Master of Science (Mathematics)

PROGRAMME GUIDE

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INTRODUCTION

Designed to strengthen student's mathematical background by in depth knowledge of mathematical concepts. The learner has to do a unique three term thesis keeping in mind the research centricity.

PROGRAMME OUTCOMES

Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviours that students acquire in their matriculation through the program

1. **Scientific exploration:** Capability of comprehending basic scientific principles, mathematical aptitude and theories to propose solutions.
2. **Conduct investigations of complex problems:** Use explorative aptitude and research methods for analysis and interpretation of data and synthesis of information to provide effective conclusions.
3. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities for societal benefits
4. **Communication:** Communicate effectively scientific findings, and to be able to assimilate, write and present effective reports to give and receive clear instruction.
5. **Societal Impact:** Acquire and apply advanced knowledge of concepts and participate in sustainable development.
6. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
7. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of upcoming scientific change.
8. **Research Problem Solving: Ability** to assimilate, evaluate and present research results objectively.

PROGRAMME SPECIFIC OUTCOMES

PSOs are statements that describe what the graduates of a specific engineering program should be able to do:

1. **PSO1:** Understand advanced level of differential equations, Complex analysis, real analysis, Functional analysis, and abstract algebra.
2. **PSO2:** Build effective conclusions through review and research gap Identifications.
3. **PSO3:** Demonstrate competence in using mathematical concepts and computational techniques for simulation and modelling.
4. **PSO4:** Exhibit the ability of comprehending the problem and building research-oriented solutions.

- **Dissertation:** Dissertation courses are incorporated in the curriculum to provide research and hands on experience to students in problem identification, laboratory work, data analysis and interpretation.
- **Professional Enhancement:** In addition to core curricula, program offers subjects like communication, Technical and soft skills to enhance personality and employability.
- **Innovative Pedagogy:** Use of innovative pedagogical tools such as demo kits in addition to animations, simulations to impart effective teaching and learning process.

PROGRAMMECODE: **OL24A9**

DURATION OF THEPROGRAMME:

Minimum Duration   2 years

Maximum Duration   4 years

MEDIUM OF INSTRUCTION/EXAMINATION:

Medium of instruction and Examination shall be English.

PROGRAMME STRUCTURE				
Term	Core Courses (CR I, CR II, CR III A, CR III B) CR I+II – (8+4) 12 x 4 Credits CR III (A) - 1 x 4 Credits CR III (B) - 1 x 8 Credits	Skill Enhancement Courses (SEC) 1 x 4 Credits	Generic Electives (GE) 4 x 4 Credits	Credits
I	Discipline Specific Core- I Discipline Specific Core- II Discipline Specific Core- III Discipline Specific Core- IV	SEC-I Fundamentals of Information Technology		20
II	Discipline Specific Core- V Discipline Specific Core- VI Discipline Specific Core- VII Discipline Specific Core- VIII Discipline Specific Core- IX		GE-I (Data Science, Contemporary Programming, Marketing, Finance, Economics)	24
III	Discipline Specific Core- X Discipline Specific Core- XI Discipline Specific Core- XII **CR III A**- TERM PAPER or Course from the GE BASKET 1 which is not chosen as Generic Elective (GE)		GE-II & GE-III (Data Science, Contemporary Programming, Marketing, Finance, Economics)	24
IV	Discipline Specific Core- XIII Discipline Specific Core- XIV **CR- III B** DISSERTATION or next 2 courses from GE BASKET 2 and 3 of same area from which the course chosen in TERM PAPER		GE- IV (Data Science, Contemporary Programming, Marketing, Finance, Economics)	20
Total	**68 Credits**	**4 Credits**	**16 Credits**	**88**

MASTER OF SCIENCE (MATHEMATICS) PROGRAMME SCHEME (ONLINE)

COURSE CODE	COURSE TITLE	Cr.	CA	ETE(Th.)	ETE(Pr.)
TERM1					
EMTH515	REAL ANALYSIS-I	4	30	70	0
EMTH516	ADVANCED ABSTRACT ALGEBRA-I	4	30	70	0
EMTH517	THEORY OF DIFFERENTIAL EQUATIONS	4	30	70	0
EGEN530	FUNDAMENTALS OF RESEARCH	4	30	70	0
ECAP145	FUNDAMENTALS OF INFORMATION TECHNOLOGY	4	30	40	30
TERM2					
EMTH528	REAL ANALYSIS-II	4	30	70	0
EMTH529	ADVANCED ABSTRACT ALGEBRA-II	4	30	70	0
EGEN531	RESEARCH METHODS AND DESIGN	4	30	70	0
EMTH542	COMPLEX ANALYSIS-I	4	30	70	0
EMTH655	CALCULUS OF VARITATION AND INTEGRAL EQUATION	4	30	70	0
GE-I	GENERIC ELECTIVE I	4	30	70	0
TERM3					
EMTH530	PARTIAL DIFFERENTIAL EQUATIONS	4	30	70	0
EMTH543	COMPLEX ANALYSIS-II	4	30	70	0
EMTH637	TOPOLOGY	4	30	70	0
GE-II	GENERIC ELECTIVE II	4	30	70	0
GE-III	GENERIC ELECTIVE III	4	30	70	0
	TERM PAPER OR	4	0	0	100
	Course from the GE Basket 1which is not chosen as Generic Elective (GE).	4	30	70	0
TERM4					
EMTH532	MECHANICS	4	30	70	0
EMTH642	FUNCTIONAL ANALYSIS	4	30	70	0
GE-IV	GENERIC ELECTIVE IV	4	30	70	0
	DISSERTATION OR	8	30	0	70
	Next 2 courses from GE Basket 2 & 3 of same area from which the course chosen in Term Paper	4	30	70	0
TOTAL CREDITS		**88**			

S. No	Course Code	Course Title	Credit	CA	ETE	ETP	Elective Area	Term
		GENERIC ELECTIVE (GE) BASKET 1						
1	ECAP172	PROGRAMMING METHODOLOGY	4	30	40	30	Programming	2
2	ECAP790	PROBABILITY AND STATISTICS	4	30	40	30	Data Science	2
3	EMKT509	CONSUMER BEHAVIOUR	4	30	70	0	Marketing	2
4	EFIN548	INTERNATIONAL FINANCIAL MANAGEMENT	4	30	70	0	Finance	2
5	EECO604	INDIAN ECONOMIC DEVELOPMENT	4	30	70	0	Economics	2

S. No	Course Code	Course Title	Credit	CA	ETE	ETP	Elective Area	Term
		GENERIC ELECTIVE (GE) BASKET 2						
1	ECAP202	OBJECT ORIENTED PROGRAMMING	4	30	40	30	Programming	3
2	ECAP792	DATA SCIENCE TOOLBOX	4	30	40	30	Data Science	3
3	EMKT505	DIGITAL AND SOCIAL MEDIA MARKETING	4	30	70	0	Marketing	3
4	EFIN508	INTERNATIONAL BANKING AND FOREX MANAGEMENT	4	30	70	0	Finance	3
5	EQTT501	MATHEMATICS FOR ECONOMISTS	4	30	70	0	Economics	3

S. No	Course Code	Course Title	Credit	CA	ETE	ETP	Elective Area	Term
		GENERIC ELECTIVE (GE) BASKET 3						
1	ECAP512	OPEN-SOURCE WEB APPLICATION DEVELOPMENT	4	30	70	0	Programming	3
2	ECAP794	ADVANCE DATA VISUALIZATION	4	30	40	30	Data Science	3
3	EMKT517	CUSTOMER RELATIONSHIP MANAGEMENT	4	30	70	0	Marketing	3
4	EFIN576	SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT	4	30	70	0	Finance	3
5	EECO528	MONETARY THEORY AND POLICY	4	30	70	0	Economics	3

S. No	Course Code	Course Title	Credit	CA	ETE	ETP	Elective Area	Term
		GENERIC ELECTIVE (GE) BASKET 4						
1	ECAP776	PPROGRAMMING IN PYTHON	4	30	40	30	Programming	4
2	ECAP737	MACHINE LEARNING	4	30	40	30	Data Science	4
3	EMKT622	PRODUCT AND BRAND MANAGEMENT	4	30	70	0	Marketing	4
4	EFIN526	FINANCIAL ANALYTICS	4	30	70	0	Finance	4
5	EECO512	ECONOMICS OF DEVELOPMENT	4	30	70	0	Economics	4

Note:

1. Students can adopt only one area from generic elective basket that will be applicable for the whole program.
2. In case of Term Paper student may choose one course against Term Paper from the Generic Basket 1 which is not chosen as Generic Elective (GE) and in case of Dissertation student may choose two courses against Dissertation from Generic Basket 2 & 3 of the same area from which the course chosen in Term Paper.
3. If student opt for Term Paper, then student is eligible to complete Dissertation in Term 4.
4. If student opt for course in place of Term Paper, then student will not allow to opt Dissertation. Student is allowed to complete two courses as per guidelines.

Course Code	EMTH515	Course Title	REAL ANALYSIS-I

WEIGHTAGE	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Describe the Riemann-Stieltjes integrability of a bounded function and prove a selection of theorems concerning Riemann-Stieltjes integration

CO2: Interpret various kinds of integrals using the fundamental theorems of calculus for the various function arises in the field of science and technology

CO3: Demonstrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability

CO4: Analyze the power series expansion for different functions and their convergence

CO5: Determine the derivatives of function of several variables and produce the rigorous proofs for important theorems

Unit No.	Content
Unit 1	**The Riemann - Stieltjes integral:** definition and existence of the Riemann - Stieltjes integral and related theorems
Unit 2	Properties of the Riemann: Stieltjes integral
Unit 3	The fundamental theorem of calculus and mean value theorems for the Riemann - Stieltjes integral
Unit 4	Integration and differentiation
Unit 5	Integration of vector valued functions and rectifiable curves
Unit 6	Pointwise and uniform convergence
Unit 7	Uniform convergence and continuity
Unit 8	Uniform convergence and integration
Unit 9	Uniform convergence and differentiation
Unit 10	The Weierstrass approximation theorem and equicontinuous families of functions
Unit 11	Power series and uniform convergence, the exponential and logarithmic functions, the trigonometric functions
Unit 12	Functions of several variables, the space of linear transformations on R^n to R^m, differentiation, partial derivatives and directional derivatives, the contraction principle
Unit 13	The inverse function theorem and the implicit function theorem
Unit 14	Algebraic operations on series, definition of addition of series, definition of multiplication of series i.e., Cauchy product of series, theorems and examples related to the convergence of Cauchy product of series.

READINGS:

1. PRINCIPLES OF MATHEMATICAL ANALYSIS by WALTER RUDIN, MCGRAW HILL EDUCATION.
2. MATHEMATICAL ANALYSIS by S.C. MALIK, SAVITA ARORA, NEW AGE INTERNATIONAL.
3. MATHEMATICAL ANALYSIS by TOM M. APOSTOL, NAROSAPUBLISHING HOUSE.

Course Code	EMTH516	Course Title	ADVANCD ABSTRACT ALGEBRA-I

	WEIGHTAGE	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: recognize the subnormal and normal series for the solvable group and nilpotent group

CO2: classify the fields and their finite and infinite extensions

CO3: analyze the behavior of polynomials over the fields

CO4: use the concepts of group automorphism in the study of Galois groups

CO5: apply the normal extension to find the splitting field

CO6: reframe the solvable group and permutation groups with radical field extension

Unit No.	Contents
Unit 1	Review of groups, Normal subgroup, centre of group and factor group
Unit 2	Normal and subnormal series, composition series, Jordan- Holder theorem, solvable groups, nilpotent group
Unit 3	Basic theory of field extension, algebraic and transcendental extension, finite extension
Unit 4	Splitting field, algebraically closed field, separable and inseparable extension
Unit 5	Normal extension, perfect fields, primitive elements, finite fields
Unit 6	Introduction of Galois theory, Galois extension
Unit 7	Automorphism of extension, Fundamental theorem of Galois theory
Unit 8	Galois groups of polynomials, composites with Galois extension
Unit 9	Galois closure, cyclotomic and abelian extension over field of rational numbers
Unit 10	Fundamental theorem of algebra, composite field extension
Unit 11	Normal closure of an algebraic extension
Unit 12	Solution of polynomial equation by radicals
Unit 13	Insolvability of general equation of degree 5 by radicals
Unit 14	Cyclic extensions and symmetric functions

READINGS:

1. TOPICS IN ALGEBRA by I.N. HERSTEIN, WILEY

2. ABSTRACT ALGEBRA by DUMMIT AND FOOTE, WILEY

3. BASIC ABSTRACT ALGEBRA by BHATTACHARYA, JAIN, NAUGPAUL, CAMBRIDGE UNIVERSITYPRESS

4. CONTEMPORARY ABSTRACT ALGEBRA by JOSEPH A. GALLIAN, NAROSA PUBLISHING HOUSE

Course code	EMTH517	Course Title	THEORY OF DIFFERENTIAL EQUATIONS

	WEIGHTAGE	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Identify the concept of initial value problem and its existence and uniqueness.

CO2: Apply basic theorems on the convergence of solutions of initial value problems.

CO3: Enumerate the concept of differential inequalities and its uniqueness.

CO4: Discuss the modeling parameters in physical and mathematical problems.

CO5: Analyze a differential equation in order to make a qualitative statement about the solution.

CO6: Analyze the dynamical systems through stability theory using the linear and non-linear differential equations.

