MANAV RACHNA UNIVERSITY

FACULTY: FACULTY OF APPLIED SCIENCES

PROGRAM: B.Sc. (Hons.) MATHEMATICS

PROGRAM CODE: MAU01

SYLLABUS: SCHEME A

MANAV RACHNA UNIVERSITY

Faculty of Applied Sciences

Department of Mathematics

Scheme & Syllabus

B.Sc. (Hons.)Mathematics
(2016-17)

MAU01- Semester I

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CREDITS
MAH113-T	ESSENTIALS OF MATHEMATICS	MA	HARD	CORE	3	1	0	0	4
MAH113-P	ESSENTIALS OF MATHEMATICS LAB				0	0	2	0	1
PHH107-T	ESSENTIALS OF PHYSICS	PH	HARD	CORE	3	1	0	0	4
PHH107-P	ESSENTIALS OF PHYSICS LAB				0	0	2	0	1
CHH101-T	GREEN CHEMISTRY	CH	HARD	CORE	3	1	0	0	4
CHH101-P	GREEN CHEMISTRY LAB				0	0	2	0	1
CSH101-T	STRUCTURED PROGRAMMING	CS	HARD	CORE	3	1	0	0	4
CSH101-P	STRUCTURED PROGRAMMING LAB				0	0	2	0	1
HLS101	BUSINESS ENGLISH	HL	SOFT	CORE	1	0	2	0	2
CSW151	COMPUTING WORKSHOP	CS	WORK SHOP	CORE	0	0	3	0	2
CHS102	ENVIRONMENTAL SCIENCE	CH	SOFT	UNIVERSITY COMPULSORY	1	0	2	0	0
FLS103	FRENCH-I	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	0
FLS101	SPANISH-I								
FLS102	GERMAN-I								

DETAILED SYLLABUS
MAU01 – SEMESTER I

Course Title/ Code	**ESSENTIALS OF MATHEMATICS / MAH113-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the mathematical concepts of matrices, calculus of single and several variables, vector and integral calculus required for solving the mathematical problems and their applications. .

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Matrices and its Applications: Elementary Transformations, Elementary Matrices, Inverse using Elementary Transformations, Rank of a matrix, Normal form of a matrix, Linear Dependence and Independence of vectors, Consistency of Linear System of Equations, Eigen Values and Eigen Vectors, Properties of Eigen Values, Cayley Hamilton theorem, Linear Transformation, Orthogonal Transformation, Complex Matrices.

SECTION B

Differential Calculus: Successive Differentiation, Leibnitz Theorem, Mean Value Theorems: Rolle's Theorem, Cauchy's Theorem, Lagrange's theorem, Taylor's and Maclaurin's Series, Partial differentiation, Euler's theorem, Total differential, Jacobian.

SECTION C

Integral Calculus: Double and Triple Integral, Evaluation of Double Integral over the region, Evaluation of Double Integral by Changing the Order of Integration, Evaluation of Double & Triple Integral by Changing the Variable. Beta and Gamma Functions, Error Function (Probability Integral).

SECTION D

De'Moivre's Theorem and its Applications: Expansion of Trigonometric Functions. Direct Circular and Hyperbolic Functions and their properties. Inverse Circular and Hyperbolic Functions and their Properties, Logarithm of a Complex Quantity, Gregory's series. Summation of Trigonometry series.

ESSENTIALS OF MATHEMATICS LAB (MAH113-P)

LAB EXERCISE:

1. Introduction to MATLAB and use of some simple MATLAB commands.
2. Introduction to some of the fundamentals of MATLAB: Variables, operators, expressions and Arrays(including vectors and matrices)
3. Introduction to graphics: Basic Two-Dimensional Graphs, Labels, Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
4. To find the Rank of a matrix, Inverse of a Square matrix and to reduce a matrix into Normal Form.
5. To solve the system of simultaneous linear equations.
6. To find the Eigen values and Eigenvectors of a square matrix.
7. Evaluation of Single integral (Definite & Indefinite) and its application.
8. Evaluation of Double integral and its application.
9. To find the n^{th}derivative of a function.
10. To find the total derivative.

RECOMMENDED BOOKS:

1. Shanti Narayan: *Differential Calculus*, S. Chand & Co.
2. Shanti Narayan: *Integral Calculus*, S. Chand & Co.
3. K. B. Dutta: *Matrix and Linear Algebra*.
4. David Widder: *Advanced Calculus*, Prentice- Hall of India.

Course Title/ Code	ESSENTIALS OF PHYSICS / PHH 107-T
Course Type:	Core (Allied)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To apply the concepts of physics to 1) different optical phenomena 2) devices based on these phenomena lasing in gases and solids 3) quantum mechanics and its simple applications

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION-A

Interference of Light

Conditions for Sustained Interference, Coherent Sources, Interference Based on the Division of Wave Front: Young's Double Slit Experiment, Fresnel Bi-Prism and its Applications, Interference Based Upon Division Of Amplitude: Interference in Thin Films, Newton's Ring and its Applications, Michelson Interferometer and its Applications.

Diffraction of Light

Fraunhofer Diffraction at Single Slit, Plane Transmission Grating, Dispersive and Resolving Power of a Grating, Rayleigh Criterion

Polarization of Light

Polarized and Un-Polarized Light, Malus's Law, Double Refraction, Nicol Prism, Quarter and Half Wave Plates, Detection and Production of Different Types of Polarized Light, Polarimetry: Bi-Quartz and Laurent's Half Shade Polarimeters. (12L)

SECTION-B

Electromagnetic Theory

Electric Flux Density, Gauss's Law and its Applications to a Spherical Symmetry and Uniformly Charged Infinite Plane Sheet, Energy Per Unit Volume, Ampere's Law and its

Modification for Non-Steady Currents, Maxwell's Equations, Wave Propagation in Free Space, Dielectrics and Conducting Medium, Poynting Theorem and its Significance (10L)

SECTION - C

Laser and Fiber Optics

Stimulated Absorption, Spontaneous and Stimulated Emission, Population Inversion, Conditions for Laser Action, Laser Properties and Laser Applications, Types of Laser: He-Ne Laser, Dye Laser, Semiconductor Laser.

Fiber Optics: Introduction, Propagation of Light Through a Fiber, Numerical Aperture, Types of Fiber, Modes of Propagation (Simple Idea), V-Number, Applications of Optical Fibers (10 L)

SECTION D

Quantum Physics: Introduction to quantum mechanics, Discovery of Planck's constant, Group velocity and phase velocity, Schrodinger wave equations-time dependent and time independent, Physical significance of wave function, Particle in one dimensional box.

List of Experiments:

1. To determine the wavelength of sodium light by Newton's rings experiment. Describe the interference pattern using polychromatic source of light.
2. To determine the wavelength of sodium light by Fresnel's biprism experiment.
3. To determine the wavelength of various colors of white light with the help of a plane transmission diffraction grating.
4. Determination of dispersive power of the given grating.
5. To determine the refractive index and Cauchy's constants of a prism by using spectrometer.
6. To determine the wavelength of sodium light by Michelson interferometer.
7. To determine the resolving power of a telescope.
8. To determine the pitch of a screw using He-Ne laser
9. To determine the specific rotation of optically active solution solution by using Laurent's half shade polarimeter.
10. To determine the numerical aperture of an optical fiber using laser light.

Suggested Books:

1. Fundamentals of Engineering Physics , M S Khurana, MR Pub, Delhi (**Text Book)**
2. Modern Physics for Engineers I & II, S P Taneja; R Chand Publication **(Text Book)**
3. Engineering Physics, Satya Prakash, Pragati Prakashan.
4. Concepts of Modern Physics, A. Beiser
5. Optics, A. Ghatak

Course Title/ Code	**GREEN CHEMISTRY /CHH101- T**
Course Type:	Core (Allied)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	Students are able to demonstrate the necessity and viability of the methods of green chemistry

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION-A

Introduction to Green Chemistry: Definition, History, Need and goals of green chemistry, Green Chemistry in sustainable development, Importance of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry.

Basic principles of Green Chemistry: Twelve Principles in Green Chemistry with their explanations and examples, Prevention of waste/by products, Atom Economy, Prevention/Minimization of hazardous/toxic products, Designing safer chemicals, Selection of safer solvents and auxiliaries, Design for energy efficiency (use of microwave and ultrasonic radiations), Use of renewable Feedstocks, Avoidance of unnecessary derivatization, Use of catalytic reagents in preference to stoichiometric reagents, Designing biodegradable products, Prevention of chemical accidents (including releases, explosions and fires), Strengthening/Development of green techniques to prevent hazardous substances in chemical process.

SECTION-B

Green Lubricants & Polymers: Introduction to Lubrication (types and mechanism), Properties of lubricants (Viscosity and its determination, flash point & fire point, cloud point & pour point, aniline point, Saponification value, Acid value and iodine value) Applications of conventional and green lubricants, Introduction & Classification of polymers, Biodegradable and non-biodegradable polymers, Synthesis of Green Polymers, Polymer Composites

SECTION-C

Green Synthesis: Comparison with conventional synthesis: Green Solvents and Reaction Conditions: Water as green solvent, Properties of water (Alkalinity, Hardness and Dissolved Oxygen and their determination),

Phase diagram of one component system - Water and CO_2, Supercritical fluids, Ionic Liquids (Introduction, properties and Ions Structure), Liquid polymers-PEG, and Renewable Solvents (Alcohols, Esters, Terpenes and 2 MeTHF).

Green reagents-Triplet Oxygen, Singlet Oxygen, Ozone, H_2O_2, Dioxirane, Dimethyl carbonate, Polymer supported Reagents

Green Catalysis- Green Catalysts/Biocatalysts, Phase transfer catalysts, Recoverable catalysts, Enzymes- their classes, specificity and selectivity.

