Pub. Co. Ltd., 2009	
<b><u>Learning Outcomes</u></b>	Upon successful completion of this course, students will have a good understanding of elementary probability	

**Course Code: IMC 104**

**Title of the Course: Programming in Python**

**Number of Credits: 6**

**Total Contact Hours: 48L+48P**

**Effective from AY: 2020-21**

<b><u>Prerequisite s for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objectives:</u></b>	The aim of the course is to provide an exposure to solve common computing problems through programming using Python language. The course is designed with a lab component to give the student hands-on experience of the basic concepts of programming.	
<b><u>Content:</u></b>	<p>Introduction to computer systems and data representation: Functional units of a Computer, Characteristics of a Computer, Data representation and Storage, Evolution of Programming Languages, Compilation and Interpretation, Structured and Procedural Programming languages (3 hours)</p> <p>The Problem Solving Process: – Requirement Analysis, Algorithmic Construction, Identifying Test Cases, Desk Checking, Implementation, Testing and maintenance issues, Data verification and validation. (4 hours)</p> <p>Python Programming Environment: Python overview, Structure of Python program, character Set, variable declarations and data types, Program Statements, Types of Instructions, Expression Evaluation rules, Type Conversions. Managing I/O operations (4 hours)</p> <p>Selection and Iterative Constructs :Writing conditions, IF-ELSE constructs Conditional operators, SWITCH ,WHILE and FOR loops, Use of BREAK and CONTINUE statements. Nested Loops (9 hours)</p> <p>Advance Data types: Lists, Tuples, Set, Dictionaries, Strings, Unicode, formatting strings, docString. Searching and sorting algorithms without using library functions. (6 hours)</p> <p>Modular Programming: Importance of User Defined Functions, Hierarchy charts, fan-in/out, cohesion and coupling and loosely coupled modules. Fan-in – Fan-out concepts. (5 hours)</p>	

	<p>User Defined Functions: Local and Global Variables, Scoping Rules, Parameters &amp; arguments. Function with variable arguments. Modules, packages, scope. Recursion &amp; Recursive Functions. Recursive v/s Iterative Functions.</p> <p>Custom Data Types and File Management: Object of a Class and basic concept of classes &amp; OOP, Files, Exceptions in file handling.</p> <p>Introduction to Packages: Python packages for plotting, mathematical computation &amp; linear regression.</p>	<p>(7 hours)</p> <p>(4 hours)</p> <p>(6 hours)</p>
<b><u>Pedagogy:</u></b>	Lectures/Practical/ tutorials/assignments/self-study.	
<b><u>References/ Readings</u></b>	<ol style="list-style-type: none"> <li>1. Taneja Sheetal, Kumar Naveen , —Python Programming - A modular approach, Pearson 2017</li> <li>2. Guttag John V., —Introduction to Computation and Programming using Python, MIT Press, 2nd Edition 2016.</li> <li>3. Maureen Sprankle, Jim Hubbard — Problem Solving and Programming Concepts, Pearson, 9th Edition 2012</li> </ol>	
<b><u>Learning Outcomes</u></b>	<p>Upon successful completion of the course, a student will be able to:</p> <ul style="list-style-type: none"> <li>● Analyze a given problem and develop a Python program to solve it.</li> <li>● Identify test cases for a given problem.</li> <li>● Understand, test, trace programs written in Python language.</li> <li>● Working with python Standard Libraries</li> </ul>	

#### Suggested Lab Assignments:

Introduction to UNIX environment- Introduction to Fedora/Ubuntu, Basic directory and file handling commands, Editor (vi editor), man pages, installation of Python and Jupyter notebook.

Programs using decision control, branch and loop control structure

1. Program to find the largest of three numbers
2. Program to print the reverse of a given number.
3. Program to check whether a given number is Armstrong or not
4. Program to print the prime numbers from 2 to n, where n is an input given by the user.
5. Program to print the patterns.

Programs using List, Set, Tuple, Dictionary & Strings

6. Program to find the largest and smallest number in a list of integers (without using



library function).

7. Program to sort a given integer list in ascending order(without using library function).
8. Program to print the sum and average of the elements of the list(without using library function).
9. Program to find the duplicate elements in the list(without using library function).
10. Program to reverse a given string and check whether it is palindrome (without using library function).
11. Program to read a string and count the number of vowels in it.
12. Program to concatenate two strings without using library functions
13. Program to arrange the list of names in alphabetical order.
14. Program to find the union, intersection and difference between two sets.
15. Program to take a sentence as an input from the user and compute the frequency of each letter. Make use of dictionary type to maintain the count.

Programs using functions & Recursion.