Unit No.	Contents
Unit 1	Initial value problem and the equivalent integral equation, mth order equation in d-dimensions as a first order systems
Unit 2	Concepts of local existence and uniqueness, Picard existence theorem, existence in the large and uniqueness of the solutions with examples.
Unit 3	Ascoli-Arzela theorem, Peano's existence theorem and its corollary
Unit 4	Picard-Lindel of theorem, maximal intervals of existence, extension theorem and corollaries
Unit 5	Kamke's convergence theorem, Kneser's theorem (statement only).
Unit 6	Differential in equalities, maximal and minimal solutions.
Unit 7	Integral inequalities, Gronwall's inequality, Theorem of Wintner.
Unit 8	Egres point and Lyapunov functions.
Unit 9	Homogeneous linear systems of differential equations, non-homogeneous linear systems, variation of constants formula.
Unit 10	Floquet theory, adjoint systems, higher order linear differential equations.
Unit 11	Linear second order differential equations, preliminaries, basic facts for theorem of Strum.
Unit 12	Strum separation theorem, Strum comparison theorem.
Unit 13	Strum-Liouville boundary value problem, number of zeros.
Unit 14	Non oscillatory equations, principal solutions, non-oscillation theorems.

READINGS:

1. Earl A Coddington and Norman Levinson (2017). *Theory of Ordinary Differential Equations*, Mc Graw Hill.
2. P. Hartman (1964), *Ordinary Differential equations*, Johan Wiley.
3. A. K. Nandkumaran, P. S. D
4. atti, Raju K. George (2017), *Ordinary Differential Equations: Principles and Applications* (CAMBRIDGEIISC SERIES) by Cambridge University Press.
5. Shair Ahmad and Rama Mohan Rao (2014), *Theory of ordinary Differential Equations*, East West Press Private Limited.

Course code	EGEN530	Course Title	FUNDAMENTAL OF RESEARCH

WEIGHTAGE	
CA	ETE(Th.)
30	70

Course Outcomes:
CO1: Develop research aptitude and get in-depth understanding of various methods of research.
CO2: Identify the appropriate research problem and conduct research in an effective way.
CO3: Understand indexing systems of various journals.
CO4: Apply ethics of research in writing research paper and dissertation thesis.
CO5: Understand basics of intellectual property rights.

Unit No.	Contents
Unit- 1	Basics of research: meaning of research, objectives of research, motivations in research, types of Research
Unit- 2	Research approaches, significance of research, research process, criteria of good research, concept of theory: deductive and inductive theory
Unit- 3	Literature survey and research gap identification, problem identification as per industrial and societal needs, potential and thrust areas, difference between scientific literature and advocacy literature
Unit- 4	Hypothesis: qualities of a good hypothesis, null hypothesis and alternative hypothesis, use of databases, search engines and research gateways, framing of timeline/Gantt chart
Unit- 5	Types and classification of journals, journal indexing, role of indexing in defining the quality of journal
Unit- 6	Journal citation indices, h-index, h5-index, h5-median, g index, i-10 index, almetrics, JIF, JIF percentile, cite score, SJR, SNIP and eigen factor
Unit- 7	Research paper review process, citation, self-citation, funding agencies, Manupatra, academic social networks: google scholar, academia research gate etc
Unit- 8	Objectivity and subjectivity in research, integrity, carefulness, openness, respect for intellectual property, confidentiality, social responsibility, competence, legality and informed consent
Unit- 9	Definition of Plagiarism, use of turnitin/ithenticate software, role of referencing/bibliography in handling plagiarism, penalties and consequences, University Grants Commission's (UGC) policy for curbing plagiarism
Unit- 10	Research writing including research paper, research proposal, review writing, thesis writing, Microsoft word (grammar checking, formatting of documents, incorporating references), reference styles
Unit- 11	Poster preparation, coherence of the ideas, use of theory, Microsoft power point (creation of posters, slides for seminar/talk)
Unit- 12	Introduction to intellectual property rights concept and theories kinds of intellectual property rights, introduction to patents, patent act 1970 – amendments of 1999, 2000, 2002 and 2005
Unit- 13	Copyright and neighboring rights concept and principles, historical development of the concept of trademark and trademark law-National and International
Unit- 14	International regime relating to IPR TRIPS and other Treaties (WIPO,WTO, GATTS)

READINGS:

1. RESEARCH DESIGN QUALITATIVE, QUANTITATIVE, AND MIXED METHODS APPROACHES byJOHN W.
2. INTELLECTUAL PROPERTY RIGHTS (IPRS) by E. T. LOKGANATHAN, NEW CENTURYPUBLICATIONS
3. RESEARCH METHODOLOGY: METHODS AND TECHNIQUES by KOTHARI C R, GARG,
4. GAURAV, NEW AGE INTERNATIONAL
5. AN INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS by J P MISHRA, CENTRAL LAWPUBLICATION
6. THE PRESENTATION BOOK, 2/E: HOW TO CREATE IT, SHAPE IT AND DELIVER IT! IMPROVEYOUR PRESENTATION SKILLS NOW PAPERBACK by EMMA LEDDEN, PEARSON

Course code	ECAP145	Course Title	FUNDAMENTALS OF INFORMATION TECHNOLOGY

	WEIGHTAGE		
	CA	ETE(Th.)	ETE (Pr.)
	30	40	30

Course Outcomes:

CO1: understand basic concepts and terminology of information technology.

CO2: have a basic understanding of personal computers and their operations.

CO3: understand various software and hardware, various security issues.

CO4: familiarize students with complete fundamentals and the packages commonly used in computing software

CO5: gain writing skills and various presentation aspects using word processing software

Unit No.	Contents
Unit1	**Computer Fundamentals:** Characteristics &Generation of Computers, Block diagram of Computer. Application of IT in various sectors. **Data Representation:** Binary Number System, Octal, Hexadecimal, decimal and their Conversion.
Unit2	**Memory:** Types, Units of memory, RAM, ROM, Secondary storage devices–HDD, Flash Drives, Optical Disks: DVD, SSD **I/O Devices:** Keyboard, Mouse, LCDs, Scanner, Plotter, Printer & Latest I/O devices in market
Unit3	**Processing Data:** Transforming data into information, how computers represent data, how computers process data, Machine cycles, Memory, Registers, The Bus, Cache Memory
Unit4	**Operating Systems:** Operating system basics, Purpose of the operating system, types of operating system, providing a user interface, Running Programs, Sharing Information, Managing Hardware, Enhancing an OS with utility software.
Unit5	**Data Communication**: Local and Global reach of the network, Digital and Analog Transmission, Data communication with standard telephone lines and Modems, Using Digital Data Connections, Wireless networks
Unit6	**Networks:** Sharing data anytime anywhere, uses of a network, Common types of a network, Hybrid Networks, how networks are structured, Network topologies and Protocols, Network Media, Network Hardware
Unit7	**Graphics and Multimedia:** Understanding graphics File Formats, Getting Images into your Computer, Graphics Software, Multimedia Basics
Unit8	**Data Base Management Systems**: The Database, The DBMS, Working with a database, Databases at Work, Common Corporate Database Management Systems
Unit9	**Software Programming and Development:** What is computer Program, hardware/Software Interaction, planning a Computer Program how programs Solve Problems
Unit 10	**Programming Languages and Programming Process:** Categories of Programming Languages, Machine and Assembly Language, Higher Level Languages, WWW development languages, he SDLC of Programming
Unit11	**Internet:** Basic Internet terms: Web Page, Website, Homepage, Browser, URL, Hypertext, ISP, Web Server, HTML, DHTML, XML, Introduction to client side and server-side scripting.

	Applications: WWW, e-mail, Instant Messaging, Internet Telephony, Videoconferencing, Web Browser & its environment
Unit12	**Understanding The Need of Security Measures:** Basic Security Concepts, Threats to Users, Threats to Hardware, Threat to Data, Cyber Terrorism. **Taking Protective Measures:** Keeping your System Safe, Protecting Yourself, protecting your Privacy, Managing Cookies, Spyware and other BUGS, keeping your data secure, Backing Update, Safeguarding your hardware
Unit13	**Cloud Computing and IoT**: SaaS, PaaS, IaaS, Public and Private Cloud; Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics of IoT and its applications.
Unit14	**Futuristic World of Data Analytics:** Introduction to Big data and Analysis Techniques: Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and overview of various tools used for data analysis.

LABORATORYWORK:

1. Hardware familiarizing with various I/O Peripheral devices, storage devices.
2. Familiarity with DOS, Implementing various internal and external commands in DOS.
3.MS-Windows: Familiarizing with windows operating system; using built-in accessories; managing files and folders using windows explorer; working with control panel; installing hardware and software.
4. MS-Office (or any other Office Suite), meaning and features, its components.
5.MS-Word (or any other word processor): Creating Document Files, Saving, Closing Files, Page Settings and Formatting Text. Spell Checking, Thesaurus, Creating Tables, Adding rows, columns. Printing Documents, Setting Print Settings, creating labels and mail merge, taking Printouts
6. MS-Excel-Working with worksheet, formulas & functions, Inserting charts, printing in Excel
7. MS-PowerPoint-Views, Designing, viewing, presenting & Printing of Slides.
8. Internet: Navigating with Internet Explorer; surfing the net, using search engines; using email facility.

Course Code	EMTH528	Course Title	REAL ANALYSIS-II

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:
CO1: Determine the conditions to prove that a set and a function is measurable or not
CO2: Discuss the difference between Riemann and Lebesgue integral
CO3: Illustrate about Dini's four derivatives and their applications
CO4: Interpret the uniqueness and extension of a measure
CO5: Demonstrate the concept of LP spaces and their completeness

Unit No.	Contents
Unit 1	Lebesgue outer measure
Unit 2	Measurable sets
Unit 3	Measurable functions
Unit 4	Comparison of Riemann Integral and Lebesgue Integral and the properties of the Lebesgue Integral of bounded functions over a set of finite measure
Unit 5	The Lebesgue Integral of non-negative measurable functions
Unit 6	The General Lebesgue Integral
Unit 7	The Four Derivatives and functions of bounded variation
Unit 8	Differentiation and integration
Unit 9	Abstract measure spaces
Unit 10	The Lp spaces and convex functions
Unit 11	Jensen's inequality and the inequalities of Holder and Minkowski
Unit 12	Completeness of Lp spaces
Unit 13	Convergence in measure and almost uniform convergence
Unit 14	Egoroff's theorem, Lusin's theorem and F.Riesz theorem that every sequence which is convergent in measure has an almost everywhere convergent subsequence.

READINGS:

1. MEASURE THEORY AND INTEGRATION by G DE BARRA, NEW AGEINTERNATIONAL.
2. REAL ANALYSIS by H.L. ROYDEN and P.M. FITZPATRICK, PEARSON
3. LEABESGUE MEASURE AND INTEGRATION by P.K. JAIN, V.P. GUPTA and PANKAJ JAIN, NEW AGEINTERNATIONAL.

Course code	EMTH529	Course Title	ADVANCED ABSTRACT ALGEBRA II

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Describe the rings as principal ideal domain, Euclidean domain and polynomial rings.
CO2: Understand vector spaces and linear transformations
CO3: Analyze the modules over the rings with and without unity as generalization of vector space.
CO4: Apply the concept of ascending series and descending series to define the Noetherian and Artinian modules.
CO5: Evaluate the Jordan and rational canonical forms for the finitely generated modules.

Unit No.	Contents
Unit 1	Unique factorization domains, Principal ideal domains, Euclidean domains, polynomial rings over unique factorization domain
Unit 2	Vector spaces, subspaces, basis and dimension of vector spaces, linear transformation
Unit 3	Representation of transformation by matrices, rank-nullity theorem
Unit 4	Definition and examples of modules, properties of modules, theorems on modules and submodules
Unit 5	Cyclic and simple modules, semi-simple modules, Schur's lemma, free modules
Unit 6	Noetherian and Artinian modules and rings, Hilbert basis theorem, Wedderburn-Artin theorem
Unit 7	Uniform module, primary module, Noether-Lasker theorem, Smith normal form over a principal ideal domain, row module, column module and rank
Unit 8	Fundamental theorem for finitely generated modules over a principal ideal domain and its application to finitely generated abelian groups
Unit 9	Generalized Jordan form over any field
Unit 10	Reduction to triangular form, nilpotent transformations, index of nilpotency, invariant subspaces,
Unit 11	Invariant of nilpotent transformation, canonical forms, similarity of linear transformations
Unit 12	Cyclic subspaces and annihilators, cyclic decomposition and the rational form
Unit 13	Primary decomposition theorem
Unit 14	Jordan blocks and Jordan forms

READINGS:

1. BASIC ABSTRACT ALGEBRA by P.B. BHATTACHARYA, S.K. JAIN.S.R. NAGPAUL, CAMBRIDGE UNIVERSITYPRESS
2. TOPICS IN ALGEBRA by I.N. HERTSTIEN, WILEY
3. ABSTRACT ALGEBRA by DAVID S DUMMIT AND RICHARD M FOOTE, WILEY

Course code	EGEN531	Course Title	RESEARCH METHODS AND DESIGN

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Understand the basic functions of MS-Excel

CO2: Discuss the fundamentals of statistics used in research and development

CO3: Identify research techniques and their use in research

CO4: Classify statistical methods in context of descriptive and inferential statistics