Green Synthesis of Adipic acid, Adiponitrile, Ibuprofen, MMA, Sebacic acid and Biodiesel, Quantitative Solid-solid synthesis

SECTION-D

Green Engineering & its Applications: Need and scope of green engineering, Basic principles of green engineering, Elimination of hazardous compounds by green compounds, Eco-friendly materials for computing Case studies of Real World/ Indian Cases: Sony Ericsson: Bromine- and Chlorine-Free Mobile Phones, Bio-based **composite resins design for electronic materials: Soy Plastics, US Presidential Green Chemistry Challenge Award Winners.**

Green Chemistry Lab (CHH101-P)

Lab Experiments

1. To determine the alkalinity of given water sample
2. To determine Hardness of water sample
3. To determine the concentration of given $KMnO_4$ solution using a Digital Photocolorimeter
4. To determine flash point and fire point of lubricating oil by Pensky's Marten's apparatus
5. To determine Viscosity of Liquid Compounds
6. To prepare (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
7. Preparation of Iron nanoparticles using tea
8. Synthesis of Green compounds (Biodiesel from vegetable oil).
9. Synthesis of green reagent Tetra butyl ammonium tribromide (TBATB)

Reference Books:

1. P1. P. T. Anastas, J. C. Warner Green Chemistry: Theory and Practice, 1998. Oxford University Press
2. 2. Concepcion Jimenez Gonzalez, David JC Constable, Green Chemistry and Engineering. 2011 John Wiley & Sons
3. 3. EMO Chiellini and Roberto Solaro Biodegradable Polymers and Plastics. 2002 Kluwer Academic Publishers.
4. 4. Paul T. Anastas, Robert H. Crabtree Green Catalysis. 2009 Wiley-VCH.
5. 5. James H. Clark, Duncan J. Macquarrie Handbook of green chemistry and technology. 2002. John Wiley & Sons
6. 6. Roger A. Sheldon, Isabel Arends, Ulf Hanefeld Green Chemistry and Catalysis. First Edition, 2007 Wiley-VCH.

Course Title/ Code	STRUCTURED PROGRAMMING/ CSH101-T
Course Type:	Core (Allied)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	Students are able to construct a program of moderate complexity from a specification

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

Section A

Programming and Unix: Students will learn the basics of programming using Scratch, They will learn to use statements, Expressions, Conditions, Selection, Iteration, Variables, Functions, Arrays, Threads and events. In addition, They will be introduced to basic Unix commands under Bash.

Introduction to Programming, Test driven development

Scratch: Introduction, Statements, Expressions, Conditions, Selection, Iteration, Variables, Functions, Arrays.

Unix: Basic commands- pwd, ls, cd, rm, cat, less, mkdir, rmdir; permissions, root

C language: statements, Expressions, Conditions, Selection iteration, Variables, Functions, arrays.

Section B

Applying Programming Constructs: Students will learn how to write programs that satisfy unit tests. The instructor will build the unit tests, Demonstrating how to break a problem down into smaller components. In the labs and homework, Students will construct programs that satisfy the unit tests. Students become familiar with the constructs of the C programming language.

Types, Constants, and variables, Statements, Expressions, Conditions, Selection, Iteration, Functions and recursion

Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming

One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Null terminated strings as array of characters, Standard library string functions.

Introduction to Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments Structure variables, Initialization, Structure assignment, Nested structure, Structures and functions, Structures and arrays: arrays of structures, Structures containing arrays, Unions. Students will become familiar with the concepts.

Section C

Practical programming: During the third quarter of the class, students will begin building their own programs by decomposing problems into smaller tasks and writing unit tests that will check to see that the program accurately accomplishes the task using Test Driven Development. They will then write the program that satisfies their own unit tests. Students will learn to apply the constructs of the C programming language to create programs.

Application of Top-down approach of problem solving, Modular programming and functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, Passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments.
Students will learn to apply these programming techniques: Structure variables, Initialization, Structure assignment, Nested structure, Structures and functions, Structures and arrays: arrays of structures, Structures containing arrays, Unions. Students will be able to use these techniques to develop programs

Concept of Files, File opening in various modes and closing of a file, Reading from a file, Writing onto a file

Section D

Memory Management and Abstraction: During the final quarter, students will be introduced to dynamic memory allocation and dynamic data structures including: dynamic arrays, linked lists, and stacks. They will consolidate their ability to use the C programming techniques they have learned in the earlier sections.

Address operators, pointer type declaration, Pointer assignment, Pointer initialization, Pointer arithmetic, Functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation.
Linked list

Structured Programming Lab (CSH101-P)

Lab Experiments:

1. Swap two numbers
2. Fibonacci series, Factorial
3. GCD
4. Sieve of Eratosthenes
5. Square Root
6. Sorting
7. Decimal to binary conversion
8. Linked lists
9. Program to support humans playing chess against each other.
10. Stacks and queues
11. Manipulating files

Reference Books:

1. *The C Programming Language*, Brian Kernighan and Dennis Ritchie
2. *The Unix Programming Environment*
3. *Pro Git*,

Help Pages:

1. Eclipse C/C++ Development Guide

Wikipedia Pages:

1. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
2. Unit testing, http://en.wikipedia.org/wiki/Unit_testing

Tool Web Sites:

1. Eclipse, https://eclipse.org/users/
2. Git, http://git-scm.com/
3. GCC, https://gcc.gnu.org/onlinedocs/gcc-4.9.3/gcc/
4. Make
5. Unix

Web tutorials:

1. Harvard's CS50, https://courses.edx.org/courses/HarvardX/CS50x3/2015/info

Course Title/ Code	**BUSINESS ENGLISH (HLS101)**
Course Type:	Core (Allied)
Course Nature:	Soft
L-T-P-O Structure	(1-0-2-0)
Objective	• To make the students well-versed in the basics of English Language, grammar and communication skills. • To enhance the interactive learning skills • To emphasize on group as well as individual performance of students. • To enhance written as well as oral performance of students. To prepare students as per society and industry need.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

GRAMMAR: Introduction to Grammar, Adverbs, Adjectives, Articles, Noun (Compound, Countable, Uncountable) Active –Passive Voice

SECTION B

TENSE and SEMANTICS: Tenses, Subject- Verb Agreement, Introduction to Verbs (Auxiliary and Modals, non-finite), Prepositions, Modifiers, Collocation, Synonym, Antonym, Phrasal Verbs, Idioms and Phrases.

SECTION C

ORAL COMMUNICATION-I: Speech Pattern-1 (Intonation, Word Stress), Speech Pattern-2 (Indianisms, Sentence Stress, Connected Speech), Link Expressions, Question Tags.

SECTION D

TECHNICAL WRITING-I: ABC of Writing, KISS Concept, Essay Writing, Report Writing, Email Etiquette, Circular Précis Writing, Memos and Notices.

Lab Activities

1. Exercises based on Grammar
2. Exercises based on Semantics
3. Introduction to Articulation Skills (Conversation: Telephonic and Face-to-Face)
4. Exercise based on Email & Report
5. Business QUIZ &Idioms and Phrases
6. Techniques & Levels of Reading Comprehension
7. Group Discussion
8. Exercise Based on Tense & S-V Agreement
9. Exercise based on Active & Passive Voice
10. Exercise Based on Intonation & Word Stress
11. Circular, Memos and Notice Writing
12. Presentation

Suggested Text Readings:

1. *A Practical Course for Developing Writing Skills in English*. J K Gangal: PHI Learning Pvt.

2. *High School English Grammar and Composition*. Wren and Martin: S.Chand and Co.

3. *A Textbook of English Phonetics for Indian Students*. T.Bala Subhrmaniam: Macmillan

4. *English Vocabulary in Use*. MaCarthy: Foundation Books, OUP

5. *English Grammar, Competition and Correspondence*. M.A. Pink and A.C.Thomas: S.Chand and Co.

Course Title/ Code	COMPUTING WORKSHOP/ CSW151
Course Type:	Core
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)
Objective	• To make the students well-versed in the basics of English Language, grammar and communication skills. • To enhance the interactive learning skills • To emphasize on group as well as individual performance of students. • To enhance written as well as oral performance of students. • To prepare students as per society and industry need

Introduction to Computer Systems (1P) : Characteristics and Components of a computer system, Memory – Primary & Secondary, Input Devices, Output Devices, Hardware and Software

Operating System (6P) : Microsoft Windows - Versions of Windows, Basic Windows elements, Folder and File management, Using essential accessories: Calculator, Notepad, Paint, WordPad. Utility of My Computer, My Documents, Recycle bin, My Network Places, Control Panel, Searching Files

Introduction to Internet (3P) : Introduction to internet, www, urls, portals, web browsers, ip addresses, searching and downloading content, e-mail, intranet.

Word Processing (9P): Creating and handling documents, Editing, Spellcheck, Formatting, Tables, Macros, Mail merge, Page setting, Headers and footers, Printing documents

Spreadsheet Package (10P): Creating and handling workbook and spreadsheet, Editing, Formatting, Cell referencing, Formulae and Functions, Charts and Graphs, Macros, Views, Sorting, Page setting, Headers and footers, Printing worksheets

Presentation Package (10P): Creating and handling presentations, Using templates, Views, Handling Master slide - Notes and Handouts, Slide Design and layout, Animations, Transition, Slide Show, Custom Show, Timing, Headers and footers, Printing Presentations and handouts.

Course Title/ Code	**ENVIRONMENTAL SCIENCES /CHS102**
Course Type:	University Compulsory
Course Nature:	Soft
L-T-P-O Structure	(1-0-2-0)
Objective	• to make the student identify the areas of environmental degradation • to make the student identify the impact of environmental degradation on the surroundings • to apply the concepts such as sustainable development in real life to help the engineering student to correlate his field with various aspects of environment.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION-A

Scope & Importance of EVS: Definition and Scope of Environmental Sciences, Importance of EVS in Various Branches of Engineering & Sciences: Computer Science and Technology, Mechanical Engineering, Electronics & Communications Engineering, Civil Engineering and Applied Sciences

SECTION B

Ecosystem dynamics: Structure and functions of Ecosystem: Trophic Level, Food Chain, Food Web, Ecological Pyramids, Energy Flow, Biogeochemical Cycles, Ecological Succession: Basic Concept, Types, Stages.