16. Write functions for addition, subtraction and multiplication of two matrices. Each function has two matrices as parameters and returns the result.
17. Program to print the Fibonacci series using recursion.
18. Program to find the GCD of two numbers using recursion.
19. Program to solve Tower of Hanoi

Programs user-defined data types & file handling

20. Program to store the item number, name, rate and quantity of 'n' items in a custom data type, where n is given as input by the user. Display the total value inventory items.
21. Program to store employee details in a Custom data type. The data should include employee ID, name, salary, and date of joining. The date of joining should be stored in a structure. The program should perform the following operations based on a menu selection
  - a) Display the details of the employees who have more than 5 years of experience with the company.
  - b) Increase the salaries according to the pay scale rules
22. Program to create a custom data type of Student with fields Roll No, Name, course, and Total\_Marks. Read the data from the user and store them in a file. Write a function to display the Roll No, name of the student who has secured the highest marks.
23. Program to count the number of characters in a file.
24. Program to search for a particular word in a file.
25. Program to handle various file exceptions.
26. Program to implement linear regression method.
27. Program to plot graphs.

**Course Code: IMC 105**

**Title of the Course: Soft Skills : Oral Communication**

**Number of Credits: 2**

**Total Contact Hours: 24**

**Effective from AY: 2020-21**

<b><u>Prerequisites for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objective:</u></b>	To introduce the essentials of effective communication in different contexts	
<b><u>Content:</u></b>	Difference between formal and informal communication; Communication process, types, Effectiveness in communication – the Roles of Sender, Receiver and the medium; Role of culture in communication; Importance of Non Verbal Communication  Oral Communication: Skills required for effective interpersonal and group communication, Effective Public speaking. Noise in communication and its prevention. Barriers and Gateways in Communication;	12 Hours  12 Hours
<b><u>Pedagogy:</u></b>	Lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study/ Case Studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
<b><u>Learning Outcomes</u></b>	The participant will be able to facilitate interpersonal Communication, participate in group discussions, and to write effectively.	

<b><u>References/Readings</u></b>	<ol style="list-style-type: none"><li>1. Business and Professional Communication by Kelly M. Quintanilla and Shawn T. Wahl, 2018, Sage Publications</li><li>2. Effective Business Communication by Anjane Sethi ,Bhavna Adhikari, 2009; Tata MacGraw Hill Education, India.</li><li>3. How to be a Great Communicator in Person, On Paper, and on Podiumby Nido Qubein, 2008; Viva Books, India.</li></ol>	
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**Course Code: IMC 106**

**Title of the Course: Perspective Building: Film Appreciation**

**Number of Credits: 2**

**Total Contact Hours: 24**

**Effective from AY: 2020-21**

Prerequisites for the course	Same as programme pre-requisites	
<u>Objective:</u>	To help the participants appreciate cinema (national and international) as having its own distinct language and philosophy, the way it stimulates people, and helps in making sense of the world.	
<u>Content:</u>	<p><b>Approaches to Films</b></p> <p>Document, Documentary and Narratives; Thought Orientation in Films; Text, Context and Non-Text</p> <p><b>Film and Other Art Forms</b></p> <p>Photography and Representation; Symbolism and Metaphors; Music, Dance and Drama; Presenting Reality and Fiction</p> <p><b>Films and our Minds</b></p> <p>Films and Emotions; Imagination; Identifying the Audience (Spectatorship); Communication and Persuasion</p> <p><b>Films and Morality</b></p> <p>Lessons from Films; Authorship and Copyright; Film Criticism; Evils and Issues – Pornography, Free Will, Laws and Artistic License</p>	<p>7 Hours</p> <p>8 hours</p> <p>8 hours</p> <p>7 hours</p>
<u>Pedagogy:</u>	Lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study/ Case Studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	

<p><u>Learning Outcomes</u></p>	<p>After completion of the course, students will develop the ability to</p> <ol style="list-style-type: none"> <li>1. Appreciate films as works of art</li> <li>2. Recognize the impact of films on society</li> <li>3. Critique films</li> </ol>	
<p><u>References/Readings</u></p>	<ol style="list-style-type: none"> <li>1. Jim Piper (2014) The Film Appreciation Book, 1st Edition; Allworth Publishers, USA</li> <li>2. Satyajit Ray (2006) Speaking of Films, International Edition Penguin, India</li> <li>3. Gregory Currie (1995) Image and Mind, Film, Philosophy and Cognitive Science; Cambridge University Press.</li> </ol>	

**Course Code: IMC 201**

**Title of the Course: Business Analytics (Finance)**

**Number of Credits: 2**

**Total Contact Hours: 24**

**Effective from AY: 2020-21**

<b>Prerequisites for the course:</b>	Programme requisites	
<b>Objective:</b>	To introduce fundamentals of financial data analysis.	
<b>Content:</b>	Reading of Annual Report, Balance Sheet, Profit and Loss Account, Vertical Form, Cash Flow statements, Comparative statements, Common Size Statements, Profitability Ratios. Basic Accounting Standards. Directors' Report, Auditor's Report, Notes to Accounts.  Understanding Annual Reports of Companies with Ratio Analyses and making basic performance decisions.  Time Value of Money, Forecasting cash flows, Estimation of Project Cost, Techniques of Capital Budgeting, Net Present Value (NPV), Internal Rate of Return (IRR), Discounted Payback, profitability Index.	8 hours  8 hours  8 hours
<b>Pedagogy:</b>	Lectures/tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study/ Case Studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
<b>Learning Outcomes:</b>	<ol style="list-style-type: none"><li>1. The participants will be able to analyze financial information that facilitates long term and short term financial decisions.</li><li>2. The participants shall be able make primary basic assessment of making capital investment decisions.</li></ol>	
<b>References/Readings:</b>	<ol style="list-style-type: none"><li>1. N. Ramchandran, Ram Kumar Kakani: 'How to Read A Balance Sheet', Tata McGraw-Hill Professional: Finance Made Easy Series, 2009.</li><li>2. N. Ramchandran, Ram Kumar Kakani: 'How to Read A Profit and Loss Account', Tata McGraw-Hill Professional:</li></ol>	