CO5: Understand the various sampling and probability distribution

CO6: Formulate and test hypothesis based on the nature of the research problem

Unit No.	Contents
Unit 1	Basic introduction to sheets/workbook-cell, row, columns, basic operations, use of all excel options and add-ins.
Unit 2	Tabulation and graphical Presentation: Discrete data, continuous data and frequency distributions.
Unit3	Graphs and their presentation, diagrammatic and graphical representation of data: bar diagram, pie-chart, line chart, histogram, frequency polygon and Ogive curves
Unit 4	Introduction to types of data-Qualitative, Quantitative, Ordinal
Unit 5	Measures of Central Tendency: Arithmetic Mean, Average Median and its importance, Characteristics of an ideal average
Unit 6	Measures of Concept of Central Tendency- Mean, Median, Mode Correlation and Regression Analysis
Unit 7	Linear Bivariate Regression, Correlation - Concept, Important
Unit 8	Methods - Scatter Diagram, Karl Pearson Coefficient of Correlation, Spearman's Rank Correlation.
Unit 9	Sampling and sampling Distribution: introduction to sampling, types of sampling: random and non-random sampling,
Unit 10	Design of Experiments, introduction to sampling distributions
Unit 11	Probability: Definition and its concept, Addition Theorem, Multiplicative Theorem
Unit 12	Probability Distribution: Concept of probability distribution, Binomial Distribution, Normal Distribution
Unit 13	Estimation: introduction, basic concept of point estimation and interval estimation, Hypothesis, Null and Alternate Hypothesis, Types of errors - Type I and Type II, Hypothesis Testing and Concept of confidence interval: Introduction
Unit 14	Importance and Types of Hypothesis, Hypothesis testing: t test, z test, chi-square, test of independence and goodness of fit(chi-square), one-way Analysis of Variance (ANOVA one way)

READINGS:

1. BUSINESS STATISTICS by J K SHARMA, VIKAS PUBLISHING HOUSE

2. RESEARCH METHODOLOGY: METHODS AND TECHNIQUES by C.R. KOTHARI AND GAURAV GARG, NEW AGE INTERNATIONAL

3. FUNDAMENTALS OF MATHEMATICAL STATISTICS by S C GUPTA, SULTAN CHAND & SONS (P) LTD.

4. STATISTICAL METHODS by S P GUPTA, S CHAND PUBLISHING

Course code	EMTH542	Course Title	COMPLEX ANALYSIS-1

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcome:

CO1: Understand the behavior of analytic functions in the complex plane.

CO2: Use Cauchy-Riemann equations for testing of analyticity of complex functions.

CO3: Solve the problems of integration of complex functions over a given path.

CO4: Compute the residue of a complex function at a point of singularity

CO5: Evaluate improper integrals in the complex plane.

CO6: Extend the application of complex function analysis in mappings and transform techniques.

Unit No.	Contents
Unit- 1	Complex functions, limit and continuity, analyticity and differentiability
Unit- 2	Necessary& sufficient condition for analyticity of complex functions, Cauchy-Riemann equations, polar form of Cauchy-Riemann equations, complex form of Cauchy-Riemann equations.
Unit- 3	Harmonic function, analytic function & harmonic conjugates.
Unit- 4	Types of curves in the complex plane, complex line integral, length of curve.
Unit- 5	Cauchy-Goursat theorem, Cauchy integral formula, Cauchy integral formula for derivatives.
Unit- 6	Gauss mean value theorem, Cauchy's inequality, maximum modulus principle.
Unit- 7	Schwarz' lemma, Morera's theorem, Liouville's theorem, fundamental theorem of algebra.
Unit- 8	Zeros of complex function, isolated & non-isolated singularities, isolated singularity at infinity.
Unit- 9	Taylor series expansion and Laurent's series expansion of complex functions.
Unit- 10	Removable singularity, poles, essential singularity, meromorphic functions, residue at a singularity, Cauchy residue theorem.
Unit- 11	Number of zeros and poles, argument principle, Rouche's theorem.
Unit- 12	Improper integrals, integrals involving sines and cosines functions, Integration along indented contours in the complex plane
Unit- 13	Principle of conformal mapping, necessary and sufficient conditions for conformal mappings
Unit- 14	Mobius transformation, fixed points and Mobius maps, triples to triples Under Mobius maps, the cross ratio and its invariance property

READINGS:

1. COMPLEX VARIABLES AND APPLICATIONS by CHURCHILL, R. V. AND BROWN, J. W., MCGRAW HILL EDUCATION.

2. FOUNDATIONS OF COMPLEX ANALYSIS by S. PONNUSAMY, NAROSA PUBLISHING HOUSE.

3. COMPLEX ANALYSIS by LARS V. AHLFORS, MCGRAW HILL EDUCATION.

4. COMPLEX VARIABLES THEORY AND APPLICATIONS by H. S. KASANA, PRENTICE HALL.

Course Code	EMTH655	Course Title	CALCULUS OF VARIATION AND INTEGRAL EQUATIONS

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Understand the difference between different types of integral equations

CO2: Understand the connection between differential and integral equations

CO3: Describe methods to solve various types of integral equations

CO4: Interpret infinitesimally small changes in the function itself due to imposed variations

CO5: Evaluate the extreme values of functional under various constraints and solve standard boundary values problems using variational methods

Unit No.	Contents
Unit- 1	Volterra and Fredholm integral equations
Unit- 2	Singular integral equation and non-linear integral equation, convolution integral, differentiation of a function under an integral sign
Unit- 3	Initial value problems reduced to Volterra integral equations; boundary value problems reduced to Fredholm integral equations
Unit- 4	Method of successive approximation and substitution, Fredholm resolvent kernel as a ratio of two series
Unit- 5	Fredholm equations with separable kernels and iterated kernels
Unit- 6	Approximation of a kernel by a separable kernel
Unit- 7	Non homogenous Fredholm equations with degenerate kernels
Unit- 8	Fundamental functions and Green functions
Unit- 9	Motivating problems of Calculus of variations
Unit- 10	Shortest distance and minimum surface of revolution
Unit- 11	Brachistochrone problem and isoperimetric problem
Unit- 12	Geodesic and fundamental lemma of Calculus of variations
Unit- 13	Euler's equation for one dependent function and generalization of Euler's equation to 'n' dependent functions
Unit- 14	Conditional extremum under geometric constraints and under integral constraints

READINGS:

1. LINEAR INTEGRAL EQUATIONS, THEORY AND TECHNIQUES by R.P. KANWAL, BIRKHAUSER BOOKS
2. CALCULUS OF VARIATIONS by GELFAND, J.M. AND FOMIN, S.V., PRENTICE HALL

Course code	EMTH530	Course Title	PARTIAL DIFFERENTIAL EQUATIONS

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Enumerate methods for solving first and second order partial differential equations.

CO2: Describe the theoretical aspects of partial differential equations.

CO3: Apply different methods to solve Laplace, Wave and Heat equations.

CO4: Analyze the fundamental and elementary solutions of boundary value problems.

Unit No.	Contents
Unit- 1	Linear first order partial differential equation, Integral surfaces passing through a given curve. Surfaces orthogonal to a given systems of surfaces, Cauchy problem for first order PDE.
Unit- 2	Non-linear first order partial differential equation: Complete integral, Envelopes, Cauchy's method of characteristics.
Unit- 3	Compatible System of First Order PDE, Charpit Method, Transport equation, Hamilton Jacobi 's equations.
Unit- 4	Second order partial differential equations: Origin of second order PDEs, examples of higher order PDEs, classification of second order partial differential equations, linear partial differential equations with constant coefficients.
Unit- 5	Non-Homogeneous Linear PDEs with constant coefficient.
Unit- 6	Other methods of solution: Separation of variables, Monge Method.
Unit- 7	Laplace Transforms tosolve PDEs.
Unit- 8	Fourier Transforms tosolve partial differential equations
Unit- 9	Other Transforms: Hopf-Cole transforms, Hodograph and Legendre transforms.
Unit- 10	Laplace equation: Fundamental and elementary solution, Energy Methods.
Unit- 11	Laplace equation: Mean value formulas, real analytic functions, properties of harmonic functions, Potential functions, Green's function.
Unit- 12	Wave equation: Solution by spherical means, Energy methods.
Unit- 13	Wave equation: Representation of solutions: Similarity solutions, plane and travelling waves, Solitons and similarity under scaling.
Unit- 14	Heat equation: Fundamental and elementary solution, Energy methods, Green's Function, Boundary value problems for diffusion equation

READINGS:

1. ELEMENTS OF PARTIAL DIFFERENTIAL EQUATIONS by IAN N. SNEDDON, DOVER PUBLICATIONS.
2. PARTIAL DIFFERENTIAL EQUATIONS by LAWRENCE C. EVANS, AMERICAN MATHEMATICAL SOCIETY.

Course code	EMTH543	Course Title	COMPLEX ANALYSIS-II

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Describe the analytic continuation and its different implications to find the natural boundary of the function.

CO2: Analyze the representation theorems for meromorphic and entire functions for the factorization theorems.

CO3: Apply the concepts of order of entire functions for mapping theorems.

CO4: Evaluate the convergence of the normal families of analytic functions.

Unit No.	Contents
Unit- 1	Analytical continuations: analytic continuation, uniqueness of analytic continuation by direct method.
Unit- 2	Uniqueness of analytic continuation along a curve, power series method of analytic continuation, natural boundary
Unit- 3	Monodromy theorem and its consequences, Poisson integral formula, Poisson kernel, conjugate Poisson kernel.
Unit- 4	Harnack's inequality, relation between mean value property and harmonic functions, Harnack's theorem, Drichlet problem.
Unit- 5	Schwarz reflection principle for harmonic functions, Schwarz reflection principle for analytic functions.
Unit- 6	Infinite sums and meromorphic functions, Runge's theorem, Mittage-Leffler's theorem, infinite product of complex numbers
Unit- 7	Infinite product of analytic functions, Factorization of entire functions, Weierstrass factorization theorem,
Unit- 8	Gamma function and its properties, Jensen's formula for the closed unit disk, Poisson Jensen's formula, Hadamard's three circles theorem.
Unit- 9	Riemann zeta function, integral representation of zeta function, global representation of zeta function, Riemann hypothesis, Riemann's functional equation.
Unit- 10	Order of entire function, genus of entire function, Hadamard's factorization theorem, convergence exponent.
Unit- 11	Open mapping theorem, Hurwitz' theorem, univalent functions, results related to univalent functions, local mapping theorem, inverse mapping theorem.
Unit- 12	Normal families of analytic functions, equicontinuity, Montel Caratheodory, Riemann mapping theorem (statement only).
Unit- 13	Bieberbach's conjecture, area theorem, Bieberbach's theorem, Koebe 1/4- theorem.
Unit- 14	Landau's theorem, Bloch's theorem, Picard's little theorem, Picard's great theorem, Schottky's theorem.

READINGS:

1. COMPLEX VARIABLES AND APPLICATIONS by CHURCHILL, R. V. AND BROWN, J. W., MCGRAW HILL EDUCATION.
2. FOUNDATIONS OF COMPLEX ANALYSIS by S. PONNUSAMY, NAROSA PUBLISHING HOUSE.
3. COMPLEX ANALYSIS by LARS V. AHLFORS, MCGRAW HILL EDUCATION.
4. COMPLEX VARIABLES THEORY AND APPLICATIONS by H. S. KASANA, PRENTICE HALL.

Course code	EMTH637	Course Title	TOPOLOGY

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Identify the topological space and their various types of subsets

CO2: Describe new topological space from given topological space with the help subspace, cartesian product and metric.

CO3: Determine connectedness and weak connectedness properties for topological space

CO4: Illustrate compactness, limit point compactness and local compactness properties for topological space

CO5: Analyze various types of countability properties for topological space

Unit No.	Contents
Unit- 1	Review of Set theory and Logic, Definition and examples of Topological Spaces, Basis and sub-bases and The Order topology
Unit- 2	Relative topology, Closed Sets, Closure, Dense Subsets, Neighbourhoods., Interior sets, exterior sets and boundary sets and Accumulation points and derived sets
Unit- 3	Definition and examples of Continuous Functions on Topological Spaces, Homeomorphism, Constructing Continuous functions and Pasting Lemma
Unit- 4	Product Topology and Metric Topology
Unit- 5	Definition and examples of Connected Spaces, Connectedness on Real Line and Components
Unit- 6	Local Connectedness and Path connectedness
Unit- 7	Compact Spaces, Basic properties of Compactness, Continuous and compact sets, Compactness and finite intersection property
Unit- 8	Compact subspace of real line, Limit point compactness, Local Compactness and Compactification
Unit- 9	First Countable axiom and Second Countable Axiom
Unit- 10	Countable compactness and Lindelof space
Unit- 11	T0, T1, T2, T(3 1/2), and T4 spaces, Characterization and basic properties ofT0,T1,T2,T(3 1/2), and T4 Spaces
Unit- 12	Relation between countability and separability and The Urysohn Lemma
Unit- 13	The Urysohn Metrization Theorem
Unit- 14	The Tietze Extension Theorem

READINGS:

1**.** TOPOLOGY by JAMES R. MUNKRES, PEARSON

2. INTRODUCTION TO TOPOLOGY PURE AND APPLIED by C.ADOMS AND R.FRANZOSA, PEARSON

Course code	EMTH532	Course Title	MECHANICS

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Understand mechanics with emphasis on the mathematical structure of the theory

CO2: Formulate the equations of motion for mechanical systems and their family of solutions

CO3: Understand the dynamics of rigid body motion

CO4: Understand Hamilton Jacobi theory

CO5: Describe Poisson algebra in terms of Poisson bracket

CO6: Understand canonical transformations in terms of Lagrange and Poisson brackets

Unit No.	Contents
Unit- 1	Particle's mechanics
Unit- 2	Energy equation for conservative field, constraint- generalized coordinates, holonomic and non holonomic systems, scleronomic and rheonomic systems
Unit- 3	Lagrange's equation of first and second kind, generalised potential
Unit- 4	Hamilton canonical equations, cyclic coordinates
Unit- 5	Conservation theorems, Routh's procedure
Unit- 6	Hamilton principle and principle of least action, some dynamic problems
Unit- 7	Hamilton and Lagrange equations of motion, Hamilton Jacobi equation of motion
Unit- 8	Hamilton Jacobi equation and verification
Unit- 9	Hamilton's equations of motion, energy equation
Unit- 10	Poisson's bracket, Poisson's first theorem
Unit- 11	Poisson Jacobi identity, Poisson's second theorem, invariances, Lagrange bracket
Unit- 12	Canonical transformations and its conditions in terms of Lagrange and Poisson brackets
Unit- 13	Invariance of Lagrange and Poisson brackets under canonical transformations,
Unit- 14	Poincare-Cartan integral invariant

READINGS:

1. CLASSICAL MECHANICS by HERBERT GOLDSTEIN CHARLES P. POOLE JOHN SAFKO, PEARSON
2. CLASSICAL MECHANICS by Dr. J. C. Upadhyaya, HIMALAYA PUBLISHING HOUSE

Course code	EMTH642	Course Title	FUNCTIONAL ANALYSIS

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Analyze the conditions needed to prove that a space is normed linear space or a Banach space.