Types of Ecosystems: Aquatic Ecosystem (Lake), Terrestrial Ecosystem (Grassland).

Biodiversity: Hot Spots, Threats, In Situ and Ex Situ Conservation.

Population and its Characteristics: Population Growth, Age Structure Pyramids.

SECTION C

Pollution prevention and sustainability: Air pollution: Sources of Air Pollution, Methods of Monitoring and Control of Air Pollution. Effect of Air Pollution on Human Beings, Plants, Animals, Materials and Atmosphere. Photochemical Smog, Ozone Layer Depletion, Green House Effect, Acid Rain.

Water pollution: Sources and Consequences of Water Pollution, Physio-Chemical and Biological Monitoring of Water Quality (TDS, TSS, BOD, COD). Eutrophication.

Soil pollution: Control Measures, Over Usage of Chemical Pesticides, Bio-Magnification.

Sustainable development: Definition, Energy Conservation In Agriculture And Industrial Sectors, Smart City Concept, Petro-Crops

SECTION D

Environmental Techniques & Assessment: Flame Photometry, Paper Chromatography, Remote Sensing and its Applications, Role of GIS in Disaster Management. Statistical Analysis: Mean, Median, Mode, and Standard Deviation Environmental Impact Analysis (EIA): Aims & Objective, ISO- 14000 and ISO- 18000
Standards and Certification, National Green Tribunal Act, Environmental Priorities in India and Environmental Regulations for Small and Large Scale Industries.

FIELD VISITS & PROJECT WORK

Visit To Waste Water Treatment Plants & Report
Visit To Any Industry For Pollution Control Methods & Report
Vermicomposting & Solid Waste Management Techniques
A Report On Biodiversity In Campus And Their Different Uses

List of Experiments:

1. To analyse a sample of water for metal ions using flame photometer
2. To determine the total dissolved oxygen in a given sample of water
3. To analyse the TDS and TSS in given sample of water
4. To calculate mean, mode, median and standard deviation of the given data
5. To separate the components in a mixture using paper chromatography
6. To determine residual chlorine in water
7. To determine free CO_2 in given sample of water
8. To study the efficacy of bioadsorptionof Tea waste
9. To study the various acts: wildlife protection act 1972, the water (prevention and control of pollution) act 1974, prevention and control of air pollution act 1981, forest conservation act 1981, environment (protection) act 1986, hazardous waste (management and handling) rules, 1989, bio-medical waste (management and handling) rules, 1998.
10. Case studies of eco-marketing: KFC, Coca Cola, Mc Donald, Tropicana, Nestle, Ceres fruit juice (methodologies for sustainable environment & advantages)

Course Title/ Code	FRENCH-I /FLS103
Course Type	Allied Elective
Course Nature	Soft
L-T-P-O Structure	(1-1-0-0)
Objective	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

SECTION A

- Les Salutations & forms of politeness
- Alphabets
- Taking leave expressions

SECTION B

- Les pronoms sujets
- Les verbes ER
- Self introduction

SECTION C

- Les noms
- Verbes Avoir, Etre, Aller & Faire
- Les articles define et indefini

SECTION D

- Les moin de l'annee
- les jours de la semaine
- Repondez aux questions.

Course Title/ Code	SPANISH-I (FLS101)
Course Type	Allied Elective
Course Nature	Soft
L-T-P-O Structure	(1-1-0-0)
Objective	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

SECTION A

- Presentation on Spanish language
- Greetings and goodbye's
- Spanish letter
- Introduction of VerboSER

SECTION B

- Uses of Verbo SER
- Introduction of Nationality
- Professions and vocabulary related to professions.
- Adjectives related to Verbo SER.
  Counting till number 20.

SECTION C

- Introduction of Articles and Indefinite articles
- Interrogatives
  Adjectives to describe things and place and Counting till number 90

SECTION D

- Introduction of Verbo ESTAR
- Uses of Verbo ESTAR with respect to positioning of objects
  Prepositions related to the positioning of an object

Course Title/ Code	**GERMAN-I (FLS102)**
Course Type	Allied Elective
Course Nature	Soft
L-T-P-O Structure	(1-1-0-0)
Objective	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

SECTION A

- Salutations/Greetings
- Introduction

SECTION B

- Introduction cntd.
- Alphabets
- Numbers 1-20

SECTION C

- Personal pronouns
- Hobbies and professions

SECTION D

- Café related vocabulary and dialogues
- Revision personal pronouns
- Common verbs and their conjugations

MAU01- Semester II

COURSE CODES	COURSE NAME	COURSE TYPE (Core/Elective / University Compulsory)	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	L	T	P	O	NO. OF CREDITS
MAH115-T	ALGEBRA	CORE	HARD	3	1	0	0	4
MAH115-P	ALGEBRA LAB			0	0	2	0	1
MAH116-T	CALCULUS-I	CORE	HARD	3	1	0	0	4
MAH116-P	CALCULUS-I LAB			0	0	2	0	1
CHH108-T	ESSENTIALS OF CHEMISTRY	CORE	HARD	3	1	0	0	4
CHH108-P	ESSENTIALS OF CHEMISTRY LAB			0	0	2	0	1
PHH108-T	MODERN PHYSICS	CORE	HARD	3	1	0	0	4
PHH108-P	MODERN PHYSICS LAB			0	0	2	0	1
HLS102	COMMUNICATIVE ENGLISH	CORE	SOFT	1	0	2	0	2
MAW119	STATISTICS USING EXCEL	CORE	WORKSHOP	0	0	3	0	2
FLS107	FRENCH-II	UNIVERSITY COMPULSORY	SOFT	1	1	0	0	0
FLS105	SPANISH-II							
FLS106	GERMAN-II							

DETAILED SYLLABUS
MAU01 – SEMESTER II

Course Title/ Code	**ALGEBRA /MAH115-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of set theory, theory of polynomials for solving the mathematical problems and their applications.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Sets, Binary relations, Equivalence relations, Congruence relation between integers, Finite product of sets, Functions, Composition of functions, Bijective functions, Invertible functions, Introduction of finite and infinite sets through correspondence, Binary operations, Principle of mathematical induction, Well-ordering property of positive integers, Division algorithm, Statement of fundamental theorem of arithmetic.

SECTION B

Polynomial, General properties of polynomials, Graphical representation of a polynomial, Maximum and minimum values of a polynomials, General properties of equations, Descartes rule of sign, Relation between coefficient and roots of the equation, Cube roots of unity.

SECTION C

Transformation of equations: Roots with sign changed, Roots multiplied with given quantities, Reciprocal roots, Increase or diminish the root by given quantity, Binomial coefficient, Cubic and Biquadratic equations, Homographic transformation, Transformation in general, Equation of differences of a cubic, Criterion of the nature of the roots of a cubic.

Solution of cubic and biquadratic equations: Use Cardon's Method to solve cubic equation. Use DesCartes Method, Ferarri's Method & Euler's Method to solve Biquadratic equation.

SECTION D

Limit of the roots of equations-Definition of limit, limits of roots, Practical Applications, Newton's method of finding limits, Inferior limits, Limit of negative roots.

Separation of the roots of an equation.- Theorem of Fourier & Budan, Application of theorem, Sturm's theorem, Application of Sturm's theorem, Conditions for reality of roots of an equation.

ALGEBRA LAB (MAH115-P)

LAB EXERCISE:

1. MATLAB Fundamentals: Decisions – if statement, if-else, Input and Output.
2. Loops : for, while Using Matlab.
3. Operations (union, intersection , difference etc.) on sets using Matlab.
4. Study of principle of mathematical induction, well-ordering property of positive integers, division algorithm using Matlab.
5. Graphical representation of a polynomial, maximum and minimum values of a polynomial using Matlab.
6. General properties of equations using Matlab.
7. Transformation of equation using Matlab.
8. Solution of Equations(Cubic and Bi-quadratic) using Matlab.
9. Limit of the roots of the given equation using Matlab
10. Separation of the roots of an equation with the help of Matlab.

RECOMMENDED BOOKS:

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.
3. Chandrika- Text Book on Algebra and Theory of equation, PothishalaPvt Ltd, 1978.

Course Title/ Code	CALCULUS-I / MAH116-T
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of differential calculus required for solving the mathematical problems and their applications.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Limit, Continuity and Differentiability of a function of single variable.
Tangents and Normals: Equation of the Tangent and Normal (Cartesian Equations; Parametric Cartesian Equations) and Indeterminate forms.

SECTION B

Asymptotes, Curvature and Evolutes.

SECTION C

Concavity and points of inflexion points, Multiple points (singular points), Tracing of curves in Cartesian, Parametric and polar form.

SECTION D

Limit, Continuity, Differentiability of a function of two variables, Partial Differentiation, total derivative, Maxima Minima of a function of two variables, Taylor's theorem for a function of two variables, Jacobians.

CALCULUS-I LAB (MAH116-P)

LAB EXERCISE:

1. To study the graph of different mathematical functions.

2. To discuss the limit, continuity & differentiability of functions of single variable using MATLAB.
3. To solve the indeterminate forms.
4. To find the equation of tangent & normal of the given cureve.
5. To find the curvature of curves, radius of curvature and centre of curvature (Cartesian, polar & parametric Coordinates) using MATLAB.
6. To find the asymptotes of given curve by using MATLAB and plot the same.
7. Tracing of Cartesian curves of single variable & several variables by using MATLAB.
8. Tracing of parametric & polar curves by using MATLAB.
9. To discuss the nature of singular points through calculation and graphical representation.
10. To discuss the limit, continuity & differentiability of functions of several variables using MATLAB.
11. To find Taylor's & Maclaurian's series expansion of functions of single and several variable by using MATLAB.
12. To find the critical points, saddle points, maxima & minima of functions of single variable using MATLAB.
13. To find the critical points, saddle points, maxima & minima of functions of several variables using MATLAB.