	Finance Made Easy Series, 2017. 3. N. Ramchandran, Ram Kumar Kakani: 'How to Read A Cash Flow Statement', Tata McGraw-Hill Professional: Finance Made Easy Series, 2017.	
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Course Code: IMC 202

Title of the Course: Microeconomics

Number of Credits: 4

Total Contact Hours: 48

Effective from AY: 2020-21

<b>Prerequisites for the Course:</b>	Programme requisites	
<b>Objective:</b>	Equip the students to understand consumer and firm behavior under profit and non-profit maximizing framework.	
<b>Content:</b>	<p><b>Module 1: Introduction and Basic Concepts</b> Nature and scope of micro economics – concept of equilibrium – static, dynamic and neutral equilibrium – Partial Vs. General equilibrium – role and limitations of price mechanisms in a free market economy</p> <p><b>Module 2: Theory of Demand</b> Theory of Consumer Behavior- Utility, indifference curve, [income and substitution effects, Slutsky’s theorem, compensated demand]; Revealed preference; consumer surplus;</p> <p><b>Module 3: Theory of production and costs</b> Production function –short period and long period; law of variable proportions and returns to scale; Isoquants – least cost combination of inputs; Returns of factors; Economies of scale; Elasticity of substitution; Euler’s Theorem; Cobb-Douglas, Constant Elasticity of Substitution (CES), Variable Elasticity of Substitution (VES) and Translog. Cost functions, cost curves, Elasticity of supply.</p> <p><b>Module 4: price and output determination</b> Demand and supply equilibrium; Cobweb theorem. Market forms – perfect and imperfect forms – equilibrium under perfect, monopoly, monopolistic, duopoly and oligopoly – importance of time element in price theory – price discrimination and measure of monopoly power – control and regulation of monopoly.</p>	<p>10 hours</p> <p>14 hours</p> <p>14 hours</p> <p>10 hours</p>
<b>Pedagogy:</b>	Lectures/ tutorials/assignments/self-study	



<b>Reference/Readings:</b>	<ol style="list-style-type: none"><li data-bbox="480 201 1243 275">1. Hal Varian, W. W. Norton and Company, Intermediate Microeconomics 2010, Sixth Edition or later</li><li data-bbox="480 310 1243 432">2. S.A. Greenlaw and D. Shapiro, Principles of Microeconomics, OpenStax Resource, Rice University, Second edition, 2017</li></ol>	
<b>Learning Outcomes:</b>	Understand the factors that determine consumption and production decisions under different market structures.	

**Course Code: IMC 203**

**Title of the Course: Linear Algebra**

**Number of Credits: 4**

**Total Contact Hours: 48**

**Effective from AY: 2020-21**

<b>Prerequisites for the course:</b>	Programme requisites	
<b>Objectives:</b>	To provide students an introduction to vectors and matrices and their use in Data Sciences.	
<b>Content:</b>	Linear Equations in Linear Algebra: Systems of linear equations, row reduction, and echelon forms, Vector equations, matrix equation, solution sets of linear systems, linear independence, Matrix of linear transformation.	8 hours
	Matrix Algebra: characteristics of invertible matrices, Partitioned matrices, matrix factorizations, application to computer graphics, dimension and rank.	4 hours
	Determinants: Properties, Cramer's rule, volume and linear transformations.	4 hours
	Vector Spaces: vector spaces and subspaces, linear transformations, Bases, coordinate systems, Dimension of a vector space, rank, change of bases	8 hours
	Eigenvalues and eigenvectors: Characteristics equation, diagonalization, eigenvectors and linear transformations, discrete dynamical systems	8 hours
	Orthogonality: inner product, length, and orthogonality, orthogonal sets, orthogonal projections, Gram-Schmidt process, inner product spaces	8 hours
	Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms, constrained optimization, Singular Value Decomposition (SVD).	8 hours
<b>Pedagogy:</b>	Lectures/ tutorials/assignments/self-study	

<b>References/Readings:</b>	<ol style="list-style-type: none"> <li>1. David C. Lay, Steven Lay, Judi Mc Donald, Linear Algebra and its Applications, Pearson, 2016.</li> <li>2. Jim DeFranza and Daniel Gagliardi, Introduction to Linear Algebra with Application, McGraw Hill Education (India), 2015.</li> <li>3. Steven J. Leon, Linear Algebra with Applications 8th Edition, Pearson, 2009</li> <li>4. Gilbert Strang, Introduction to Linear Algebra 5th Ed. South Asian Edition, Wellesley-Cambridge Press, 2016.</li> </ol>	
<b>Learning Outcomes:</b>	The student will be able to use computational techniques and algebraic skills essential for the study of systems of linear equations to understand, formulate and solve problems.	