CO2: Understand the concept of linear functionals and Hahn-Banach theorem.

CO3: Define the concept of reflexive spaces and understand some standard theorems.

CO4: Construct concept of compact operations and Hilbert spaces.

CO5: Identify the concepts of convex sets and orthonormal sets.

CO6: Describe various operators over Hilbert spaces.

Unit No.	Contents
Unit- 1	Normed linear spaces, Banach spaces and examples, properties of normed spaces.
Unit- 2	Finite dimensional normed spaces and subspaces, quotient space and its completeness, dual space and completeness, equivalent norms.
Unit- 3	Bounded and continuous linear operators, linear functional, compactness and finite dimensional space.
Unit- 4	Conjugate of an operator, conjugate spaces, Hahn-Banach theorem (real and complex form) and its consequences.
Unit- 5	Reflexive spaces, Category theorem, uniform boundedness principle and its consequences.
Unit- 6	Inner product space, Hilbert space, Schwarz's inequality, Hilbert space as a normed linear space, further properties of inner product spaces.
Unit- 7	Parseval's identity, Convex sets in Hilbert spaces, projection theorem, conjugate of Hilbert space
Unit- 8	Open mapping theorem and its application, closed graph theorem, weak and strong convergence, convergence of sequences of operators and functional.
Unit- 9	Orthogonal complements and direct sums, orthonormal sets, Bessel's inequality, Riesz Fischer theorem, complete orthonormal sets.
Unit- 10	Self-adjoint operator, positive operator, normal operator, unitary operator, isometric operators.
Unit- 11	Compact linear operators and its relations with continuous operators, properties of compact operators.
Unit- 12	Riesz representation theorem, representation of functionals on Hilbert Spaces, Hilbert adjoint operator.
Unit- 13	Reflexivity of Hilbert space, orthogonal projection.
Unit- 14	Spectrum of an operator, spectral properties of bounded linear operators, non-emptiness of the spectrum

READINGS:

1. INTRODUCTORY FUNCTIONAL ANALYSIS WITH APPLICATIONS by ERWIN KREYSZIG, WILEY
2. PRINCIPLES OF MATHEMATICAL ANALYSIS by WALTER RUDIN, MCGRAW HILL EDUCATION

Course Code	ECAP172	Course Title	PROGRAMMING METHODOLOGIES

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Develop programming skills and familiar with programming environment with C Program structure

CO2: Declaration of variables and constants.

CO3: Understand arrays, its declaration and uses.

CO4: Implement, test, debug, and document programs in C

Unit No.	Content
Unit-1	**Introduction:** Introduction to Programming, Program concept, Characteristics of programing, stages in program development, Algorithms, Notations, Flowchart, and Types of programing methodologies.
Unit-2	**Constant and Variable:** Machine Language, Assembly Language, High Level Languages, C Program Structure, Character Set, Identifiers and Keywords, Constants and Variables.
Unit-3	**Unformatted and Formatted I/O:** Functions- printf(), scanf(), getchar(), putchar(), gets(), puts(), Expressions.
Unit-4	**Data Types & Operators:** Various data types - data range, size, Unary and Binary operators, Arithmetic Operators, Relational Operators, Logical Operators, Conditional Operators, Assignment Operator, Bitwise Operators.
Unit-5	**Control Structure:** Designing structured programs by using Top-Down design, Type conversion and Type modifiers, if statements - simple if, if-else, multiple if, if-else ladder, nested if, switch-case statement, while, do-while & for statements, break and continue statements, go to statement.
Unit-6	**Functions:** Function Definition and Prototypes, Scope rules - Local and Global scope of functions, Function arguments - passing arguments by value and passing arguments by reference, Return Type of function, Recursion, Library Functions.
Unit-7	**Arrays:** Declaring arrays in C, Defining and Processing of 1-dimensional and 2-dimensional arrays, Passing array as an argument to function, Multi-dimensional Arrays.
Unit-8	**Array Applications:** Sorting and Searching, Character Arrays.
Unit-9	**Strings:** Defining and Initializing strings, Reading and Writing strings, Processing of strings, String Library Functions - strcat(), strcpy(), strcmp(), strlen(), strrev().
Unit-10	**Storage Classes:** Storage class specifiers, Scope of a variable, Auto, Static, Extern, Register, Static variables and functions, Const Qualifier.
Unit-11	**Pointers:** Pointer data type, Pointer declaration, Initialization, accessing values using pointers, Pointer expressions and arithmetic, Operations on Pointers.
Unit-12	**Dynamic Memory Management:** Dynamic Memory Management functions, malloc(), calloc(), realloc() and free(), Pointers and arrays, Pointers and functions.
Unit-13	**Structures and Unions:** Structure declaration, definition and initialization, accessing structures in functions, Structures and Pointers, array of structures, nested structures, Self-referential structures, Unions.
Unit-14	**File Structure:** Categories of files, Opening and closing files, file opening modes, Text and binary files, Reading and writing in files, Appending in files, Creating Header files, Preprocessor Directives and Macros.

LABORATORYWORK:

Data Types & Operators: Various data types - data range, size, Unary and Binary operators, Arithmetic Operators, Relational Operators, Logical Operators, Conditional Operators, Assignment Operator, Bitwise Operators.

Control Structure: if statements - simple if, if-else, multiple if, if-else ladder, nested if, switch-case statement, while, do-while & for statements, break and continue statements, go to statement.

Functions: Function Definition and Prototypes, Scope rules - Local and Global scope of functions, Function arguments - passing arguments by value and passing arguments by reference, Return Type of function, Recursion, Library Functions.

Arrays: Declaring arrays in C, Defining and Processing of 1-dimensional and 2-dimensional arrays, Passing array as an argument to function, Multi-dimensional Arrays.

Pointers: Pointer declaration, Initialization, accessing values using pointers, Pointer expressions and arithmetic, Operations on Pointers.

Structures and Unions: Structure declaration, definition and initialization, accessing structures in functions, Structures and Pointers, array of structures, nested structures, Self-referential structures, Unions.

File Structure: Opening and closing files, file opening modes, Text and binary files, Reading and writing in files, appending in files, Creating Header files.

READINGS:

1. THE COMPLETE REFERENCE by HERBERT SCHILDT, MC GRAW HILL

2. PROGRAMMING IN ANSI C by E. BALAGURUSWAMY, MC GRAW HILL

Course code	ECAP790	Course Title	PROBABILITY AND STATISTICS

	WEIGHTAGE		
	CA	ETE(Th.)	ETE (Pr.)
	30	40	30

Course Outcomes:

CO1: Experiment to carry out simple data investigations for categorical variables.

CO2: Measure a random variable that describe randomness or an uncertainty in certain realistic situation. It can be of either discrete or continuous type.

CO3: Employ the different types of data and choose an appropriate way to display them.

CO4: Identify and compare techniques for collecting data from primary and secondary sources, and identify questions and issues involving different data types

Unit No.	Content
Unit-1	Introduction to probability: Elements of Set Theory, Sample Space and Probability Measure, Statistical Independence, Conditional Probability, Counting Sample Points, Mutually and pair wise independent events, multiplication theorem of probability for independent events, Baye's theorem.
Unit-2	Introduction to statistics and data analysis: Statistical Inference, Samples, Populations and Experimental Design, Measures of Location: The Sample Mean and Median, Measures of Variability, Discrete and Continuous Data, Statistical Modeling, Scientific Inspection, and Graphical Diagnostics, Graphical Methods and Data Description, General Types of Statistical Studies.
Unit-3	Mathematical expectations: Definition, expected value of random variable, expected value of function of a random variable, properties of expectations, Various measures of Central Tendency, Dispersion, skewness and Kurtosis for continuous probability distribution, continuous distribution function, Variance, Properties of variance, covariance.
Unit-4	Moments: Chebyshev Inequality, Moments of Two or More Random Variables, Moments of Sums of Random Variables, Moment Generating Function, Properties of moment generating function, cumulants, Raw and central moments.
Unit-5	Relation between moments: raw moments & central moments, Effect of change of origin and scale on moments, Pearsonian coefficients Measures of skewness, kurtosis.
Unit-6	Correlation, regression and analysis of variance: Pearson's Correlation coefficient, Spearman's Rank correlation coefficient, Regression Concepts, Regression lines, Multiple correlation and regression, Analysis of Variance- One-way classification and two-way classification.
Unit-7	Standard distribution: Binomial, Poisson, Negative Binomial Distribution, Normal Distribution and their properties.
Unit-8	Statistical quality control: Introduction, Process control, control charts for variables – X and R, X and S charts control, charts for attributes: p chart, np chart, c chart and their applications in process control
Unit-9	Index numbers: Learn about the need of index numbers, explain the different methods of constructing index numbers, evaluate the tests for judging the soundness of an index number.
Unit-10	Time series: Explain about time series, describe components of time series, and define measurement of variations of time series.
Unit-11	Sampling theory: Sampling Theory, Random Samples and random Numbers, Sampling with and without replacement, sampling distributions, sampling distribution of means, sampling distribution of properties, sampling distribution of differences and sum, standard errors, software demonstration of elementary sampling Theory.
Unit-12	Hypothesis testing: Definition of hypothesis, interpret statistical procedure of hypothesis

	testing, use application of hypothesis testing in several business contexts.
Unit-13	Tests of significance: Based On t, F and Z Distributions: -Student's (t) distribution, definition, properties, critical value of t, Application of t-distribution, Test for single mean, t-test for difference of mean, Fischer Z- transformation, F-statistic, critical value of F distribution, application.
Unit-14	Statistical tools and techniques: Bayesian Concepts, Bayesian Inferences, Bayes Estimates Using Decision Theory Framework, Statistical Tools: Excel, R-Studio and SPSS.

READINGS:

1. FUNDAMENTALS OF MATHEMATICAL STATISTICS by S.C. GUPTA AND V. K. KAPOOR, SULTAN CHAND & SONS (P) LTD.
2. PROBABILITY & STATISTICS FOR ENGINEERS & SCIENTISTS by RONALD E. WALPOLE, PEARSON

Course Code	EMKT509	Course Title	CONSUMER BEHAVIOR

		WEIGHTAGES	
		CA	ETE(Th.)
		30	70

Course Outcomes:
CO1: Understand the implications of consumer behavior concepts & theories for businesses and wider society.
CO2: Discern how individuals and groups influence consumer behavior, and how marketers utilize this knowledge to help achieve organizational objectives.
CO3: Analyze the dynamic interplay of internal and external factors influencing consumer behavior and accordingly develop a marketing strategy.
CO4: Articulate practical and comprehensive managerial understanding of consumer behavior.
CO5: Develop the understanding of marketing regulation, consumer protection act and contemporary issues in consumer behaviour.

Unit No.	Content
Unit-1	**Consumer Behavior and Marketing strategy**: consumer behaviour, market strategy and applications of consumer behavior.
Unit-2	**Market Analysis and Consumer Decisions:** market analysis components, segmentation strategy and consumer decisions and consumer behavior models.
Unit-3	**Culture and Group influence**: cultural and group influence on consumer behavior, concept of culture, cross cultural marketing strategy, the household life cycle and marketing strategy.
Unit-4	**Groups, Reference Group and Diffusion of Innovation**: groups, types of groups, reference group influence on consumption process & marketing strategies and diffusion of innovation.
Unit-5	**Perception**: perception, exposure, attention and interpretation, perception and marketing strategy.
Unit-6	**Learning and Personality:** memory's role in learning, learning theories, brand image and product positioning, brand equity and brand leverage motivation, personality and emotion.
Unit-7	**Motivation and Emotion**: motivation theory and marketing strategy use of personality in marketing practice, emotions and marketing strategy.
Unit-8	**Attitude and Market Segmentation**: attitude, influencing attitude, attitude components and change strategies, market segmentation and product development strategies based on attitudes.
Unit-9	**Self-Concept and Consumer Decisions**: nature of lifestyle, the VALS system consumer decision process and types of consumer decisions.
Unit-10	**Consumer Decision Making Process**: process of problem recognition and uncontrollable determinants of problem recognition, marketing strategy and problem recognition, information, alternative evaluation and selection, types and sources of information, consumer decision making and evaluation criteria.
Unit-11	**Decision Rules and Attributes of consumers:** decision rules for attitude-based choices, attributes affecting retail outlet selection, consumer characteristics and outlet choice, in-store and online influence on brand choice and evaluation criteria.
Unit-12	**Post purchase Processes and Dissonance**: post purchase processes, post purchase dissonance, product use and non-use, disposition.
Unit-13	**Purchase Evaluation and Customer Satisfaction**: purchase evaluation, customer satisfaction, dissatisfaction responses, repeat purchase and customer commitment.