RECOMMENDED BOOKS:

1. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore, 2002
3. Shanti Narayan: Differential Calculus, S. Chand & Co.

Course Title/ Code	ESSENTIALS OF CHEMISTRY(CHH108-T)
Course Type:	Core(Allied)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	• To introduce concepts and phenomenon related to electronic structure of atom. • To calculate concentration of solutions. • To understand various types of titration and their applications. • To derive and calculate pH of hydrolysis of salts. • To understand concept and application of colloids and catalysis. • To calculate adsorption isotherms.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

ATOMIC STRUCTURE: Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

SECTION B

Analytical Chemistry: Titrations: Terminology- equivalence point and end point, primary and secondary standards, reactions used for titrations, molarity and normality, some examples of stoichiometric calculations.

Acid-base titration, Acid-base indicators, theory of acid base indicators, calculation of pH values at different stages of the acid base titration and titration curve.

Precipitation and Complexometric Titration: indicator theory, effect of complexing agents and their advantages, examples including EDTA based titration and titration curve.

Back and blank titration with examples, Gravimetric Method of Analysis with examples Electrochemistry in Analysis: Redox titrations, Redox indicators, their use in volumetric analysis, iodometry and iodimetry, example of titration from other redox systems.

SECTION C

IONIC EQUILIBRIA: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids.

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Theory of acid–base indicators; selection of indicators and their limitations. Hydrolysis and hydrolysis constants.

SECTION D

SURFACE AND COLLOIDS CHEMISTRY: Physical adsorption, chemisorption, nature of adsorbed state. Adsorption- Langmuir and Freundlich isotherms. Multi layer adsorption-BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), emulsions and emulsifiers, association colloids (micelles), gels. Applications of colloids.

Catalysis: Types of catalysts, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis and mechanism.

ESSENTIALS OF CHEMISTRY LAB(CHH108-P)

LIST OF EXPERIMENTS:

1. To determine strength of unknown HCl by titrating it against N/10 NaOH
2. To estimate the amount of Zinc present in a given solution by EDTA method.
3. To estimate the amount of Magnesium present in a given solution by EDTA method.
4. To estimate the amount of copper present in given solution by EDTA method.
5. To determine amount of Cu(II) in an unknown sample by iodometric titration.
6. To determine strength of given solution of ferrous ammonium sulphate (mohr salt) being provided with N/30 $KMnO_4$.
7. To estimate amount of Barium gravimetrically.
8. To find the Strength of an acid (Strong Acid -HCl OR Weak acid- CH_3 COOH) conductometrically.
9. To determine the adsorption of aqueous acetic acid by activated charcoal and study adsorption isotherm
10. To determine the solubility of a salt (KCl or NaCl) in water at room temperature
11. To determine the solubility of organic acid (oxalic acid) in water at room temperature

12. To determine the solubility product of calcium hydroxide using common ion effect of sodium hydroxide or any other strong alkali.

RECOMMENDED BOOKS:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University 12 Press (2014).
2. Qualitative Analysis Day and Underwood, 5th edition, Prentice-Hall (1986).
3. Fundamentals of Analytical Chemistry Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch, 9th Edition,Cengage Learning(2013).
4. F. A. Cotton, G. Wilkinson, P. G. Gauss, Basic Inorganic Chemistry, 3rd Edition, John Wiley, 1995
5. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Course Title/ Code	**MODERN PHYICS(PHH108-T)**
Course Type:	Core(Allied)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	• To study the relativistic effects • To study and analyze different types of spectra • To study nuclear models and detectors.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION - A

Inertial and Non inertial frame of references, Michelson-Morley Experiment (Qualitative), Einstein's Postulates of Special Theory of Relativity, Lorentz Transformations, Length Contraction, Time dilation, velocity Addition Theorem, Variation of mass with velocity, Mass – Energy Equivalence Relation (10L)

SECTION - B

Bohr's Model of Hydrogen Atom, Spectral Series, Schrodinger Equation in Spherical Polar Coordinates, Hydrogen Atom (Qualitatively), Quantum Numbers and Selection Rules (Qualitative). Stern-Gerlach Experiment, Spin as An Intrinsic Quantum Number, Fine Structure

(12L)

SECTION C

Magnetic Moment of the Electron, Lande g-Factor, Vector Model – Space Quantization, Zeeman Effect, Pauli Exclusion Principle, Shell Structure. Hund's Rule, Spectroscopic Terms of Many Electron Atoms in the Ground State Diatomic Molecules–Rotational and Vibrational Energy Levels, Basic Ideas About Molecular Spectra, Raman Effect and Its Application to Molecular Spectroscopy (Qualitatively). (12 L)

SECTION D

Structure of nuclei
Basic Properties of Nuclei: Mass, Radii, Charge, Angular Momentum, Spin, Magnetic Moment (μ), Stability and Binding Energy.

Nuclear Models
Liquid Drop Model, Mass formula, Shell Model, Meson Theory of Nuclear Forces

Detectors of Nuclear Radiations
Interaction of Energetic particles with matter, Ionization chamber, GM Counter, Cloud Chambers, Wilson Cloud Chamber, Bubble Chamber, Scintillation Detectors, Semiconductor Detectors (Qualitative Discussion Only) (12L)

List of Experiments

1. Verification of Stefan's Law and Wien's displacement law by constructing Black Body Spectrum
2. Measurement of sodium doublet using Michelson Interferometer
3. Construction of Wave Packet by superposition of waves
4. Hydrogen spectra using Transmission Grating
5. Measurement of e/m of an electron
6. Measurement of Charge of an electron using Millikan Oil Drop method.
7. Measurement of energy Band Gap of intrinsic semiconductor by Four Probe Method
8. Measurement of Hall effect.
9. Thermionic emission of electron
10. Energy band measurement for semiconductor diode/ diode laser.
11. To determine the Rydberg's Constant wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg's Constant.
11. To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode.
12. To determine the value of Planck's constant by using a Photoelectric Cell.
13. To determine the value of Planck's constant by using LEDs of at least 4 Different Wavelengths.

Recommended Books:

1. Concepts of modern Physics A Beiser, S Mahajan & S R Chaudhary (Text Book)
2. Modern Physics-R A Serway, C J Moses & C A Moyer
3. Atomic and Molecular Spectra: Laser-R Kumar (Text Book)
4. Fundamentals of Molecular Spectroscopy-C N Banwell & E M Mccash
5. Introduction to Molecular Spectra – H E White

Course Title/Code	Communicative English (HLS102)
Course Type	Allied Core
Course Nature	Soft
L-T-P-O Structure	1-0-2-0
Objective	• To equip the students with effective communication skills. • To deal extensively with the requirements of Industry. • To equip students with the nuances of technical writing. • To bridge the gap between college and work-place • To understand the genres of English Literature.

	UNIT	**WEIGHTAGE**
SYLLABUS	**A**	**30%**
	B	**20%**
	C	**25%**
	D	**25%**
	TOTAL	**100%**

SCOPE & IMPORTANCE OF COMMUNICATIVE ENGLISH

This course aims to take off from the threshold of the previous paper dealt in Semester I. Dealing extensively with requirements of Industry, the paper aspires to equip students with the nuances of technical writing, excellent communication flair and presentation skills. Eventually, the agenda is to bridge the gap between college and work-place.

SECTION A

LEXIS and SYNTAX: Homonym, Homophones, Words often confused, Foreign Words, Sentence, Kinds of Sentence, Parts of Sentence, The Phrase, The Clause, Synthesis of Simple Sentence, Spotting the Errors (Articles, Pronoun, Preposition, Adjective, Verb).

SECTION B

ORAL COMMUNICATION-II: Importance of Speech Sounds, IPA Symbols (Vowels and Consonants), Phonetic Transcription, Phoneme and Syllables.

SECTION C

TECHNICAL WRITING-II: Business Letters, Job Application and CV Writing, Paraphrasing, Punctuation, Situation Writing, Paragraph Writing, Developing Outlines.

SECTION D

LITERATURE: *Goodbye Party for Miss. Pushpa T S* - Nissim Ezekiel, *Scientists and Engineers Need Literature*- Troy Camplin, *The Time Machine* - H. G.Wells.

LAB ACTIVITIES

1. Exercise on Lexis.
2. Exercise on Syntax
3. Exercise on Spotting the Errors
4. One- Man Task
5. Role-Play Activities
6. Mock-Interview
7. Paragraph Writing
8. Situation Writing
9. Slogan Writing
10. Phonetic Transcription
11. Synthesizing Sentences
12. Presentation (Book Review/ Movie Review)

Suggested Text Reading:

1. *A Practical Course for Developing Writing Skills in English*. J K Gangal: PHI Learning Pvt.
2. *A Textbook of English Phonetics for Indian Students*. T.Bala Subhrmaniam: Macmillan Camplin, Troy. 'Why Scientists and Engineers Need Literature'. www.popecenter.org. Web.
3. *English Vocabulary in Use*. MaCarthy: Foundation Books, OUP. Print.
4. *English Grammar, Competition and Correspondenc.* M.A. Pink and A.C.Thomas: S. Chand and Co. Print.
5. Ezekiel, Nissim. *Goodbye Party for Miss. Pushpa T.S*. Modern Indian Literature: Poems and Short Stories. Ed. Harish Trivedi. New Delhi: OUP, 2001. Print.
6. *Reading Between the Line: Students Book.* MacRae: Foundation Books. CUP, New Delhi.
7. Wells, H.G. *The Time Machine*. London: Norton Classics, 1989. Print.
8. *A Practical Course for Developing Writing Skills in English*. J K Gangal: PHI Learning Pvt. Print
9. *A Textbook of English Phonetics for Indian Students*. T.Bala Subhrmaniam: Macmillan. Print.
10. Camplin, Troy. 'Why Scientists and Engineers Need Literature'. www.popecenter.org. Web.
11. Ezekiel, Nissim. *Goodbye Party for Miss. Pushpa T.S*. Modern Indian Literature: Poems and Short Stories. Ed. Harish Trivedi. New Delhi: OUP, 2001. Print.
12. Wells, H.G. *The Time Machine*. London: Norton Classics, 1989. Print.