**Course Code: IMC 204**

**Title of the Course: Algorithms and Data Structures**

**Number of Credits: 6 (4L+2P)**

**Total Contact Hours: 48L + 48P**

**Effective from AY: 2020-21**

<b>Prerequisites for the course:</b>	IMC104 : Programming in Python	
<b>Objectives:</b>	To introduce the fundamental concepts of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.	
<b>Content:</b>	<p>Introduction: Three level Approach - Application/User level, Abstract/Logical level, Physical/Implementation level; Concept of Abstract Data Types (ADTs), Data Structure definition, Data type vs. data structure, Applications of data structures,</p> <p>Algorithms analysis and its complexity, Best case, worst case , and Average case performance, time-space tradeoff, Asymptotic Analysis, Big-O notation.</p> <p>Linear Data Structures: Array and its application: Polynomials, Sparse matrices, String-pattern Matching. Linked Lists, Doubly linked list, Circular linked list, Stack and Queues.</p> <p>Nonlinear Data Structures: Trees: Binary tree representation, Binary Search Trees, AVL Trees, M-way Search Trees, B-trees. B tree algorithms, Heap Structures; Graphs: Graph representations; Graph Traversals</p> <p>Complexity of Searching &amp; Sorting algorithms: Bubble sort, Quick sort, Selection sort, Insertion sort, Merge sort and Heap sort. An Empirical Comparison of Sorting Algorithms, Lower bounds for Sorting. Linear search, binary search.</p> <p>Dynamic programming and Greedy algorithms: Assembly line scheduling, Matrix-chain multiplication; Prim's Algorithm, Kruskal's Algorithm</p>	<p>4 hours</p> <p>4 hours</p> <p>10 hours</p> <p>12 hours</p> <p>12 hours</p> <p>6 hours</p>

<b>Pedagogy:</b>	lectures/Practical/ tutorials/assignments/self-study	
<b>References/Readings:</b>	<ol style="list-style-type: none"> <li>1. Horowitz, Ellis, Sartaj Sahni, and Susan Anderson-Freed. "Fundamentals of data structures in C". WH Freeman &amp; Co., Latest edition.</li> <li>2. Benjamin Baka, Basant Agarwal, "Hands on Data Structure and Algorithms with Python", Second Edition, O'Reilly, 2018.</li> <li>3. Cormen Thomas, L. Charles, R. Ronald, S. Clifford, "Introduction to Algorithms", Second Edition,EEE, PHI.</li> <li>4. Allen, Weiss Mark. "Data structures and algorithm analysis in C". Pearson Education India, 2011.</li> <li>5. Dasgupta, Papadimitriou, and Vazirani. "Algorithms". McGraw-Hill, 2006.</li> </ol>	
<b>Learning Outcomes:</b>	<p>Upon successful completion of the course, a student will be able to</p> <ul style="list-style-type: none"> <li>● Implement common data structures such as lists, stacks, queues, graphs, and binary trees for solving programming problems.</li> <li>● Identify and use appropriate data structures in the context of solution to a given problem.</li> </ul>	

### **Suggested Lab Assignments:**

Object-Oriented Design Goals, Object-Oriented Design Principles.

1. The programming assignment should introduce and enforce the concepts of encapsulation, polymorphism and Inheritance.

ADT Specifications and Implementation of following basic data structures

2. Singly Linked Linear Lists
3. Singly Linked Circular Lists
4. Doubly Linked Linear Lists
5. Doubly Linked circular Lists
6. Stack using linked list

## 7. Queue using linked list

### ADT Specifications and Implementation of following non-linear data structures

8. Binary Trees
9. Binary Search Trees
10. AVL Trees
11. B-Trees and its variants

### Application of stack

12. Program to convert the given infix expression to postfix expression using stack.
13. Program to evaluate a postfix expression using stack.
14. Program to traverse a binary tree in the following way: Pre-order, In-order, Post-order

### Applications of Binary Trees

15. Write a program to implement Huffman encoding using Binary tree.
16. Write a program to create a binary tree for the given infix expression.

### Applications of AVL Trees

17. Write a program that reads a list of names and telephone number from a text file and inserts them into an AVL tree. Write function to allow the user to search the tree.