Unit-14	**Consumer Behavior and Marketing Regulation**: regulation and marketing to children, regulation and marketing to adults, consumer protection act and contemporary issues in consumer behavior.

READINGS:

1. CONSUMER BEHAVIOR- BUILDING MARKETING STARTEGY by DEL I HAWKINS, DAVID L MOTHERSBAUGH, & AMIT MOOKERJEE, MCGRAW HILL EDUCATION
2. CONSUMER BEHAVIOR by RAJNEESH KRISHNA, OXFORD UNIVERSITY PRESS.
3. SCHIFFMAN, L. G., &KANUK, L. L. CONSUMER BEHAVIOR. NEW DELHI, PRENTICE HALL.

Course Code	EFIN548	Course Title	INTERNATIONAL FINANCIAL MANAGEMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Understand the critical financial issues of international firms and international investors in present scenario.

CO2: Analyze the framework of exchange rates and foreign exchange exposuress and forces affecting exchange rates.

CO3: Evaluate the international capital structure and international capital budgeting mechanism of multinational corporations.

CO4: Analyze the different modes of raising finance in international market and significance of international finance in MNCs.

Unit No.	Content
Unit-1	**Introduction to International Financial management:** Domestic vs. international finance, International financial market integration, currency crisis, and global recession and risk spill over
Unit-2	**Balance of Payments** - Structure - Contents of Current, Capital, and Reserve Accounts – Linkages and Impact on Exchange Rates, Capital Markets, & Economy - Understanding BOP structure of a country for Investment and Raising Finance
Unit-3	**Foreign Exchange Markets and Exchange Rate Mathematics**: Nature, Functions, Transactions, Participants, Forex Markets in India, Forex dealing, Foreign exchange regimes, Foreign exchange rate determination, factors affecting foreign exchange
Unit-4	**Forecasting Foreign Exchange Rate:** Exchange Rate Forecasting– Purchasing Power Parity, Covered and Uncovered Interest Rate Parity – International Fisher's Effect - Forward Rate Parity–Influence of these parity relationships on Exchange Rates
Unit-5	**Foreign Exchange Spot and Derivative Market**: Spot and Forward Contracts- Cash and Spot Forex Trading, Forward Contracts- Long and Short Forward contract, Foreign Exchange Futures Contract- Contract specification trading at National Stock Exchange of India
Unit-6	**Management of Foreign Exchange Risk:** Foreign Exchange Exposure: Risk, Measurement and Management: Global Firms Foreign exchange exposure - Transaction, economic and translation exposures, potential currency exposure impact on global firms and investor performance
Unit-7	**International Capital Markets** - Sources of International Finance - Debt and Equity Markets –International Equity Diversification, Short-term Vs Long-term Finance – Export Import Finance
Unit-8	**Capital Structure of the Multinational Firm:** International Capital Structure – Parent Vs Subsidiary Norms, Global Capital Structure – Factors affecting the choice of markets and structure. International Cost of Capital – Calculation – Cost of Foreign Debt, Cost of Foreign Equity, Use of International CAPM
Unit-9	**Capital Budgeting of the Multinational Firm:** International Capital Budgeting – Key Issues – Unique Cashflows – Adjusted Present Value Approach. Foreign Direct Investment – Motives – Determinants – International Portfolio Diversification.
Unit-10	**Working Capital Management of the Multinational Firm:** International Working Capital Management – International Cash Management – Decentralized Vs Centralized Cash Management – Bilateral Vs Multilateral Netting – Central Cash Pool

Unit-11	**Option Contracts** American and European Currency Options, call and Put option, Option and risk management strategies. Introduction to currency swap, Foreign exchange risk management strategies through Forward contracts, future contracts, money market hedges, and options contracts.
Unit-12	**Managing Foreign Operations**: ADRs; benefits and costs of ADR holdings for investors; benefits and costs of ADR issuance for corporations, External Commercial Borrowing and International refinancing, issues and challenges before multinational subsidiaries
Unit-13	**Multinational Cash management**: Centralized perspective of Cash Flow Analysis, Techniques to Optimize Cash Flow- Leading and Lagging, Netting, Matching.
Unit-14	**Country Risk Analysis-** Nature of Country Risk Assessment, Techniques to assess Country Risk, Raters of Country Risk, Multinational Capital Budgeting: Problems and issues in Foreign Investment Analysis, Techniques of Multinational Capital Budgeting- NPV, IRR, APV

READINGS:

1. Shapiro, A.C. (2013). Multinational Financial Management. (10thed.). John, Inc.
2. Buckley, A. (2009). Multinational Finance. (5thed.). Pearson Education.
3. Levi, M.D. (2018). International Finance. (6th ed.). Routledge Publications
4. Madura, J. (2018). International Financial Management. (13thed.). Cengage Learning India Pvt Ltd.

Course Code	EFIN548	Course Title	INDIAN ECONOMIC DEVELOPMENT

WEIGHTAGES	
CA	ETE(Th.)
30	70

Course Outcomes:

CO1: Examine a comprehensive understanding of the current issues influencing economic development of India

CO2: Impart the understanding of critical concerns of Indian economy

CO3: Application of economic theory in the context of India

CO4: Develop the analytical skills amongst students relating with core economic debates in the context of India

CO5: Interpret the role and impact of foreign trade and investment in Indian economy

Unit No.	Content
Unit-1	**Indian economy since independence**: trends and composition of national income, changes in agriculture and industrial sector, strategies of self-reliance on import substitution and protection
Unit-2	**Human development**: human development index, characteristics of developing world, Millennium Development Goals and Sustainable Development Goals in India, state of human development in India
Unit-3	**Cooperative federalism**: evolution of planning, role and functions of Niti Aayog, role of centre and state, macroeconomic crisis, post 1991 structural and financial sector reforms
Unit-4	**Demographic constraint**: India's demographic transition, India's demographic dividend, structural constraint in economic growth, sustainable development and climatic changes
Unit-5	**Poverty and inequality in India**: periodisation of Indian growth experience, causes of poverty, poverty alleviation programmes, inequality after economic reforms
Unit-6	**Unemployment in India:** unemployment: labour market reforms and skill development in India
Unit-7	**Agriculture sector**: agriculture growth, green revolution in India, factors affecting the agriculture growth, rural development programmes including poverty alleviation programmes
Unit-8	**Agricultural policy**: land reforms, agriculture price policy, food subsidy and public distribution system, food security and food security bill
Unit-9	**Industrial development:** industrial policy reforms, CCI and MRTP act, industrial policy in 12th five year plan, privatisation and disinvestment, role of small and medium enterprises
Unit-10	**Services sector:** growth and sectoral shares in service sector, India's service trade, fdi in India's service sector, liberalisation of services in India
Unit-11	**Fiscal policy:** 14th finance commission, financial powers of the states, financial aspects of 73rd and74th constitutional amendments, foreign responsibility and budget management act
Unit-12	**Foreign trade**: impact of import substitution and export promotion, balance of payment, foreign exchange reserves, India and WTO
Unit-13	**Monetary Policy**: Reserve Bank of India and its functioning, various policy rates of the RBI, the reports of various Monetary Policy Committees
Unit-14	**Structural Reforms of the Indian Economy**: Features of Economic reforms and structural adjustment programme: Liberalization, Privatization and Globalization, appraisal of Economic reform programme

READINGS:

1. INDIAN ECONOMY PERFORMANCE AND POLICIES by UMA KAPILA, ACADEMIC FOUNDATION
2. THE INDIAN ECONOMY by NILANJAN BANIK, SAGE PUBLICATIONS
3. THE INDIAN ECONOMY by DUTT AND SUNDHARAM, S. CHAND & COMPANY

Course Code	ECAP202	Course Title	OBJECT-ORIENTED PROGRAMMING

	WEIGHTAGE		
CA	ETE(Th.)	ETE (Pr.)	
30	40	30	

Course Outcomes:

CO1: Familiarize with the basic concepts of object-oriented programming

CO2: Understand the object construction, memory allocation and deallocation

CO3: Develop programs using object-oriented concepts like encapsulation, inheritance and polymorphism

CO4: Analyse the different behaviour of overloaded operations in different situations

Unit No.	Contents
Unit- 1	**Principles of OOP:** introduction, procedural vs object oriented programming, basic concepts of object oriented programming, object oriented languages, benefits of OOP's
Unit- 2	**Basics of C++:** C Vs C++, a simple C++ program, compiling & linking, tokens, keywords, identifiers & constants, data types, reference variables
Unit- 3	**Operators and type casting:** operators in C++, scope resolution operator, member de-referencing operators, type casting: implicit and explicit type casting
Unit- 4	**Control structures:** decision making controls, iterative controls and jumping controls
Unit- 5	**Pointers and structures:** main function, function prototyping, handling pointers, C structures and limitations
Unit- 6	**Classes and objects:** specifying class, a sample C++ program with class, access specifiers, defining member functions, nesting of member functions
Unit- 7	**More on classes and objects:** function definition inside the class and outside the class, private member functions, arrays within class, memory allocation of objects
Unit- 8	**Handling functions:** function calling mechanisms: call by Value, call by address & call by reference, objects as function arguments
Unit- 9	**More on functions:** inline functions, making outside function inline, friend functions
Unit- 10	**Static members and polymorphism:** Static Data Members & Static Functions, Function Overloading
Unit- 11	**Constructors and destructors:** constructors, parameterized constructors, copy constructor and dynamic constructor, multiple constructor in a class
Unit- 12	**More on constructors and destructors:** constructors with default arguments, dynamic initialization of objects, destructors
Unit- 13	**Inheritance:** defining derived classes, single inheritance, making a private member inheritable, multilevel inheritance, hierarchical inheritance, multiple inheritance, hybrid inheritance
Unit- 14	**File handling:** file handling operations: open, close, read and write

LABORATORY WORK:

Implementation of C++ Programming Concepts (Classes and objects, inline functions, friend functions, constructor and destructors, function overloading, inheritance, working with files)

READINGS:

1. OBJECT ORIENTED PROGRAMMING WITH C++ by E BALAGURUSAMY, MC GRAW HILL
2. LET US C++ by YASHAVANT KANETKAR, BPB PUBLICATIONS
3. OBJECT ORIENTED PROGRAMMING IN C++ by ROBERT LAFORE, GALGOTIA PUBLICATIONS
4. THE C++ PROGRAMMING LANGUAGE by BJARNE STROUSTRUP, PEARSON

Course Code	ECAP792	Course Title	DATA SCIENCE TOOL BOX

	WEIGHTAGE		
CA	ETE(Th.)	ETE (Pr.)	
30	40	30	

Course Outcomes:

CO1: Observe the Various Methods to Extract Knowledge Using Data Mining Techniques

CO2: Evaluate Current Trends in Data Mining Such as Web Mining, Spatial-Temporal Mining.

CO3: Apply Different Data Mining Methodologies with Information Systems.

CO4: Analyze Research of Database Systems and Able to Improve The. Decision-Making Process

CO5: Observe the Various Methods to Extract Knowledge Using Data Mining Techniques

CO6: Evaluate Current Trends in Data Mining Such as Web Mining, Spatial-Temporal Mining.

CO7: Apply Different Data Mining Methodologies with Information Systems.