Course Title/ Code	**STATISTICS USING EXCEL(MAW119)**
Course Type:	Core(Departmental)
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)
Objective	The students would be able to apply the concepts of Statistics for solving mathematical problems using excel.

LAB EXERCISE:

1. To present the data by tables and by diagrams. To study the frequency distributions by histogram and frequency polygon.
2. To find mean, median, mode, quartiles, deciles and percentiles for the data.
3. To find mean deviation, standard deviation, coefficient of mean deviation and coefficient of variation. Comparison of various measures of dispersion.
4. To find moments, coefficient of skewness and measures of kurtosis.
5. Bivariate data scatter diagram, principle of least squares and fitting of polynomials and exponential curves.
6. To find coefficient of correlation and rank correlation. Multiple correlation analysis.
7. To find regression coefficients and lines of regression.
8. To construct the index numbers by different methods. Time reversal, factor reversal and circular tests.
9. Analysis of time series by using different methods (graphical method, method of semi averages, method of fitting curves).
10. To study Sampling distributions. Tests of significance based on t and F distributions.
11. Test of significance based on Chi- square distribution.

RECOMMENDED BOOKS:

1. Gupta, S.C. and Kapoor, V.K. (2007): Fundamentals of Mathematical Statistics, 11th Edn., (Reprint). Sultan Chand and Sons.
2. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rdEdn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
3. Glyn Davis & Branko Pecar, Business Statistics using Excel, 2010, Oxford university press.

MAU01- Semester III

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CREDITS
MAH221-T	REAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4
MAH221-P	REAL ANALYSIS LAB				0	0	2	0	1
MAH222-T	CALCULUS-II	MA	HARD	CORE	3	1	0	0	4
MAH222-P	CALCULUS-II LAB				0	0	2	0	1
MAH223-T	DIFFERENTIAL EQUATIONS & MM I	MA	HARD	CORE	3	1	0	0	4
MAH223-P	DIFFERENTIAL EQUATIONS & MM I LAB				0	0	2	0	1
MAH224-T	GEOMETRY OF TWO AND THREE DIMENSIONS	MA	HARD	CORE	3	1	0	0	4
MAH224-P	GEOMETRY OF TWO AND THREE DIMENSIONS				0	0	2	0	1
	BASKET OF COURSES BY HUMANITIES DEPTT.	HL	SOFT	ELECTIVE	1	0	2	0	2
	BASKET OF COURSES BY MANAGEMENT DEPTT.	MC	SOFT	ELECTIVE	1	0	2	0	2
MAW225	LaTeX	MA	WORKSHOP	CORE	0	0	3	0	2
FLS211	FRENCH-III	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	0
FLS209	SPANISH-III								
FLS210	GERMAN-III								

DETAILED SYLLABUS
MAU01 –SEMESTER III

Course Title/ Code	**REAL ANALYSIS / MAH221-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	*Students shall be able to apply the Characterization of Real numbers, concepts of Sequences and series of Real numbers and their convergence behavior in solving the mathematical problems.*

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Dedekind Theory and Characterization of Real Numbers: Rational numbers, section of Rational numbers, Irrational numbers, real numbers, Dedekind Theorem, Cantor's Theory, Equivalence of the definition of Dedekind & Cantor. Suprema and infima, the completeness property of $\boldsymbol{R}$, the Archimedean property, density of rational numbers in $\boldsymbol{R}$, characterization of intervals, neighborhoods, open sets, closed sets, limit points of a set, isolated points, closure, complements ,idea of uncountability of $\boldsymbol{R}$, Boundedness of $\boldsymbol{R}$, ,

SECTION B

Sequence of Real Numbers: Sequences, bounded sequence, limit of a sequence, convergent sequences, limit theorems, monotone sequences, monotone convergence theorem, subsequences, convergence and divergence criteria, existence of monotonic subsequences (idea only), Bolzano-

Weierstrass theorem for sequences and sets, definition of Cauchy sequence, Cauchy's convergence criterion, limit superior and limit inferior of a sequence.

SECTION C

Infinite series: Definition of infinite series, sequence of partial sums, convergence of infinite series, Cauchy criterion, absolute and conditional convergence, convergence via boundedness of sequence of partial sums, tests of convergence: comparison test, limit comparison test, ratio test, Cauchy's nth root test (proof based on limit superior), integral test (without proof), alternating series, Leibniz test.

SECTION D

Convergence, Absolute convergence, Cauchy criterion for uniform convergence, series of functions and convergence, Weierstrass M-test, Weierstrass approximation theorem (statement only).Differentiation and integration of Power series, Abel's theorem (without proof), exponential and logarithmic functions.

REAL ANALYSIS LAB (MAH221-T)

LAB EXERCISE:

1. Creation and usage of Function files in MATLAB.
2. Inline function with one independent variable and several independent variables.
3. Solution of Application problems using function files.
4. Plotting of recursive sequences.
5. Find a value of that will make the following inequality holds for all >:
   (i) $(0.9)^n < 10^{-3}$
   (ii) $(2)^n/n! < 10^{-7}$
6. Study the convergence of sequences through plotting.
7. Verify Bolzano Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
8. Study the convergence/ divergence of infinite series by plotting their sequences of partial sum.
9. Cauchy's root test by plotting nth roots.
10. Ratio test by plotting the ratio of nth and (n+1)th term.
11. For the following sequences $\langle a_n \rangle$, given $\in > 0$ and $p \in N$, find $m \in N$ such that (i) $|a_{m+p} - a_m| < \in$ (ii) $|a_{2m+p} - a_{2m}| < \in$.
    For $\left(\in = \frac{1}{2^k}, p = 10^j, j = 1, 2, 3, 4 \ldots.\right), k = 0, 1, 2, 5 \ldots$
    a) $a_n = \frac{n+1}{n}$
    b) $a_n = \frac{1}{n}$
    c) $a_n = 1 + \frac{1}{2!} + \cdots \frac{1}{n!}$

d) $a_n = \frac{(-1)^n}{n}$

e) $a_n = 1 - \frac{1}{2} + \frac{1}{3} \ldots \frac{(-1)^n}{n!}$

12. For the following series $\sum a_n$, calculate

(i) $\left|\frac{a_{n+1}}{a_n}\right|$ (ii) $|a_n|^{\frac{1}{n}}$ for n = 10^j, j = 1, 2, 3… and identify the convergent series.

a) $a_n = \frac{1}{n}$

b) $a_n = \frac{1}{n^2}$

c) $a_n = \left(\frac{1}{n}\right)^{1/n}$

d) $a_n = \left(1 + \frac{1}{\sqrt{n}}\right)^{-n^{3/2}}$

e) $a_n = \frac{1}{n^2}$

f) $a_n = \frac{n!}{n^n}$

g) $a_n = \frac{n^3+5}{3^n+2}$

h) $a_n = \frac{1}{n^2+n}$

i) $a_n = \frac{1}{\sqrt{n+1}}$

j) $a_n = \cos n$

k) $a_n = \frac{1}{n \log n}$

l) $a_n = \frac{1}{n(\log n)^2}$.

RECOMMENDED BOOKS:

1. W. Rudin - Principles of Mathematical Analysis - Mc. Graw Hill IntEdition (3rd)
2. Robert G. Bartle and Donald R. Shebert- Introductionto Real Analysis - Wiley Indi a, 3rd ed.
3. Sterling K. Berberian - A First course in Real Analysis -1994 , Springer Verlag, Ny .I nc.
4. S.C. Malik, Principle of Real Analysis, PHI .
5. P.K. Jain ,SK Kaushik, INTRODUCTION TO REAL ANALYSIS, S CHAND.

Course Title/ Code	**CALCULUS – II / MAH222-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	*The students would be able to apply the concepts of Integral and Vector calculus required for solving the mathematical problems and their applications.*

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Reduction formulae, derivations and illustrations of reduction formulae, area of curves, length of arc of curves, volume and surface area of solids of revolution.

SECTION B

Double Integral ,Application of double integral to find Area enclosed by plane curves , Triple integral, Change of variables, volume of solids of revolution using double and triple integral. Centre of gravity, moment of Inertia.

SECTION C

Limit & Continuity of vector functions, differentiation & integration of vector functions, tangent and normal components of vector functions, vector fields and scalar fields, the gradient of a scalar field and directional derivative, Divergence and curl of a vector field and their physical interpretations, Combined operations, Irrotational and solenoidal fields.

SECTION D

Vector Integration : Line integral, Integrals independent of path, Surfaces in space, Orientability, Surface integral, volume integral, Gauss Divergence theorem , Stoke's theorem and Green's theorem.

CALCULUS – II LAB (MAH222-P)

LAB EXERCISE:

1. Evaluation of single integrals and their applications
2. Evaluation of area and volume using double and triple integrals.
3. To study limit, continuity and differentiability of a vector point function.
4. To find the gradient of of a scalar point function.
5. To find the divergence and curl of a vector point function.
6. To verify various identities of vector differentiation .
7. To find the work done using line integral of a vector point function.
8. To find surface integral of a vector point function.
9. To find volume integral of a vector point function.
10. To verify Divergence theorem , Green's theorem and Stoke's theorem

RECOMMENDED BOOKS:

1. Shanti Narayan: Integral Calculus, S. Chand & Co.
2. Integral calculus By C.M. Prasad, S.N. Srivastava.

Course Title/ Code	**DIFFERENTIAL EQUATIONS & MATHEMATICAL MODELING-I / MAH223-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	*The students would be able to apply the concepts of theory of ordinary differential equation and mathematical modeling required for solving the mathematical problems and their applications.*

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Differential equations and mathematical models, order and degree of a differential equation, exact differential equations and integrating factors of first order differential equations, reducible second order differential equations, application of first order differential equations to acceleration-velocity model, growth and decay model.