### Searching and sorting

18. Program to implement Binary search technique using Iterative method and Recursive methods.
19. Programs to implement following sorting algorithm- Bubble sort, Selection sort, Insertion sort, Quicksort, Merge sort and Heap sort

### Implementation of Dynamic programming

20. Assembly line scheduling
21. Matrix-chain multiplication

### Implementation of Greedy algorithms

22. Prim's Algorithm
23. Kruskal's Algorithm

**Course Code: IMC 205**

**Title of the Course: Probability & Statistics - II**

**Number of Credits: 4**

**Total Contact Hours: 48**

**Effective from AY: 2020-21**

<b>Prerequisites for the course:</b>	IMC 103: Probability and Statistics - I	
<b>Objectives:</b>	To introduce the basic theory and techniques of parameter estimation and tests of hypotheses.	
<b>Content:</b>	<p><b>Module 1:</b> Continuous distributions: Uniform, exponential, normal, standard normal, T-distribution, Chi-Square and F-distribution</p> <p><b>Module 2:</b> Sampling distributions, Parameter Estimation of mean and proportion.</p> <p><b>Module 3:</b> Hypothesis tests about mean and proportion, Chi-square tests, analysis of variance, least squares curve fitting, the coefficient of Determination, Confidence Intervals</p> <p><b>Module 4:</b> Non parametric tests: sign test, Rank test, Median test</p>	12 hours 12 hours 12 hours 12 hours
<b>Pedagogy:</b>	Lectures/ tutorials/assignments/self-study	
<b>References/Readings:</b>	<ol style="list-style-type: none"><li>1. David M. Levine, David F. Stephan, Timothy C. Krehbiel, and Mark L. Berenson, Statistics for Managers: Using Microsoft Excel, Pearson Education, Inc., (2008) Fifth Edition or later</li><li>2. Christian Heumann, Michael Schomaker, and Shalabh, Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R, Springer, (2016).</li><li>3. James T. McClave, P. George Benson, Terry Sincich Statistics for Business and Economics, Perason, (2018).</li><li>4. Robert S. Witte and John S. Witte, Statistics, Wiley, Eleventh Editio, (2017).</li></ol>	
<b>Learning Outcomes:</b>	Students will be able to design samples for data collection, summarise data visually and in tabular form, and execute statistical analyses with spreadsheet software.	

Course Code: IMC 206

Title of the Course: Soft Skills: Written Communication

Number of Credits: 2

Total Contact Hours: 24

Effective from AY: 2020-21

<b>Prerequisites for the course:</b>	Programme requisites	
<b>Objective:</b>	To introduce the essentials of effective communication in different contexts	
<b>Content:</b>	<p>Written Communication: Fundamentals of effective writing; different forms of written communication; report writing; Structure and content of various types of reports; Creativity in Communication.</p> <p>Content Writing: Writing content for the website, Writing profiles. Writing content for brochures of events, Designing and writing for newsletters. Handling Public relations through Press release/reports/advertisements.</p> <p>E-Correspondence: Email etiquette (components, formats, attachments, content and language) , Maintaining social media presence.</p>	<p>10 hours</p> <p>8 hours</p> <p>6 hours</p>
<b>Pedagogy:</b>	Lectures/ tutorials/outreach activities/vocational training/ seminars/ term papers/assignments/ presentations/ self-study/ Case Studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
<b>Learning Outcomes:</b>	Students will be able to communicate effectively in various written forms.	
<b>References/Readings:</b>	<ol style="list-style-type: none"><li>1. Stanton, Nicky. Mastering Communication (5th Edition), Macmillan, 2009.</li><li>2. Dalmar, Fisher. Communication in Organisation, West Pub, 1993.</li><li>3. Kilian, Crawford. Writing for the Web. Self-Counsel Press, Fifth edition, 2015.</li><li>4. Kallos, Judith. Email Etiquette Made Easy, Lulu.com. 2007.</li></ol>	



Course Code: IMC 301

Title of the Course: Marketing Analysis

Number of Credits: 4

from AY: 2020-21

Total Contact Hours: 48Effective

<b><u>Prerequisites for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objective:</u></b>	At the end of the course, the students would have competence in understanding and using Marketing Frameworks, Theories and analytical tools for analysing and decision making in the area of Marketing.	
<b><u>Content:</u></b>	<p>Role of Marketing, Core Concepts of Needs, Wants and Demands, Marketing Orientation of Companies. Strategic Planning and Marketing Management Process. External Environment including Customers and Suppliers.</p> <p>Consumer Behaviour and Consumer markets, Theories of Consumption Behaviour, Buying Process and decision making process. Types of Buying behavior. Organisational Buying behavior, Industrial Market, Reseller Markets, Government Markets.</p> <p>Marketing Information Systems, concepts and components, Market Measurement and Forecasting techniques, Demand Estimation, Segmentation, Targeting and Positioning, Types of segmentation, Basis for Segmentation.</p> <p>Marketing Plan, Process and evaluation, New Product Development Process, Product Life Cycle concept, different strategies of different stages of PLC, Strategies for Leaders, Followers, Challengers and Nichers.</p> <p>Product Concept and hierarchy, Product decisions,</p>	<p>8 hours</p> <p>8 hours</p> <p>8 hours</p> <p>8 hours</p>