CO8: Understand Big Data Concepts

CO9: Define Need of Big Data Analytics in Real World

CO10: Develop Interest in The Area of Hadoop Cluster Mechanism

CO11: Apply the Big Data Learning in Research

Unit No.	Content
Unit-1	**Data Science Fundamentals:** What is Data Science? What is Data? The Data Science Process, Need of Data Science, Global requirement of Data Scientist.
Unit-2	**Using Data Science Tool R and RStudio:** Installing R, Installing R Studio, RStudio Tour, R Packages, Projects in R
Unit-3	**Version Control and GitHub:** Version Control, Github and Git, Linking Github and R Studio, Projects under Version Control
Unit-4	**Introduction to Python:** Variables and expressions, conditional execution (loops, branching, and try/except), functions, Python data structures (strings, lists, dictionaries, and tuples), and manipulating files
Unit-5	**Python as Data Visualization:** Introduction to Data Visualization, introduction to Matplotlib, Basic Plotting with Matplotlib, importing Dataset, Line Plot, Area Plots, Histograms Bar Charts, Waffle Charts, Word Clouds
Unit-6	**Introduction to Rapid Miner:** Downloading and Installation of Rapid Miner, Introduction to different modules of Rapid miner interface, working with different sample data in Rapid miner, Working with different sample process in Rapid miner
Unit-7	**Introduction to operators in RapidMiner:** Introduction to various operators in RapidMiner, working with different data processing operators, Using various filters. Statistical. Analysis of sample data.
Unit-8	**Introduction to Big Data:** Understanding big data concepts and terminology datasets data analysis data analytics descriptive analytics, diagnostic analytics, predictive analytics, prescriptive analytics business intelligence (BI) ,key performance indicators (KPI) big data characteristics volume, velocity ,variety veracity value different types of data :structured data ,unstructured data ,semi- structured data ,metadata case study background history identifying data characteristics volume velocity variety veracity
Unit-9	**Business Motivations and Drivers for Big Data Adoption:** Business Motivations and Drivers for Big Data Adoption : marketplace dynamics business architecture business process management information and communications technology data analytics and data science

	digitization affordable technology and commodity hardware social media hyper-connected communities and devices cloud computing internet of everything (IoE) case study example
Unit-10	**Introduction to Weka mining tools:** Introduction to Weka tool, importing data into Rapid miner using different formats of files, Storing and retrieving data using rapid miner.
Unit-11	**Data Import and Export in Rapid Miner:** Graphical representation of data in rapid miner, Hands on practice problems on data import/export. Identification and removal of duplicates, apply operations for handling meta data like rename or attribute role definition, Identify and remove the missing values in the data set
Unit-12	**Data Pre-processing using rapid miner:** Apriori method for finding frequent itemset Weka/Rapid miner tool Apply data mining pre-processing techniques and methods to large data sets, Hands on practice problems on data pre-processing
Unit-13	**Introduction to classification:** Introduction to Classification methods, applying model for prediction, Bayesian Classification on new imported data, Bayesian Classification on existed dummy data set, Decision Tree classification on both new and dummy data sets
Unit-14	**Introduction to clustering:** Introduction to Clustering algorithms, differentiate clustering and classification, K-means clustering, Hierarchical clustering algorithm

READINGS:

1. Data Mining and Machine Learning, A Programmer's Guide to Data Mining, Ron Zacharski, 2015.
2. DATA MINING: CONCEPTS AND TECHNIQUES by JAWEI HAN, MICHELINE KAMBER AND JIAN PE, MORGAN KAUFMANN
3. NTRODUCTION TO DATA MINING by PANG-NING TAN, MICHAEL STEINBACH, VIPIN KUMAR, PEARSON

Course Code	EMKT505	Course Title	DIGITAL AND SOCIAL MEDIA MARKETING

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Define social media marketing goal setting necessary to achieve successful online campaigns.

CO2: Describe the stages of the social media marketing strategy development process.

CO3: Develop effective social media marketing strategies for various types of industries.

CO4: Devise an integrated social media marketing strategy using a variety of services, tools and platforms to accomplish marketing objectives.

CO5: Analyze the progress in achieving social media goals with a variety of powerful measurement tools, services, and metrics.

Unit No.	Contents
Unit- 1	**Evolution of digital marketing**- the digital consumer & communities online and digital marketing landscape.
Unit- 2	**Search Engine Marketing**- Pay Per Click (PPC) and online advertising, search engine optimization and search engine marketing.
Unit- 3	**Social media and consumer engagement**: Social feedback cycle, social web and engagement, operations and marketing connection.
Unit- 4	**Customer engagement** -affiliate marketing & strategic partnerships-Email marketing-Content strategies.
Unit- 5	**New role of the customer**: social interactions, customer relationships, outreach and influencer relations.
Unit- 6	**Social listening**-importance of social analytics, know your influencers, web analytics, and business analytics.
Unit- 7	**Mobile Marketing**-integrating digital and social and media strategies.
Unit- 8	**Social technology and business decisions:** creation of social business, understanding the conversations, social CRM and decision support.
Unit- 9	**Social CRM:** social CRM and business design and build a social CRM program.
Unit- 10	**Engagement on the social web:** engagement as a customer activity, engagement as a business activity and extend engagement.
Unit- 11	**Social objects:** meaning of social object, build on existing social objects, create new social objects and use of social objects in business.
Unit- 12	**Social graph:** role of social graph, social graphs spread information, use of social graphs in the business and measure the social graphs.
Unit- 13	**Social applications:** importance of social applications, social applications drive engagement and planning a social application.
Unit- 14	**Social business ecosystem:** social profiles, social applications, using brand outposts and communities, social ecosystem**.**

READINGS:

1. SOCIAL MEDIA MARKETING by DAVE EVANS AND JAKE MCKEEE, WILEY
2. SOCIAL MEDIA MARKETING: A STRATEGIC APPROACH by MELISSA S. BARKER, DONALD I.BARKER, NICHOLAS F. BORMANN, DEBRA ZAHAY, MARY LOU ROBERTS, CENGAGE LEARNING
3. ADVANCED SOCIAL MEDIA MARKETING: HOW TO LEAD, LAUNCH, AND MANAGE A SUCCESSFUL SOCIAL MEDIA PROGRAM by TOM FUNK, APRESS

Course Code	EFIN508	Course Title	INTERNATIONAL BANKING AND FOREX MANAGEMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Understand the dimensions of international banking

CO2: Establish legal and regulatory issues in international banking institutions

CO3: Demonstrate foreign exchange market operations

CO4: Discover the functions of different bodies in foreign exchange management

CO5: Analyze various management issues in international finance

Unit	Topics
Unit- 1	**International banking:** global trends and developments in international banking, international financial centers, offshore banking units, profitability of international banking operations
Unit- 2	**Offshore banking & offshore currency trading;** Factors contributing to the growth of international banking & Eurocurrency trading, regulatory asymmetry
Unit- 3	**International finance:** fundamental principles of lending to MNCs, documentation and monitoring
Unit- 4	**International credit appraisal:** International credit policy agencies and global capital markets, raising resources, project and infrastructure finance, financing of mergers and acquisitions
Unit- 5	**Legal and regulatory aspects:** country risk and bank risk management, international debt management
Unit- 6	**International regulatory bodies:** Role of IMF and World Bank in international debt crisis management, anti-money laundering laws
Unit- 7	**Foreign exchange business:** Foreign exchange management act (FEMA), foreign exchange management philosophy, different types of exchange rates
Unit- 8	**International Financial Markets:** Foreign exchange markets, international money markets, international credit markets, international bond markets & international stock markets; Regulatory asymmetry & its implications; Recycling of petrodollars
Unit- 9	**Role of RBI towards FOREX:** RBI and FEDAI role in regulating foreign exchange, rules regarding rate structure, Indian norms
Unit- 10	**International trade:** regulations covering international trade, various aspects of international trade, government policies
Unit- 11	**International Trade organization:** DGFT and their schemes, customs procedures, banks' role in implementing these policies and schemes, WTO-its impact
Unit- 12	**Foreign Exchange Risk Management -** Risk of forex fluctuations, impacts of global milieu, Types of fore risks, strategies for managing the risk, comprising policies, procedures and controls
Unit- 13	**Challenges of international Banking:** Bank failure & safety nets, the problem of moral hazard & systemically important financial institutions; Problems in regulating international banking, regulatory arbitrage; BIS & Basel Committee-issues & challenges.
Unit- 14	**Contemporary issues:** lessons from recent crisis in international banking crude oil relationship with foreign exchange, countries holding foreign exchange reserves, impact of federal policy decision on forex valuations, India economic crises of early nineties

READINGS:

1. INTERNATIONAL BANKING BY P. SUBRAMANIAN, MACMILLAN
2. INTERNATIONAL BANKING OPERATIONS by B. Y. OLKAR, A. K. TRIVEDI, A. K. PATWARDHAN, A. R. PAWSE, MACMILLAN.

Course Code	EQTT501	Course Title	MATHEMATICS FOR ECONOMISTS

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Solve fundamental problems in both macroeconomics and microeconomics using mathematical tools.

CO2: Calculate economic problems through calculus

CO3: Articulate optimization tools to describe feasible choices and to find best solution in the choices available

CO4: Analyze the economic models like IS LM curve, growth function and logistic function mathematically.

CO5: Estimate the application of mathematical tools for conducting research in empirical economics

CO6: Evaluate the empirical economic problems through mathematical application

Unit No.	Content
Unit-1	**Function:** concept of function, types of function, domain, range and limits basics, inclination and slope, logarithmic and exponential function, homogenous function, cobb douglas production function, cost functions and production functions
Unit-2	**Basic real Analysis:** in normed spaces, notions of open, closed and compact sets, continuous functions, their optima and their existence. Notions of differentiability of mappings between Euclidean spaces, chain rule, higher order derivatives. Implicit and inverse function theorem, comparative statics.
Unit-3	**Quadratic Equations**: Introduction, Properties of Roots: Types of roots (Real and Imaginary), Sum of roots, product of roots, Solving Quadratic Equations using properties of roots, Solution of Quadratic Equations
Unit-4	**Linear Programming:** simplex method, statement of basic theorems of linear programming, formulation of the dual of primal and its interpretation, shadow prices and their uses, formulation of linear programming through graphical method, duality
Unit-5	**Maxima and Minima**: minimization of cost, maximization of revenue, profit maximization under monopoly, duopoly, bilateral monopoly, economic order quantity, transactions demand for money, law of equimarginal utility, problem of maxima and minima in single and multivariable function, constrained and unconstrained optimization problems
Unit-6	**Matrices**: Introduction to matrix, Types of matrix, Addition and subtraction of matrix, Multiplication of matrices, Determinants, Inverse of matrices, Solution of equations using matrices
Unit-7	**Input-Output Analysis:** introduction, assumptions, Leonteif open and closed systems, Hawkin Simon conditions, general equilibrium system, equilibrium prices:3 industry case, multiple chain: economic interpretation of leontief inverse
Unit-8	**Differential calculus: functions of one variable:** differentiation and rules of differentiation, implicit differentiation, logarithmic differentiation, point elasticity and elasticity of substitution, production function and marginal revenue product, output elasticity and aggregate demand, logistic function, rate of growth, implicit functions and policy models, IS- LM equations
Unit-9	**Differential calculus: functions of two or more variable:** partial derivatives, Euler's theorem, maxima and minima: stationary points, pure competition, monopolist producing two commodities, discriminating monopolist

Unit-10	**Integration:** concept, simple rules of integration, indefinite integral, integration by substitution, integration by parts, integration by partial fractions, irrational functions, consumer surplus, producer surplus, propensity to consume and the consumption function, the learning curve, Ginni coefficient, pareto income distribution, capital formation, relation between capital and investment
Unit-11	**Differential and difference equations:** solution of first order and second order equations, applications in trade cycle models, growth models and lagged market equilibrium models, Cobcueb model, effect of public prediction on market stability, Samuelson multiplier acceleration model, Duesenberry multiplier accelerator model of income determination
Unit-12	**Linear Algebra:** matrix: types, properties of determinants, inverse of matrix, solution by crammer's rule and matrix inverse method, linear independence and dependence of vectors, characteristic roots and vectors, quadratic forms: application of matrix in input- output analysis.
Unit-13	**Optimization**: characterizations of differentiable concave and quasiconcave functions, characterization of interior optima, Lagrangecharacterization of optima subject to equality constraints, Karush-John-Kuhn-tucker characterization of optima subject to inequality constraints.
Unit-14	**Trigonometric Functions**: Introduction to Angles, Relation between Radian and Degree, Sign of Trigonometric Functions in different Quadrants, Basic trigonometric function (excluding geometrical function)

READINGS:

1. MATHEMATICS AND STATISTICS FOR ECONOMICS, 2/E by G S MONGA, VIKAS PUBLISHING
2. HOUSE MATHEMATICS FORSTUDENT OF ECONNOMISTS by AGGARWAL, C.S AND JOSHI, R.C, NEW ACADEMIC PUBLISHERS
3. MATHEMATICAL ANALYSIS FOR ECONOMISTS by RGD ALLEN, MACMILLAN

Course Code	ECAP512	Course Title	OPEN-SOURCE WEB APPLICATION DEVELOPMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcome:

CO1: Develop dynamic web applications using PHP

CO2: Apply database concepts for effectively manage data using server site script

CO3: Summarize the different aspects of server site and client site scripts

CO4: Apply the parsing technique to read data from other sources

Unit No.	Content
Unit-1	**My SQL**: current and future versions of mySQL, installing mysql. basic security guidelines. privilege system and working with user privileges
Unit-2	**Apache Server**: versions of apache. choosing appropriate installation method. installing on windows. apache configuration file structure. apache log file. starting apache for first time
Unit-3	**PHP**: versions of php. installation of php. php.ini basics. testing installation
Unit-4	**Data Types & Operators:** Various data types - data range, size, Unary and Binary **Building Blocks of PHP**: variables, data types, operators & expressions, constants, switching flow, loops, code blocks and browser output
Unit-5	**Functions**: meaning, calling, defining a function. return value from user-defined function. saving state with 'static' function. testing for existence of function
Unit-6	**Arrays**: what are arrays, creating arrays, array related functions
Unit-7	**Objects**: creating an object. object inheritance
Unit-8	**Working with String, Dates & Time**: formatting string with php. using date and time functions with php. other string, date/time functions
Unit-9	**Forms**: creating simple input form. accessing form input with user defined arrays, html and php code on a single page. using hidden fields to save state. redirecting user. working with file upload
Unit-10	**Cookies**: introducing cookies, setting cookies, deleting cookies with php, session function overview, starting session, working with session variables. destroying sessions and unsetting variables
Unit-11	**Files and Directories**: include files with include(). validating files. creating files, deleting files, opening a file for reading, writing, appending
Unit-12	**Images**: understanding image creation process, necessary modifications to php, drawing a new image, modifying existing images, image creation from user input
Unit-13	**Stored Procedures**: what are transactions, what are stored procedures
Unit-14	**Connecting to MySQL with PHP**: working with mysql data

READINGS:

1. TEACH YOURSELF PHP, MYSQL & APACHE, BY: MELONI, PEARSON EDUCATION.
2. OPEN-SOURCE DEVELOPMENT WITH LAMP: USING LINUX, APACHE, MYSQL, PERL & PHP BY: JAMES LEE, PEARSON EDUCATION
3. PHP: A BEGINNER'S GUIDE BY: VASWANI, VIKRAM, BY: TATA MC-GRAW HILL

Course Code	ECAP794	Course Title	ADVANCE DATA VISUALISATION

	WEIGHTAGE		
CA	ETE(Th.)	ETE (Pr.)	
30	40	30	

Course Outcomes:

CO1: Discuss the terminology used in Tableau Prep.