SECTION B

Introduction to compartmental models, lake pollution model (with case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills, case study of alcohol in the bloodstream), exponential growth of population, limited growth of population, limited growth with harvesting.

SECTION C

General solution of homogeneous equation of second order, principle of superposition for a homogeneous equation, Wronskian, its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method

of undetermined coefficients, applications of second order differential equations to mechanical vibrations.

SECTION D

Equilibrium points, interpretation of the phase plane, predator-prey model and its analysis, competing species and its analysis, epidemic model of influenza and its analysis, battle model.

DIFFERENTIAL EQUATIONS & MATHEMATICAL MODELING-I LAB (MAH223-P)
LAB EXERCISE:

1. To find the solution of exact differential equation.
2. To find the solution of ordinary differential equation.
3. To find the solution of simultaneous linear differential equation.
4. To find the solution of Cauchy's and Legendre's linear differential equation.
5. Plotting of second order solution family of differential equation.
6. Plotting of third order solution family of differential equation.
7. Growth Model (exponential case only).
8. Decay Model (exponential case only).
9.
    a) Lake pollution model(with constant season flow and pollution concentration).
    b) Case of single cold pill and a course of cold pills.
    c) Limited growth of population(with and without harvesting)
10.
    a) Predator – prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
    b) Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
    c) Battle model (basic battle model, jungle warfare, long range weapons).

RECOMMENDED BOOKS:

1. Belinda Barnes and Glenn R. Fulford: Mathematical Modeling with Case Studies, A Differential Equation Approach Using Maple, Taylor and Francis, London and New York,2002.
2. C. H. Edwards and D. E. Penny: Differential Equations and Boundary Value Problems: Computing and Modeling, Pearson Education, India, 2005.
3. S. L. Ross: Differential Equations, John Wiley and Sons, India, 2004.
4. M.D. Rai Singhania : Advanced differential equations.

Course Title/ Code	**GEOMETRY OF TWO AND THREE DIMENSIONS / MAH224-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	*The students would be able to trace conics and apply the concepts of sphere, cones, cylinders and paraboloids required for solving the mathematical problems.*

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

General equation of second degree: Introduction, Condition for a pair of straight line, circle ,parabola ,hyperbola and ellipse. Tracing of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic. System of conics.

SECTION B

Confocal conics. Polar equation of a conic, tangent and normal to the conic. System of co-ordinates.

SECTION C

Sphere: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres. Co-axial system of spheres.

SECTION D

Cones. Right circular cone, enveloping cone and reciprocal cone.
Cylinder: Right circular cylinder and enveloping cylinder.

Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Enveloping cone of a conicoid. Enveloping cylinder of a coincoid , Paraboloids.

GEOMETRY OF TWO AND THREE DIMENSIONS LAB (MAH224-P)

LAB EXERCISE:

1. Sketching of Cartesian curves.
2. Sketching of Parametric curves.
3. Sketching of polar curves.
4. Sketching of a sphere, plane section of a sphere and intersection of two spheres.
5. Sketching of a cylinder, plane section of a cylinder and intersection of two cylinders.
6. Sketching of a cone and its intersection by a plane.
7. Sketching of ellipsoid and hyperboloid of one sheet.
8. Sketching of ellipsoid and hyperboloid of two sheets .
9. Sketching of elliptic cone, elliptic paraboloid, hyperbolic paraboloid of Cartesian coordinates.
10. Graph of hyperbolic functions.

RECOMMENDED BOOKS:

1. P.K.Jain and Khalil Ahmad:A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.
2. S. L. Loney: The elements of coordinate geometry, by Michigan Historical Reprint Series.
3. Shanti Narayan: Analytical Solid Geometry, S. Chand and Company.

Course Title/ Code	**LaTeX / MAW225**
Course Type:	Core (Departmental)
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)
Objective	The students would be able to apply the concepts of LaTeX to create a document of Scientific Writing.

LAB EXERCISE:

1. Introduction and basics of LaTeX.
2. Document structure and text formatting in LaTeX.
3. Mechanics of error and warning, lengths, Counters and Boxes.
4. Fundamentals for creating Technical Texts.
5. To Create Special Pages: Indexing ,Glossary, Bibliography
6. To Create Special Documents: Letters, Presentations, Curriculum Vitae.
7. Creating Graphics in LaTeX.
8. Programming: Macros, Plain text, Creating Packages, Themes.
9. Miscellaneous : Modular Documents, Collaborative Writing of LaTeX Documents, Export to other Formats.
10. Math – Type in Microsoft Word.

MAU01- Semester IV

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CREDITS
MAH226-T	ADVANCED ANALYSIS	MA	HARD	CORE	3	1	0	0	4
MAH226-P	ADVANCED ANALYSIS LAB				0	0	2	0	1
MAH227-T	GROUP THEORY	MA	HARD	CORE	3	1	0	0	4
MAH227-P	GROUP THEORY LAB				0	0	2	0	1
MAH228-T	DIFFERENTIAL EQUATIONS & MM II	MA	HARD	CORE	3	1	0	0	4
MAH228-P	DIFFERENTIAL EQUATIONS & MM II LAB				0	0	2	0	1
MAH229-T	PROBABILITY & MATHEMATICAL STATISTICS	MA	HARD	CORE	3	1	0	0	4
MAH229-P	PROBABILITY & MATHEMATICAL STATISTICS LAB				0	0	2	0	1
MAS230	QUANTITATIVE APTITUDE	MA	SOFT	CORE	1	0	2	0	2
	BASKET OF COURSES ON ENVIRONMENTAL ETHICS & SUSTAINABLE DEPARTMENT	ALL	SOFT	ELECTIVE	1	0	2	0	2
MAW231	SPSS	MA	WORKSHOP	CORE	0	0	3	0	2
FLS215	FRENCH-IV	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	0
FLS213	SPANISH-IV								
FLS214	GERMAN-IV								

DETAILED SYLLABUS
MAU04 –SEMESTER IV

Course Title/ Code	**ADVANCE REAL ANALYSIS /MAH226-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	**The students would be able to apply the concepts of theory of Riemann Integrals and fundamentals of Complex Analysis required for solving the mathematical problems and their applications.**

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

Section A

Riemann Integral-I: The Upper and lower R-integrals, Integrable (R) functions, Properties of definite and indefinite integral Riemann condition of integrability, Riemann sum, Basic inequality of Riemann integral, algebraic and order properties of the Riemann integral. Riemann integrability for continuous functions, monotonic functions and functions with finite number of discontinuities.

Section B

Riemann Integral-II: The fundamental theorem of integral calculus, Riemann-Stieltjes Integral, Improper integrals, Convergence of improper integrals, tests of convergence for improper integrals, Abel's and Dirichlet's tests for improper integrals, Beta and Gamma functions.

Section C

Uniform Continuity and Convergence: Point wise and uniform convergence of sequence of functions, Uniform convergence and continuity, Uniform convergence and differentiation, Uniform convergence and integration, Weierstrass approximation theorem.

Section D

Function of Complex Variable: Complex number system, function of Complex variable, Limit, Continuity, Differentiability, Analytic function, Cauchy-Riemann equations, Harmonic functions, Milne-Thomson method.

ADVANCED ANALYSIS LAB (MAH226-P)

LAB EXERCISE:

1. Introduction to Maple and Methods of entering expressions in 1-D and 2-D Math
2. An introduction to the point-and-click features in Maple and An introduction to the commands of the Maple Language.
3. Entering and evaluating mathematical expressions in Document mode.
4. Worksheet mode – input prompt and commands.
5. Pallets
6. To solve standard mathematical problems.
7. To construct and compute with expressions that has units, scientific constants or uncertainty.
8. Differential Calculus using Maple.
9. Integral Calculus using Maple.
10. Vector calculus using Maple.
11. Verification of Cauchy Riemann equations and evaluation oh Harmonic functions.

RECOMMENDED BOOKS:

1. W. Rudin- Principles of Mathematical Analysis - Mc. Graw Hill Int .Edition (3rd)
2. C. C. Pugh, Real Mathematical Analysis- Springer Verlag, Ny. Inc.
3. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International (P).
4. J. W. Brown and R. V. Churchill, Complex variable and Application.

Course Title/ Code	**GROUP THEORY (MAH227-T)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	***The students would be able to apply the concepts of Groups and their properties in mathematical problems and their applications.***

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

Section A

Definition and examples of groups, Symmetry of a square, Dihedral groups, Subgroups and examples of subgroups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups, Product (HK) of two subgroups, Definition and properties of cosets, Lagrange's theorem and consequences.

Section B

Centralizer, Normalizer, Center of a Group, Commutator Subgroup, Quotient Group, Homomorphism, Isomorphism, Automorphism of group and structure of cyclic groups, Generators of Cyclic Groups, Classification of subgroups of cyclic groups. Cycle notation for Permutations, Properties of Permutations, Even and Odd Permutations, Alternating Group, A Check-Digit Scheme based on the dihedral group D5.

Section C

Cayley's theorem, Properties of Isomorphism, Isomorphism theorems I, II and III, Inner Automorphism, Automorphism and Inner Automorphism group, Automorphism group of finite and infinite cyclic groups, Applications of Factor groups to Automorphism groups, Cauchy's theorem for finite abelian groups.

Section D

Fermat's Little theorem, An application of cosets to permutation groups, the rotation group of a cube and a soccer ball, definition and examples of the external direct product of a finite number of groups, Normal subgroups, Factor groups, Applications of factor groups to the alternating group A_4.