	<p>Branding and Packaging Decisions, Pricing and setting of Price, Methods of Pricing and initiating responses to Price Cuts. Channels of Distribution, Role and Types of Channel, Distribution Channel design and management and modification. Retailing and Wholesaling. Advertising and Integrated Marketing Communication. Advertising decisions, Media decisions, Sales promotion concept and designing. Sales Management and Personal Selling. Digital Marketing and Social Media Marketing.</p> <p>Marketing Plan, Audits and Control of Marketing Decisions. Annual Plan Control, Profitability Control, Efficiency Control and Strategic Control.</p>	8 hours
<b><u>Pedagogy:</u></b>	Pedagogy includes interactive sessions involving lectures, case studies, presentations, debates and field based work.	
<b><u>Learning Outcomes</u></b>	<ol style="list-style-type: none"> <li>1. Ability to identify the market Segments</li> <li>2. Ability to analyse the market Segments</li> </ol>	
<b><u>References/Readings</u></b>	<ol style="list-style-type: none"> <li>1. Majarao, Simon; 'The Essence of Marketing'; Prentice Hall of India Limited; New Delhi; Latest edition.</li> <li>2. Brand Equity and News Items of Economic Times, Articles from Popular Business Periodicals, etc.</li> <li>3. Kotler, Philip., Keller Kevin., Koshy Abraham., and JhaMithileshawar; 'Marketing Management: A South Asian Perspective'; Pearson Education India, Latest edition.</li> <li>4. Ramaswami.,Namkumari; Marketing Management, McMilanIndiaLtd. New Delhi.</li> </ol>	

Latest Edition

5. Baines, Paul; Chris, Fill; Kelly, Page; Sinha, Piyush Kumar: Marketing Management; Oxford Press, India. Latest Edition

**Course Code: IMC 302**

**Title of the Course: Deductive and Inferential Mathematics**

**Number of Credits: 4**

**Total Contact Hours: 48**

**Effective from AY: 2020-21**

Prerequisites for the Course:	XII Mathematics	
Objective:	On completion of this course, the learner should be able to successfully explore, conjecture and reason logically to arrive at a solution to a given problem using appropriate mathematical methods and will learn to estimate the impact of a policy/decision in the presence of uncertainty	
Content:	<p><b>Mathematical Logic &amp; Proofs</b> An open sentence, a closed sentence, Definition of proposition or a Statement. Strong emphasis on the Distinction between Inclusive OR and Exclusive OR. Truth tables. Compound Proposition. Algorithms, Truth tables and Tautologies</p> <p>Equivalent statements (<math>\equiv</math>). Examples and important logical results. De Morgan Laws for negation. Conditional and Biconditionals, Arguments and Proofs</p> <p><b>Well-formed-formulae .</b> Equivalence of formulae. Various laws governing the well-formed formulae. Duality law. Normal Form. Disjunctive normal form, conjunctive normal form, Principal disjunctive normal form, Principal conjunctive normal form. Propositional Calculus. Predicate Calculus. Predicate Formula. Equivalence of Predicate Formulae. Inference Theory.</p> <p><b>Inferential Statistics</b> Introduction to Probability Theory using Kolmogorov Technique: Definition of an experiment. Outcomes of an experiment. Outcomes which are not <b>decomposable</b>.</p>	<p>12 hours</p> <p>12 hours</p> <p>12 hours</p>

	<p>Sample space as the set of all <b>non-decomposable</b> outcomes of an experiment. Event as any subset of the sample space of an experiment under consideration.</p> <p>Idea of variations. Standard deviation as the root mean square deviation with respect to the mean. Mathematical Expectation and Expected Values.</p> <p>Random Variables: Idea of Distribution of a Function. Some standard Distributions such as Binomial., Normal, Poisson and Exponential. Their standard properties with the stress on Normal Distribution. Use of Normal Distribution Table to solve problems.</p>	12 hours
Pedagogy		
Reference/Readings	<ol style="list-style-type: none"> <li>1. A textbook of Discrete Mathematics by Dr. S. K. Sarkar, Chand &amp; Company, New Delhi.</li> <li>2. Discrete Mathematics and its Applications by Kenneth Rosen, Tata McGraw Hill.</li> <li>3. Discrete Mathematics for Computer Scientists by John Truss, Addison Wesley (Pearson Education).</li> <li>4. Discrete Mathematics and Graph Theory by Purna Chandra Biswal, Prentice Hall of India.</li> <li>5. Statistics for Management by Richard Levin and David Rubin, Prentice Hall of India.</li> <li>6. Statistics for Business and Economics by Anderson, Sweeney and Williams, Thomson South Western.</li> <li>7. Statistics for Management by Anand Sharma, Himalaya Publishing House, Mumbai.</li> <li>8. Engineering Mathematics Volume II by Kandasamy, Tilagavathy and Gunavanthi, Chand &amp; Company, New Delhi.</li> </ol>	
Learning Outcomes	<ol style="list-style-type: none"> <li>1. Learner will understand how to explore, conjecture and reason logically to model/arrive at a solution to a given problem</li> <li>2. Learner will be able to use a variety of mathematical methods effectively to solve problems</li> <li>3. Learner will learn decision making in the presence of uncertainty and will learn to quantify the uncertainty in estimation /the decision</li> </ol>	