CO2: Identify how Tableau Prep approaches data sampling.

CO3: Construct and understand data prep flows that address common scenarios encountered in data preparation, as applied to common data use cases.

CO4: Review the quality of the data and perform exploratory analysis.

CO5: Manage and Connect Data Source.

Unit No.	Content
Unit-1	**Introduction to Data Visualization**: Acquiring and Visualizing Data, Simultaneous acquisition and visualization, Applications of Data Visualization, Keys factors of Data Visualization. Reading Data from Standard text files (.txt, .csv, XML), Displaying JSON content.
Unit-2	**Making charts interactive and animated**: Data joins, updates and exits, interactive buttons, Updating charts, Adding transactions, using keys , wrapping the update phase in a function, Adding a Play button to the page, Making the Play button go, Allow the user to interrupt the play, sequence.
Unit-3	**Managing, organizing and enhancing data:** Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization
Unit-4	**Creation of Hierarchies:** Create hierarchies to drill down into data, Creating groups for data, Creating and Using Sets Create data filters, Create calculated fields, Combine data sources using data blending, Creating & using Parameters, Bringing in More data with Joins
Unit-5	**Chart types and their usage in tableau:** Defining data and their different visualization ways, Building various charts, Visualizing data using Bar Chart, Lines Charts, Scatterplots, Heat maps, Histograms, Maps, Dual Axis, Charts, Pie Charts.
Unit-6	**Visualization data with advanced analytics:** Polygon Maps, Bump Charts, Control charts, Funnel charts, Pareto charts, Waterfall charts, Usage and filtration of data with charts, Visualizing categorical data, Visualizing time series data, Visualizing multiple variables, Visualizing geospatial data, Map box integrations, Web Mapping Services, Background Images
Unit-7	**Interactive dashboards and story points in tableau:** Creating a dashboard, Designing dashboard, Add motions, Adding interactivity with actions, Dashboard layout and formatting, Add extra detail to visualization using Marks Shelf, Add Size, Shape, Labels, Details, Tool tips in visualization, Sharing and collaborating dashboards.
Unit-8	Story Points and how to create them, Designing effective slide presentations to showcase data story, Publish online business dashboards with Tableau, Exporting Pdfs, Sharing Dashboard Securely
Unit-9	**Introduction:** Installation of TABLEAU, Tableau Interface, Data Types, Tableau features **Tableau Data Sources:** Connecting data with tableau, Joining data sources, Combine data sources using data blending, Creating and Using Sets Create data filters, Creating & using Parameters, Bringing in More data with Joins
Unit-10	**Managing, organizing and enhancing data in tableau:** Splitting data, Pivoting &Transforming data, Blue & green pills Filters, Blue& green pills effect on dates, Cleaning data by Bulk Re-aliasing, Setting data defaults, Create hierarchies to drill down into data, Creating groups for data, Create calculated fields

Unit-11	**Sharing your Work**: Tableau data source, Tableau data extract, Tableau workbook, Tableau packaged workbook.
Unit-12	**Mathematical and visual analytics in tableau**: Aggregate calculations, Date calculations, Logic calculations, Number calculations, String calculations, Type calculations, LOD Expressions, Add reference lines and trend lines
Unit-13	**Interactive dashboards and story points in tableau**: Creating a dashboard, Designing dashboard, Add motions, Adding interactivity with actions, Dashboard layout and formatting, Add extra detail to visualization using Marks Shelf, Add Size, Shape, Labels
Unit-14	**Publishing work:** Sharing and collaborating dashboards, Story Points and how to create them, Designing effective slide presentations to showcase data story, Publish online business dashboards with Tableau, Exporting Pdfs, Sharing Dashboard Securely

READINGS:

1. DESIGNING DATA VISUALIZATIONS: REPRESENTING INFORMATIONAL RELATIONSHIPS by JULIE STEELE, NOAH ILIINSKY, KINDLE EDITION
2. MASTERING PYTHON DATA VISUALIZATION PAPERBACK by KIRTHI RAMAN, PACKT PUBLISHING

Course Code	EMKT517	Course Title	CUSTOMER RELATIONSHIP MANAGEMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Develop an insight and new learning in the area of customer relationship management.

CO2: Identify and respond to customers' needs, expectations and issues to build productive and rewarding relationships with customers.

CO3: Discuss the conceptual foundations of relationship marketing and its implications for further knowledge development in the field of business.

CO4: Develop a conceptual understanding and the knowledge pertaining to practical application for building and managing partnering relationships with customers and suppliers.

CO5: Analyse how CRM is being used in consumer and business markets-implementation, management, benefits, problems and solutions.

Unit No.	Content
Unit-1	**Introduction to CRM:** definition, CRM as a business strategy, elements of CRM, processes and systems, entrance, applications and success of CRM.
Unit-2	**Conceptual Foundations:** evolution and benefits of CRM; building customer relationship and zero customer defection.
Unit-3	**Strategy and Organization of CRM:** customer-supplier relationships, CRM as an integral business strategy and the relationship-oriented organization.
Unit-4	**CRM Marketing Aspects:** customer knowledge, communication and multichannel, the individualized customer proposition and the relationship policy.
Unit-5	**Analytical CRM:** relationship data management, data analyses and datamining, segmentation and selections, retention and cross-sell analyses.
Unit-6	**Operational CRM:** call center management, use of internet, website and applications of direct mail.
Unit-7	**CRM Systems and their Implementation:** CRM systems, implementation of CRM systems, and the future aspects.
Unit-8	**E CRM:** application of e-CRM technologies-emails, websites, chat rooms, forums and other channels.
Unit-9	**CRM Process:** introduction and objectives of a CRM process, an insight into CRM and ECRTA and online CRM.
Unit-10	**Developing CRM Strategy:** role of CRM in business strategy and understanding service quality with regard to CRM.
Unit-11	**CRM Links in E-Business:** E-Commerce and customer relationships on the internet.
Unit-12	**Economics of Customer Relationship Management**: market share Vs customer share orientation, customer life time value and customer profitability.
Unit-13	**CRM Implementation:** choosing the right CRM solution and framework for implementing CRM.
Unit-14	**CRM Application in B2B and B2C Market:** importance of CRM in B2B and B2C market, benefits of B2C and B2B CRM, B2B and B2C application in banking and hospitality sectors.

READINGS:

1. CUSTOMER RELATIONSHIP MANAGMENT by ED PEELEN, Pearson Education India
2. THE CRM HANDBOOK- A BUSINESS GUIDE TO CUSTOMERRELATIONSHIP MANAGEMENT by JILL DYCHE, Pearson Education India.
3. CUSTOMER RELATIONSHIP MANAGEMENT-GETTING IT RIGHT by JUDITH W. KINCAID. Pearson Education India.

Course Code	EFIN576	Course Title	SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Assess the characteristics of different Investment alternatives and how to trade in the stock market.

CO2: Apply different valuation models to find the intrinsic value of the shares.

CO3: Use the fundamental and technical analysis to predict the stock price movement.

CO4: Construct, revise and evaluate portfolios of different securities.

Unit No.	Content
Unit-1	**Introduction to Security Analysis**: securities market structure, major Indian stock exchanges, stock exchange players, investment objectives, investment process, investment alternatives, investment alternatives evaluation, and common error in investment process
Unit-2	**Risk and Return**: concept of return, measurement of return, concept of risk, types of risk, measurement of risk
Unit-3	**Equity valuation**: balance sheet valuation, dividend discount model, free cash flow model, earning multiplier approach
Unit-4	**Fixed Income and Other Investment Alternatives**: pricing, yields and risks of investments in fixed income securities, real estate, commodities, other alternative investments, strategies for investments in various investment alternatives
Unit-5	**Efficient Market Hypothesis:** forms of EMH, test for EMH, depository system, depository process and participants, calculation of sensex and nifty, listing of securities
Unit-6	**Fundamental Analysis**: industry analysis, economic analysis, company analysis, introduction to fundamental analysis, financial health
Unit-7	**Technical Analysis:** technical indicators, Dow Theory, fundamental v/s technical analysis, Elliot wave theory, chart patterns
Unit-8	**Portfolio Construction and Management**: portfolio risk, portfolio return, diversification, Markowitz model
Unit-9	**Portfolio Risk and Return Management**: portfolio risk and return with different correlations, efficient frontier, optimal portfolio
Unit-10	**Asset Pricing**: standard capital asset pricing model, capital asset pricing model, arbitrage pricing theory
Unit-11	**Derivative and Regulatory Aspect**: meaning and reasons of derivative trading, types of derivatives, forward, futures and options, regulation of derivative market
Unit-12	**Evaluation of Portfolio Performance**: Sharpe's performance index, Treynor's performance index, Jensen performance index
Unit-13	**Portfolio Revision**: active and passive management, rupee cost averaging, constant rupee plan, constant ratio plan, variable ratio plan
Unit-14	**Contemporary Issues in Investment**: fintech scope and challenges, algo trading issues and development, robo advisors, high frequency trade

READINGS:

1. SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT by K SASIDHARAN & ALEX K MATHEWS, MCGRAW HILL EDUCATION
2. SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT by PUNITHAVATHY PANDIAN, VIKAS PUBLISHING HOUSE

Course Code	EECO528	Course Title	MONETARY THEORY AND POLICY

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Describe the role of financial institutions and its importance in the economy

CO2: Develop the skills to build investment strategy on different financial markets

CO3: Analyze role of money in the economy and the impact of financial market on the macro economy

CO4: Demonstrate analytical and problem-solving skills within money, banking, and financial market disciplines

Unit No.	Content
Unit-1	**Financial system:** nature and role of financial system, money and near money, financial intermediate and financial intermediaries, the structure of financial system, functions of the financial sector, equilibrium in financial market
Unit-2	**Financial system and economic development:** financial system and economic development of India, function of financial system
Unit-3	**Commercial banking in India:** functions, theories, credit creation, structure, nationalization, objectives, performance and evaluation, balance sheet and portfolio management of banks
Unit-4	**Central banking:** meaning and functions, techniques of credit control with special reference to India and credit policy in India, central banks and monetary policy in India
Unit-5	**Co-operative banks**: introduction, origin and growth of cooperative banks, features, types, structure and role of government
Unit-6	**Regional rural banks in India:** functions and organization of regional rural banks, performance of regional rural banks, problems and challenges of regional rural banks
Unit-7	**Risk and financial assets:** meaning and types of risk, return on assets, risk—return trade off, violation of securities
Unit-8	**Non-bank financial intermediaries:** definition and types of non -bank financial institutions their growth and impact on India's economic development, measures taken to control their operations
Unit-9	**Capital market:** instruments, players, trading - primary and secondary market, role of stock exchanges and stock indices, fixed income securities market - structure and trends, government securities market, call money market, treasury bill market
Unit-10	**Bonds market:** bonds market, trading in government-securities market, interest rate - theories, determinants, dynamics of short term and long term rates,
Unit-11	**Structure of bond market:** trading in bond market, term structure of interest rates, yield curve, trends, debt securitization and structured products debt in bond market.
Unit-12	**Financial market:** role and structure of money and capital market, money market, commercial bill market, discount market, government securities market, markets for derivatives- futures and option
Unit-13	**Derivative Market:** uses and pricing derivation and primary and secondary market for securities, stock exchange board of India- the impact on working capital market in India
Unit-14	**Insurance market**: insurance regulatory and development authority and its role in financial markets, treasury bill market

READINGS:

1. Financial Institutions and Markets by L.M Bhole and Jitendra Mahakud, Tata Mcgraw Hill, India
2. Money, Banking, International Trade and Public Finance by D.M. Mithani. Himalaya Publishing House Pvt.
3. Indian Financial System By M.Y Khan, Tata Mcgraw Hill, India

Course Code	ECAP776	Course Title	PROGRAMMING IN PYTHON

	WEIGHTAGE		
CA	ETE(Th.)	ETE (Pr.)	
30	40	30	

Course Outcomes:

CO1: Understand the basic structure and features of Python programming

CO2: Interpret object-oriented programming concepts such as encapsulation, inheritance and polymorphism as implemented in Python