Group Theory Lab (MAH227-P)

LAB EXERCISE:

1. Linear Algebra using Maple.
2. Plots – 1 using Maple.
3. Plots – 2 using Maple.
4. Animations using Maple.
5. Creating Mathematical Documents – 1 using Maple.
6. Creating Mathematical Documents – 2 using Maple.
7. Listing elements of a permutation group using MAPLE's functions.
8. Listing elements of permutation groups without the cosets command.
9. Embedded Subgroups of a Symmetric Group and Cayley's Theorem
10. Cayley's Group Table.
11. Regular Permutation Representations**.**

RECOMMENDED BOOKS:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4^{th} Edition), Narosa Publishing House.
2. M.K. Singhal & Asha Rani Singhal, Algebra, R. Chand & Co.
3. Surjeet Singh & Qazi Zameeruddin, Modern Algebra, Vikas publishing house.

Course Title/ Code	**DIFFERENTIAL EQUATIONS & MATHEMATICAL MODELING - II (MAH228-T)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	***The students would be able to apply the concepts of partial differential equations required for solving the mathematical problems and their applications.***

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION-A

First Order Partial Differential Equation: Introduction, classification, construction and geometrical interpretation of first order partial differential equations (PDE), Lagrange's method of solution of first order Linear PDE, Solution of Non-Linear First Order PDE : Charpit's Method, Standard Forms-I, II, III and IV, Method of separation of variables for first order PDE.

SECTION-B

Linear Partial Differential Equations with Constant Coefficients: Linear PDE with Constant Coefficients, Solution of Linear Homogeneous PDE with Constant Coefficients : Method of finding the Complementary Function (C.F.) and Particular Integral (P.I.)- Method –I ,II and general method . Solution of Non-Homogeneous Linear PDE with Constant Coefficients: Method of finding the Complementary Function (C.F.) and Particular Integral (P.I.). Equations Reducible to Linear PDE with Constant Coefficients.

SECTION-C

Second Order Partial Differential Equation with Variable Coefficients: Introduction, Type-I, Type-II, Type-III, Type-IV, Laplace's Transformation, Canonical Forms, The Solution of Linear Hyperbolic Equations, Riemann Method of solution of general Hyperbolic Equations of second order.

SECTION-D

Boundary Value Problems: Introduction , Method of separation of variables for second order PDE, Vibrating string Problem -Wave Equation, Existence and uniqueness of solution of Vibrating string Problem(one and two dimension), heat conduction problem, existence and uniqueness of solution of heat conduction problem(one and two dimension), Laplace equation(two and three dimensions).

DIFFERENTIAL EQUATIONS & MATHEMATICAL MODELING - II LAB (MAH228-P)

LAB EXERCISE:

1. Solution of Cauchy problem for first order PDE.
2. Finding the characteristics for the first order PDE.
3. Plot the integral surfaces of a given first order PDE with initial data.
4. Solution of the wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for any two of the following associated conditions:
   (a) $u(x,0) = \emptyset(x), u_t(x,0) = \varphi(x),\ x \in R, t > 0.$
   (b) $u(x,0) = \emptyset(x),\ u_t(x,0) = \varphi(x),\ u(0,t) = 0,\ x \in (0,\infty), t > 0.$
   (c) $u(x,0) = \emptyset(x),\ u_t(x,0) = \varphi(x),\ u_x(0,t) = 0,\ x \in (0,\infty), t > 0.$
   (d) $u(x,0) = \emptyset(x),\ u_t(x,0) = \varphi(x),\ u(0,t) = 0, u(l,t) = 0,\ 0 < x < l, t > 0.$
5. Solution of one-dimensional heat equation $u_t = ku_{xx}$,for a Homogeneous rod of length l i.e. to solve the IBVP:

$$u_t = ku_{xx}\ , 0 < x < l, t > 0$$
$$u(0,t) = 0, u(l,t) = 0, t \geq 0,$$
$$u(x,0) = f(x), 0 \leq x \leq l$$

6. To find the solution of Laplace equation.

RECOMMENDED BOOKS:

1. TynMyint-U and LokenathDebnath, Linear Partial Differential Equation for Scientists and Engineers, Springer, Indian reprint, 2006.
2. Ioannis P Stavroulakis and Stepan A Tersian, Partial Differential Equations: An Introduction with Mathematica and MAPLE, World Scientific, Second Edition 2004.
3. M.D. RaiSinghania : Advanced differential equations
4. N.M. Kapur, a Text book of Differential Equations, Pitambar Publishing Company.

Course Title/ Code	**PROBABILITY & MATHEMATICAL STATISTICS / MAH229-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	***The students would be able to apply the concepts of probability theory required for solving the mathematical problems and their applications.***

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

Section A

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Section B

Joint cumulative distribution function and its properties, Joint probability density functions, Marginal and conditional distributions, Expectation of function of two random variables, Conditional expectations, Independent random variables.

Section C

Bivariate normal distribution, Correlation coefficient, Joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Section D

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance.

PROBABILITY & MATHEMATICAL STATISTICS LAB (MAH229-P)
LAB EXERCISE:

1. To find the solution of the problems using Binomial Distribution.
2. To find the solution of the problems using Poisson distribution.
3. To find the solution of the problems using Negative Binomial Distribution.
4. To find the solution of the problems using Normal Distribution.
5. To find the solution of the problems using Uniform Distribution.
6. To find the solution of the problems using Exponential Distribution.
7. Illustration of Central Limit theorem.
8. To find coefficient of correlation and rank correlation.
9. To find regression coefficients and lines of regression.
10. To study multiple correlation analysis.

RECOMMENDED BOOKS:

1. Irwin Miller and Marylees Miller, John E. Freund's Mathematical Statistics with Applications (7th Edition), Pearson Education, Asia, 2006.
2. Sheldon Ross, Introduction to Probability Models (9th Edition), Academic Press, Indian Reprint, 2007
3. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, (3rd Edition), Tata McGraw- Hill, Reprint 2007

Course Title/ Code	QUANTITATIVE APTITUDE (MAS230)
Course Type:	Core (Departmental)
Course Nature:	Soft
L-T-P-O Structure	(1-0-2-0)
Objective	The students would be able to apply the concepts of quantitative techniques required for solving the mathematical problems and their applications.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

Section A

H.C.F & L.C.M of Numbers, Square Roots & Cube Roots, Average, Problems on Ages, Percentage, Profit & Loss.

Section B

Ratio and Proportions, Numbers, Time & work, Time & Distance, Problems on Trains.

Section C

Simple Interest, Compound Interest, Area, Volume & Surface Area, Races and Games of Skill.

Section D

Calendar, Clocks, Permutations & Combinations, Probability.

RECOMMENDED BOOK:

1. Quantitative Aptitude –R.S. Aggarwal

LAB EXERCISE:

1. (a)To solve the problems of H.C.F. & L.C.M. of Numbers.
   (b) To solve the problems of Square Roots & Cube Roots.
2. (a) To solve the problems of Average.
   (b) To solve the Problems on Ages.
3. To solve the problems of Percentage, Profit & Loss.
4. To solve the problems of Ratio & Proportion, Numbers.
5. To solve the problems of Time & work.
6. To solve the problems of Time & Distance, Problems on Trains.
7. To solve the problems of Simple Interest and Compound Interest.
8. To solve the problems of Area, Volume & Surface Areas.
9. To solve the problems of Races & Games of Skill.
10. To solve the problems of Calendar and Clocks.
11. To solve the problems of Permutations & Combinations and Probability.

Course Title/ Code	**SPSS WORKSHOP (MAW231)**
Course Type:	Core (Departmental)
Course Nature:	Workshop
L-T-P-O Structure	(0-0-3-0)
Objective	The student would be able to apply the concepts of SPSS for Data Analysis.

Introduction -Introduction to SPSS - Data analysis with SPSS: General aspects, Workflow, Critical issues - SPSS: General description, Functions, Menus, Commands - SPSS file management, Frequently used dialog boxes, Editing output, Printing results, Creating and editing a data file.

Managing Data-Listing cases, Replacing missing values, Computing new variables, Recording variables, Exploring data, Selecting cases, Sorting cases, Merging files.

Graphs-Creating and editing graphs and charts

Frequencies- Frequencies, bar charts, histograms, percentiles.

LAB EXERCISE:

1. Introduction SPSS software, open and save an SPSS data file, define codes for categorical variables in SPSS,print a copy of an SPSS data file.
2. Categorize a quantitative variable, create a bar chart,create a pie chart.
3. Create a modified box plot of one quantitative variable,create modified box plots of one quantitative variable to compare groups, create modified box plots to compare quantitative variables.
4. Enter a contingency table into an SPSS data file,create a pie chart from a contingency table, create a stacked bar chart from a contingency table.
5. Create a contingency table from raw data entered into an SPSS data file, create a stacked bar chart from a contingency table.

6. Obtain the equation of the least squares line for predicting one quantitative variable from another quantitative variable create a graph of the least squares line on a scatter plot create a modified box plot of the residuals.
7. Enter data into an SPSS data file perform two-sample t tests and create appropriate graphical displays.
8. Perform a one-sample paired t test and create an appropriate graphical display.
9. Enter data into an SPSS data file, perform a one-way analysis of variance and create and an appropriate graphical display.
10. Perform a chi-square goodness-of-fit test and create and appropriate graphical display create a stacked bar chart from a contingency table.