Course Code: IMC 303

Title of the Course: Macroeconomics

Number of Credits: 4

Total Contact Hours: 48

Effective from AY: 2020-21

<b><u>Prerequisites for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objectives:</u></b>	Provide a basic understanding of how aggregate variables like national income, aggregate prices, employment, and exchange rates get determined by interaction of public policy and individual agents	
<b><u>Content:</u></b>	<p><b><u>Module 1: Introduction to Macroeconomics : What is it about.</u></b> Aggregate Income and its Dimensions, Measuring output, Real and Nominal Incomes, Savings, Balance of Payments and the Money supply. The sources and Use of Savings, The Balance of Payments, The Money supply</p> <p><b><u>Module 2: Consumption &amp; Investment.</u></b> Keynes on Consumption, Consumption Smoothing, Temporary and Permanent Shocks, Stochastic Income Expectations, Effect of Interest Rates, Aggregating Across Individuals, Savings and Portfolio Choice, Profit Maximization and the Optimal Capital Stock, Adjustment Costs and Investment Decisions, Financial Structure and Investment, Residential and Inventory Investment, Irreversibility and Investment, Investment in Developing Countries, Investment in India</p> <p><b><u>Module 3: Trade Balance and Exchange rates, Demand for Money, Labour market.</u></b> The Real Exchange Rate, Other Approaches to the Trade Balance, Exchange Rates and Assets, Purchasing Power Parity, Choice of Exchange Rate Regimes, Money, Bonds, and Private Wealth, Nominal and Real Interest Rates, Financial Assets and the Budget Constraint, Money as a store of value, Seigniorage, Profit Maximization and Labour Demand, Utility and Labour Supply, Aggregate Supply with /</p>	10 14 14

	<p>without Money illusion, Introducing Unemployment, Cyclical Unemployment and the Output Gap, The Static Phillips Curve, The Dynamic Phillips Curve</p> <p><b>Module 4: IS-LM model :</b></p> <p>Walras Law, Nominal Versus Real Rate of Interest, The IS Curve, The LM Curve, IS and LM - Fiscal and Monetary Policy, IS - LM in India, Ricardian Equivalence–determination of equilibrium income and interest rates – fiscal and monetary policy.</p>	10
<b><u>Pedagogy:</u></b>	Lectures/ tutorials/assignments/self-study	
<b><u>References/Readings</u></b>	<p><i>Essential Reading</i></p> <p>1. Macroeconomics by Errol D’Souza, Pearson Education, Delhi Second Edition 2012</p> <p><i>Additional Reading</i></p> <p>2. Macroeconomics: Theories and Policies, by Richard T. Froyen, Pearson Education, 10th Edition or later, 2013</p>	
<b><u>Learning Outcomes</u></b>	Understand the factors that determine consumption and production decisions under different market structures.	

Course Code: IMC 304

Title of the Course: Database Management Systems

Number of Credits: 6 (4L + 2P)

Total Contact Hours: 48L+48P

Effective from AY: 2020-21

<b><u>Prerequisites for the course:</u></b>	Operating Systems, Data and File Structures, A programming language	
<b><u>Objectives:</u></b>	To Provide students with theoretical knowledge and practical skills to effectively design , implement and query a relational database application	
<b><u>Content:</u></b>	<p><b>Basic concepts</b> Database &amp; Database Users, Characteristics of the Database Approach, Database Systems, Concepts &amp; Architecture Data Models, Schemes &amp; Instances, DBMS Architecture of Data Independence, Data Base languages &amp; Interfaces, Introduction to present day Database Systems (NoSQL, GraphDB).</p> <p><b>Relational Model</b> The Relational Model, Overview of Design Process, Data Modelling using the Entity – Relationship approach , Structure of Relational Databases, Relational Algebra</p> <p><b>SQL-A Relational Database Language Data</b> Data Definition in SQL, structure of SQL queries, Set operations, aggregate functions, Nested Subqueries, Modification of the database, Views Specifying Integrity Constraints &amp; Indexes in SQL. A Relational Database Management System</p> <p><b>Relational DataBase Design</b> Features of a Good Relational design, Function Dependencies &amp; Normalization , Normal forms based on primary keys (1NF, 2NF, 3NF, BCNF) Covers of Functional Dependencies, Canonical covers. Loss less join and Dependency preserving decomposition algorithms.</p> <p><b>Transactions</b> Concept and states of transactions, Properties of Transactions, issues in Concurrent execution of transactions, concept of serializability, Recovery techniques</p>	<p>6 hours</p> <p>10 hours</p> <p>12 hours</p> <p>10 hours</p> <p>10 hours</p>