CO3: Apply pandas and NumPy for data analysis

CO4: Implement machine learning algorithms

CO5: Analyse real-life situation specific problems and perceive solutions

CO6: Build exploratory data analysis and visualizations

Unit No.	Contents
Unit- 1	**Python basics:** introduction, data types and operators, control statements, functions
Unit- 2	**Python data structures: s**trings, lists, sets, tuples and dictionaries
Unit- 3	**OOP concepts:** OOP features, encapsulation, inheritance
Unit- 4	**More on OOP concepts:** function overloading, operator overloading and method overriding,
Unit- 5	**Exception handling**: catching exceptions, catching multiple exceptions, raising exceptions, custom exception
Unit- 6	**Introduction to NumPy**: arrays vs lists, array creation routines, arrays from existing data, indexing and slicing
Unit- 7	**Operations on NumPy arrays**: array manipulation, broadcasting, binary operators
Unit- 8	**NumPy functions**: mathematical functions, statistical functions, sort, search and counting functions
Unit- 9	**Handling data with pandas**: introduction to pandas, series, data frame, sorting, working with csv files, operations using data frame
Unit- 10	**Data cleanup:** investigation, matching and formatting
Unit- 11	**Data visualization:** introduction to matplotlib, line plot, multiple subplots in one figure, bar chart, histogram, box and whisker plot, scatter plot, pie charts
Unit- 12	**Data visualization:** introduction to seaborn, seaborn Vs matplotlib, data visualization using seaborn
Unit- 13	**Machine learning:** introduction, types of machine learning
Unit- 14	**Machine learning algorithms:** linear regression, k-nearest neighbours, decision trees, random forests, k-means clustering

LABORATORY WORK:

Implementation of Python programming concepts (control statements, functions, strings, lists, sets, tuples, dictionaries, OOP concepts, exception handling, NumPy arrays and functions, pandas, data visualization, machine learning algorithms)

READINGS:

1. Programming and Problem Solving with Python by Ashok Kamthane, Amit Ashok kamthane, McGrawHill 2nd Edition
2. Hands-On Data Analysis with NumPy and pandas by Curtis Mille, Kindle Edition
3. Python for Data Analysis by Wes McKinney, O'Reilly Media
4. Machine Learning for Absolute Beginners by Oliver Theobald, Kindle Edition

Course Code	ECAP737	Course Title	MACHINE LEARNING

	WEIGHTAGE		
CA	ETE(Th.)	ETE (Pr.)
30	40	30

Course Outcomes: Through this course students should be able to

CO1: Apply python libraries for data analysis and machine learning model development

CO2: Evaluate important features from a given dataset

CO3: Apply machine learning models for real world problems

CO4: Evaluate the performances of different machine learning models

Unit No.	Contents
Unit- 1	**Introduction to Machine Learning:** History of Machine Learning, Basic definitions, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Issues in machine learning, Different Applications of Machine learning.
Unit- 2	**Python Basics:** Introduction to Python, Jupiter Notebook, and Python packages for data Science.
Unit- 3	**Data Pre-processing:** Introduction to Data Analysis, Importing and Exporting Data in python, Data wrangling, Exploratory Data Analysis.
Unit- 4	**Pre-processing Implementation in python**
Unit- 5	**Regression:** Simple Linear Regression, Multiple Linear Regression, Non-Linear Regression, A mathematical formulation of Regression models, Model Evaluation in Regression Models.
Unit- 6	**Regression Implementation:** Implementation and performance analysis of Linear Regression, Multi Regression, Non-Linear Regression
Unit- 7	**Classification**: Classification Problems, Decision Boundaries, K-Nearest Neighbours, Decision Trees, Building Decision Tree, Training and Visualizing a Decision Tree.
Unit- 8	**Classification Algorithms:** Logistic Regression, Support Vector Machine, Margin, Kernel function and Kernel SVM.
Unit- 9	**Classification Implementation:** Implementation and performance analysis of KNN, SVM and Logistic Regression
Unit- 10	**Clustering:** Introduction, K-Means Algorithm, A mathematical formulation of the K-Means algorithm, Hierarchal Clustering.
Unit- 11	**Ensemble methods:** Bagging, random forests, boosting.
Unit- 12	**Clustering Implementation:** Implementation and performance analysis of k-Means and Hierarchal Clustering, Implement and compare any two ensemble-based machine learning approaches on different datasets.
Unit- 13	**Neural network:** Biological Structure of a Neuron, Perceptron, multilayer networks and backpropagation, introduction to deep neural Networks, Evaluation Metrics of machine learning models.
Unit- 14	**Neural network Implementation:** Design of an Artificial Neural Network for given dataset, Implement and compare the performances of any three-machine learning based classification models on different datasets

Laboratory Work:

Implementation of machine learning concepts (Data Analysis, Importing and Exporting Data in python, Data wrangling, Exploratory Data Analysis, Simple Linear Regression, Multiple Linear Regression, Non-Linear Regression, K-Nearest Neighbours, Decision Trees, Logistic Regression, Support Vector Machine, Margin, Kernel function and Kernel SVM, K-Means Algorithm, Bagging, random forests, boosting,)

READINGS:

1. Applied Machine Learning by Madan Gopal (2018), McGraw Hill Education, India
2. Machine Learning by Tom Mitchell (2017), McGraw Hill Education, India
3. Principles of Soft Computing by S. N. Sivanandam and S. N. Deepa (2018), Wiley, India

Course Code	EMKT622	Course Title	PRODUCT AND BRAND MANAGEMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Develop product and process related skills necessary to understand customer needs and competitive position

CO2: Measure and formulate effective brand strategies to build, manage and measure brand equity

CO3: Observe design and develop sustainable brand and product portfolio strategies

CO4: Differentiate product and brand strategies of various companies

Unit No.	Content
Unit-1	**Introduction to product management:** product related concepts, competitive set & competitor analysis, category attractiveness, environmental analysis
Unit-2	**Product strategy:** developing product strategies, product modification, line extension, elements of product strategy, product strategy over the life cycle
Unit-3	**Product lifecycle management:** idea generation, idea screening, concept development and testing, business analysis, beta and market testing, implementation, product commercialization
Unit-4	**Introduction to brand management:** brand and brand management, brands versus products, branding challenges and opportunities, strategic brand management process
Unit-5	**Customer based brand equity:** defining customer-based brand equity, making a strong brand, sources of brand equity, building a strong brand: the four steps of brand building
Unit-6	**Designing marketing programs to build brand equity**: new perspectives on marketing, product strategy, pricing strategy, channel strategy
Unit-7	**Designing and implementing branding strategies**: brand architecture, brand hierarchy, designing a branding strategy
Unit-8	**Managing brand extensions**: brand extension, advantages of brand extensions, disadvantages of brand extension
Unit-9	**Planning & Implementing brand marketing programs:** criteria for choosing brand elements, options &tactics for brand elements
Unit-10	**Strategic brand management process:** introduction & phases, identifying & establishing brand positioning, building a strong brand, positioning guidelines
Unit-11	**IMC in branding:** use of IMC for brand building, leveraging secondary brand associations to brand building
Unit-12	**Measuring & interpreting brand performance:** developing a brand equity measurement &management system, measuring sources and outcome of brand equity
Unit-13	**Growing & sustaining Brand Equity:** designing & implementing branding strategies, managing brands over time
Unit-14	**Managing brands:** reinforcing brands, revitalizing brands and other ways to manage brands

READINGS:

1. STRATEGIC BRAND MANAGEMENT by KELLER, K L., PARMESWARAN, A.M.G. AND JACOB, I, PEARSON
2. BRAND MANAGEMENT: PRINCIPLES AND PRACTICES by DUTTA, K,, OXFORD UNIVERSITY PRESS
3. BRAND MANAGEMENT: TEXT & CASES by VERMA, H V,, EXCEL BOOKS

Course Code	EFIN526	Course Title	FINANCIAL ANALYTICS

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Analyze financial ratios to assess a firm's past performance as well as problems and suggest strategies for dealing with problems

CO2: Use trend and regression analysis to forecast sales and any other financial variables

CO3: Calculate the present value and future value of a stream of cash flows

CO4: Apply several discounted cash flow (DCF) models to value a common stock

CO5: Employ sensitivity and scenario analysis in capital budgeting decisions

CO6: Demonstrate various valuation techniques to make investment decisions and portfolio management

Unit No.	Content
Unit-1	**Building basic financial statements:** building an income statement, building a balance sheet, creating common-size income statements, creating a common-size balance sheet, building a statement of cash flows
Unit-2	**Cash Budget:** collections and disbursements, calculating the ending cash balance, adding interest and investment of excess cash
Unit-3	**Financial statement analysis:** financial ratios (liquidity ratios, efficiency ratios, coverage ratios, leverage and profitability ratios), z score model for financial distress prediction
Unit-4	**Financial forecasting:** forecasting the income statement**,** forecasting assets on the balance sheet**,** linear trend extrapolation**,** regression analysis
Unit-5	**Break-Even and Leverage Analysis:** calculating break-even points, leverage analysis, linking break-even points and leverage measures
Unit-6	**Time value of money:** present value (single and multiple cash flows), future value (single and multiple cash flows), annuity, perpetuity, growing annuity, loan amortization, compounding interest rates
Unit-7	**Cost of Capital:** capital structure components cost of debt, cost of common equity, cost of preferred equity, role of flotation costs, cost of overall capital structure WACC
Unit-8	**Common stock valuation:** fundamentals of valuation, analysis of beta**,** return on equity, determining required rate of return through CAPM, dividend discount models (constant growth, two stage growth and three stage growth)
Unit-9	**Discounted cash flow models of business valuation:** earnings model, free cash flow model (FCFF, FCFE), relative valuation
Unit-10	**Capital budgeting and risk analysis:** net present value**,** internal rate of return, pay back and discounted payback period**,** sensitivity analysis**,** scenario analysis
Unit-11	**Analysis of bonds and long term financing:** valuation of bonds**,** current yield**,** bond equivalent yield**,** macaulay duration**,** modified duration**,** convexity
Unit-12	**Financial risk measurement and analysis:** risk measurement in fixed income markets**,** market risk analysis**,** credit risk measurement
Unit-13	**Portfolio Statistics and Diversification:** determining portfolio risk and return, portfolios with more than two securities, locating portfolios on the efficient frontier, charting the efficient frontier, role SML and CML in security portfolio management
Unit-14	**Pricing of derivative instruments:** charting futures pay offs, charting of options payoffs, futures and options pricing, variables affecting pricing of futures and options

Reading:

1. FINANCIAL ANALYSIS WITH MICROSOFT EXCEL by TIMOTHY R. MAYES AND TODD M. SHANK, CENGAGE LEARNING

References:

1. CORPORATE FINANCIAL ANALYSIS WITH MICROSOFT EXCEL by FRANCIS J. CLAUSS, MC GRAW HILL

Course Code	EECO512	Course Title	ECONOMICS OF DEVELOPMENT

	WEIGHTAGES	
	CA	ETE(Th.)
	30	70

Course Outcomes:

CO1: Evaluate the fundamental economic concepts and theories of developmental economics.

CO2: Analyze the developmental approaches, policies, and the issues related to the developmental problems that the world community faces in day-to-day life.

CO3: Examine the current pattern of development models and relate to the real macroeconomic problems.

CO4: Analyze the role of markets and private property through applying basic concepts and tools development

CO5: Assess of modern economic growth and development, and environmental problems and issues.

CO6: Apply the different development models which relate to structural transformation includes agricultural transformation, rural-urban interaction or migration.

Unit No.	Content
Unit-1	**Overview of economic development**: introduction to development, measurement issues in economic development, factors in economic development, structural features of economic development, objectives of economic development., nature of development economics, capability approach to measure development
Unit-2	**Overview of Economic Development (contd.):** Stylised facts of growth. Sources of economics growth, economic development and echnological change. Redistribution with growth, measurement of inequality.
Unit-3	**Comparative models of development and underdevelopment**: human resource development and infrastructure, theories of development classical theory (Smith, Ricardo, Malthus), Rostow's theory of stages of growth, Myrdal's backwash and spread effects
Unit-4	**Approaches to Development**: partial theories, vicious circle of poverty Nurkse, Lewis approach of unlimited supply of labor, balanced growth approach, big push approach, unbalanced growth approach, critical minimum effort thesis, nelson's low level equilibrium trap.
Unit-5	**Growth models**: Harrod-Domar instability of equilibrium, technical progress and economic growth, neo classical growth models, corrected Model of Passineti, Solow growth models, human capital and economic growth
Unit-6	Dualism-social and technological. Lewis, Ranis and Fei, Jorgenson and Todaro Models. Surplus labour in agriculture - measurement and use. Employment and unemployment in underdeveloped countries.
Unit-7	**Strategies of economic growth**-balanced vs. unbalanced growth and their tests, big push and critical minimum efforts thesis
Unit-8	**Development policy making**: nature of development planning, role of market and civil society in economic development, development political economy, institution and developmental path, aggregate model, trend and governance reforms.
Unit-9	**Measuring Development and Development Gap**: conventional approach physical quality life index, measurement of inequality, theory of demographic transition, population and economic development, indicator and measurement of poverty, concept of inclusive growth with reference to India, Institutions and economic growth

Unit-10	**Rural-urban interaction and development**: formal and informal urban sector, rural urban migration, theory of urbanisation, role of cities
Unit-11	**Agriculture transformation and development**: agriculture progress and rural development, economics of agriculture development, improving small scale agriculture, Washington consensus development policy making and the role of the state, agrarian system in development world
Unit-12	**Human and social aspects of development**: education and health in economic development, human capital approach of development, poverty and human capital, inequality and social welfare, social and private cost benefits of development, Investing in education and health
Unit-13	**Capital formation:** Two gap theory, domestic and external sources, foreign investment, multinationals, foreign aid, and trade vs. aid, inflation and economic growth. Human capital formation and its utilization.
Unit-14	**Proximate Causes of Growth**: Human Capital: The Ben Porath model of human capital accumulation; The Nelson-Phelps model of skill-technology complementarity.

READINGS:

1. Economic Development by Michael P. Todaro& Stephen C. Smith, Pearson

2. Development Economics by Debraj Ray, Oxford University Press