<b><u>Pedagogy:</u></b>	Lectures/ tutorials/assignments/class presentations and debates/peer reviews/workshops/self-study	
<b><u>References/ Readings</u></b>	<ol style="list-style-type: none"> <li>1. Korth, Silberchartz, “ Database System Concepts” McGrawhill Publication.</li> <li>2. Elmasri and Navathe, “ Fundamentals of Database Systems”, Addison Wesley, New Delhi.</li> <li>3. Database Management Systems –R. Ramakrishnan, J.Gehrke – T.McGraw Hill</li> <li>4. Desai B., “ An Introduction to Database Concepts”, Galgotia Publications, New Delhi.</li> <li>5. Rob,Coronel, “Database Systems (Design, Implementation and Management)”</li> <li>6. Date C. J. , “ An Introduction to Database Systems”, Publication House, New Delhi.</li> </ol>	
<b><u>Learning Outcomes</u></b>	<ol style="list-style-type: none"> <li>1. Understand and evaluate the role of database management systems in information technology applications within organizations;</li> <li>2. Recognise and use logical design methods and tools for databases;</li> <li>3 Implement a database solution to an information technology problem;</li> <li>4. Understand the SQL data definition and SQL query languages;</li> <li>5. Develop sophisticated queries to extract information from databases</li> <li>6. Understand how the database manages and recovers from concurrent and multiple transactions</li> </ol>	

**Suggested Lab Assignments:**

**A. Installation of DBMS Software**

**B. Data Definition Language(DDL) Statements**

Creating tables, with or without constraints.

Understanding Data types.

Creating User Defined data Types

Altering the structure of the table

Dropping tables..

CreatingSequences

**C. Query in Data Dictionary**

1. To view the structure of the table created by the user.
2. To view user information.
3. To view integrity constraints.

#### **D. Data Manipulation Language(DML) Statements**

1. Inserting Data into the table.
2. Updating Data into the table.
3. Deleting Data from the table.

#### **E. Simple SQL statements**

1. Displaying all the attributes and tuples from the table.
2. Displaying selected attributes/tuples from the table.
3. Using Logical and comparison operators.
4. Ordering data

#### **F. Complex SQL Statements**

1. Using aggregate functions (using Group by and having clauses).
2. Creating SQL Aliases and View.
3. Joins and Nested queries.
4. Creating temporary tables in SQL statements

#### **G. Transaction Control Language(TCL) statements**

#### **H. Embedded SQL statements**

1. Procedures with and without cursors

#### **I. Amazon Relational Data Service Setup**

**Course Code: IMC 305**

**Title of the Course: Soft Skills :Interview Facing Skills and Mock Interviews**

**Number of Credits: 2**

**Total Contact Hours: 24**

**Effective from AY: 2020-21**

<b><u>Prerequisites for the course:</u></b>	Same as programme pre-requisites	
<b><u>Objective:</u></b>	To introduce the basics of writing resumes and preparatory skills required to face interviews	
<b><u>Content:</u></b>	<p>Fundamentals of Resume Writing, Writing effective Cover letters and emails to organizations. 4 hours</p> <p>Group Discussions – different types, Different types of interviews and basic competencies required in facing interviews. 4 hours</p> <p>Preparation required prior to facing an interview – industry and firm analysis. SWOT analysis; Frequently asked questions in interviews 4 hours</p> <p>Mock interviews to assess conceptual clarity, domain knowledge, soft skills, and perspectives held, etc. 4 hours 4 hours 4 hours 1</p>	
<b><u>Pedagogy:</u></b>	Lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ selfstudy/ Case Studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning	
<b><u>Learning Outcomes</u></b>	An ability to face interviews	

**References/Reading**

**s**

1. Prasad, HariMohan, How to prepare for Group Discussion and Interview, Tata McGraw Hill, Latest Edition
2. Patnaik, Priyadarshini, Group Discussion and Interview Skills, Cambridge University Press, Latest Edition

**Course Code: IMC 306**

**Title of the Course: Perspective Building: Character Development**

**Number of Credits: 2**

**Total Contact Hours: 24**

**Effective from AY: 2020-21**

Prerequisites for the course	Same as programme pre-requisites	
<u>Objective:</u>	Have a holistic outlook towards life, to face and solve the challenges in their day to day life by strengthening their Emotional intelligence. Using their Talents to develop their personality and using this to bring happiness in their life and career. Changing their behaviour by becoming passionate and positively energized in doing their studies, job and life.Help them to become productive, proactive and persevere in all that they do in their lives and to become good Managers and professionals	
<u>Content:</u>	<p>Talents you are born with, using Talents to enhance your personality and succeed. 3 hours</p> <p>Using the E – Enthusiasm. Using this to build your passion and positive Energy. 3 hours</p> <p>E - Efforts – Persevere and reach your goals. 3 hours</p> <p>In Efficiency - un Productive and not planned or not Pro active . 3 hours</p> <p>Dealing with their negative Self Awareness, Self Regulation, Motivation, Empathy and Social Skill. 3 hours</p> <p>E - Positive Emotional Intelligence to reach your goals. 3 hours</p> <p>Negative Attitude with regards to oneself, family and Friends. 3 hours</p>	

	Positive Attitude	3 hours
<u>Pedagogy:</u>	Use of Presentations, Activities, Discussions	
<u>Learning Outcomes</u>		
<u>References/Readings</u>	<ol style="list-style-type: none"> <li>1. Rich Dad Poor Dad – Robert Kiyosaki . Warner books</li> <li>2. Think and grow Rich – Napoleon Hill. The Ralston Society</li> <li>3. The Power of now- Eckhart Tolle. Namaste Publishing</li> </ol>	