RECOMMENDED BOOK:

1. SPSS Statistics for Dummies by KEITH MCCORMICK, JESUS SALCEDO, AARON POH Wiley India Pvt Ltd.

MAU01- Semester V

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CREDITS
MAH333-T	RING THEORY	MA	HARD	CORE	3	1	0	0	4
MAH333-P	RING THEORY LAB				0	0	2	0	1
MAH334-T	NUMERICAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4
MAH334-P	NUMERICAL ANALYSIS LAB				0	0	2	1	2
MAH335-T	MECHANICS	MA	HARD	ELECTIVE (ANY TWO)	3	1	0	0	4
MAH335-P	MECHANICS LAB				0	0	2	0	1
MAH336-T	NUMBER THEORY				3	1	0	0	4
MAH336-P	NUMBER THEORY LAB				0	0	2	0	1
MAH337-T	DISCRETE MATHEMATICS AND GRAPH ANALYSIS				3	1	0	0	4
MAH337-P	DISCRETE MATHEMATICS AND GRAPH ANALYSIS LAB				0	0	2	0	1
	PORTFOLIO MANAGEMENT	MC			3	1	0	1	5
MAN338	SEMINARS/PRESENTATIONS	MA	NTCC		0	0	0	1	1

DETAILED SYLLABUS
MAU01 –SEMESTER V

Course Title/ Code	**RING THEORY (MAH333-T)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of ring theory required for solving the mathematical problems and their applications.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Definition and examples of rings, properties of rings, Subrings, Integral domains, Definition and examples of fields, Characteristic of a ring.

SECTION B

Ideals, Ideal generated by subsets in a commutative ring with unity, Factor rings, Operations on ideals, Prime ideals and maximal ideals, Definition and Examples of ring homomorphism, properties of ring homomorphism.

SECTION C

Isomorphism, Isomorphism theorems I, II and III, Field of quotients.

Definition of polynomial rings over commutative rings, The division algorithm and consequences, Principal ideal domains.

SECTION D

Factorization of polynomials, reducibility tests, Irreducibility tests, Eisenstein criterion, Unique factorization in Z[x], An application of unique factorization to weird dice, Divisibility in integral domains, Irreducibles, Primes, Unique factorization domains, Euclidean domains.

RING THEORY LAB (MAH333-P)

LAB EXERCISE :

1. Basic programming constructs in Maple.
2. Iterative commands.
3. Maple programs & Display methods of Maple codes – 1.
4. Maple programs & Display methods of Maple codes – 2.
5. Basic interacting with Maple documents containing embedded components and Methods for creating embedded components that work together and with the user document.
6. Methods for launching a Maplet and Methods for authoring and saving a Maplet.
7. Saving to Maple file formats, Reading from Files, Exporting to Other Formats.
8. To construct the non zero elements as powers of x in a finite field Z_p [x]/(f(x)) for prime p and primitive polynomial f(x) $\in$ Z_p [x].
    i. To verify that f(x) is irreducible in Z_p [x] using the function Irreduc(f(x)) mod p.
    ii. To verify that f(x) is primitive in Z_p [x] using the function primitive(f(x))/mod p.
    iii. To construct the non zero element in Z_p (x)/f(x) as powers of x, using the function powmod().

RECOMMENDED BOOKS:

1. Joseph A. Gallian, Contemporary Abstract Algebra(4^{th} Edition), Narosa Publishing House

2. M.K. Singhal & Asha Rani Singhal, Algebra, R.chand& Co.

3. Surjeet Singh & Qazi Zameeruddin, Modern Algebra, Vikas publishing house.

Course Title/ Code	**NUMERICAL ANALYSIS (MAH334-T)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of numerical analysis required for solving the mathematical problems and their applications.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Errors in numerical calculations introduction, Numbers and their accuracy, Absolute, Relative and Percentage errors and their analysis, General error formula.

Solution of nonlinear equations bracketing methods for locating a root, Initial approximations and convergence criteria, Bisection method, Regula Falsi, Newton- Raphson and Secant method.

Interpolation and curve fitting: Introduction to interpolation, Newton's formula for equispaced points.

SECTION B

Lagrange approximation, Newton's divided difference formula, Hermite interpolation. Curve fitting by a straight line and a second degree curve and laws reducible to linear law.

Numerical differentiation and integration: Approximating the derivatives, Numerical differentiation formulas (forward, backward and central), introduction to numerical quadrature, Newton- cotes formula, Gaussian quadrature - Gauss Legendre & Gauss Chebyshev's.

SECTION C

Solution of linear systems: Direct methods, Gaussian elimination, Matrix inversion, UV factorization, Iterative methods for linear systems (Gauss Seidel & Gauss Jacobi), LU decomposition. Eigen value problems: Jacobi, Given's and Householder's methods for symmetric matrices, Power and inverse power methods.

SECTION D

Solution of differential equations: Introduction to differential equations, Initial value problems, Picard's method, Taylor series method , Euler's methods, classical method of Runge-Kutta method of order IV , Predictor-Corrector methods(Milne's & Adam's Bashforth). Partial differential equations: Solution of hyperbolic, parabolic and elliptic equations.

NUMERICAL ANALYSIS LAB (MAH334-P)

LAB EXERCISE:

1. To find roots of an equation using Bisection method.
2. To find roots of an equation using Regula Falsi method.
3. To find roots of an equation using Newton Raphson method.
4. To find roots of an equation using Secant method.
5. To find the value of a dependent variable for a given value of an independent variable using Lagrange's interpolation method for a given set of data.
6. To find the value of a dependent variable for a given value of an independent variable using Newton divided difference interpolation for a given set of data.
7. To find the value of a definite integral using Trapezoidal rule of integration.
8. To find the value of a definite integral using Simpson's 1/3 rule of integration.
9. To find the value of a definite integral using Simpson's 3/8 rule of integration.
10. To find the solution of an ordinary differential equation of first order by Euler's modified method
11. To find the solution of an ordinary differential equation of first order by R-K method
12. To find the solution of a system of simultaneous algebraic equations using the Gauss-Jacobi iterative method.
13. To find the solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method.
14. To fit a straight line using the method of least squares.

RECOMMENDED BOOKS:

1. B. Bradie, a Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New age International Publisher, India, 5th edition, 2007.
3. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India,7th edition, 2008.

Course Title/ Code	MECHANICS (MAH335-T)
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of Statics and Dynamics required for solving the mathematical problems and their applications.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Composition and Resolution of forces. Parallel forces. Moments and Couples.

SECTION B

Analytical conditions of equilibrium of coplanar forces. Friction. Centre of Gravity

SECTION C

Velocity and acceleration along radial, Transverse, Tangential and Normal directions. Relative velocity and acceleration. Mass, Momentum and Force. Newton's laws of motion. Work, Power and Energy. Definitions of Conservative forces and Impulsive forces

SECTION D

Simple harmonic motion. Elastic strings. Resisted motion, Projectile and motion in a non-resisting medium, Constrained motion on a smooth vertical circle, Collisions (direct).

MECHANICS LAB (MAH335-P)

LAB EXERCISE:

1. To find the moment of the force F about the point .
2. To Find gravitational Potential energy.
3. To find velocity and acceleration.
4. To find angular momentum.
5. To find the centre of mass and centre of gravity.
6. To find the work done by a variable force and constant force.
7. To find the final velocity of bodies after collision and the loss of kinetic energy.
8. To find the Resistance force exerted by the brakes (in vehicles) or air drag using Newton's laws of motion.

RECOMMENDED BOOKS:

1. S.L. Loney : Statics, Macmillan Company, London

2. R.S. Verma : A Text Book on Statics, Pothishala Pvt. Ltd., Allahabad

3. S.L.Loney : An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press, 1956

4. F. Chorlton : Dynamics, CBS Publishers, New Delhi

5. A.S. Ramsey: Dynamics Part-1&2, CBS Publisher & Distributors.

Course Title/ Code	NUMBER THEORY / MAH336-T
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of number theory required for solving the mathematical problems and their applications.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION-A

Divisibility and Factorization: Divisibility: Definition, properties, division algorithm, greatest integer function ,Primes: Definition, Euclid's Theorem, Prime Number Theorem (statement only), Goldbach and Twin Primes conjectures, Fermat primes, Mersenne primes ,The greatest common divisor: Definition, properties, Euclid's algorithm, linear combinations and the gcd ,The least common multiple: Definition and properties, The Fundamental Theorem of Arithmetic: Euclid's Lemma, canonical prime factorization, divisibility, gcd, and lcm in terms of prime factorizations ,Primes in arithmetic progressions: Dirichlet's Theorem on primes in arithmetic progressions (statement only)

SECTION-B

Congruences: Definitions and basic properties, residue classes, complete residue systems, reduced residue systems , Linear congruences in one variable, Euclid's algorithm , Simultaneous linear congruences, Chinese Remainder Theorem , Wilson's Theorem , Fermat's Theorem, pseudoprimes and Carmichael numbers , Euler's Theorem

SECTION-C

Arithmetic functions: Arithmetic function, multiplicative functions: definitions and basic examples , The Moebius function, Moebius inversion formula , The Euler phi function, Carmichael conjecture , The number-of-divisors and sum-of-divisors functions , Perfect numbers, characterization of even perfect numbers

SECTION-D

Quadratic residues: Quadratic residues and nonresidues , The Legendre symbol: Definition and basic properties, Euler's Criterion, Gauss' Lemma , The law of quadratic reciprocity

Primitive roots: The order of an integer , Primitive roots: Definition and properties, The Primitive Root Theorem: Characterization of integers for which a primitive root exists

NUMBER THEORY LAB (MAH336-P)

LAB EXERCISES

1. To study the divisibility of integers .
2. Operate on prime numbers, check and prove primality.
3. Factorization of integers, verification of factorization algorithms.
4. To find Quotients and remainders, primitive roots, orders of residue classes, Euler's quotient function.
5. Solve linear congruences, compute modular roots.
6. To develop and study Bernoulli, Fibonacci, Mersenne, and other sequences of numbers.
7. To verify Euler phi, Carmichael, Moebius, and other number theoretic functions.
8. ASCII encoding and decoding, continued fraction expansion.

RECOMMENDED BOOKS

1. Elementary Number Theory and its applications, 5th edition, by Kenneth H. Rosen.
2. Elementary Number Theory by D. Burton

Course Title/ Code	**DISCRETE MATHEMATICS AND GRAPH ANALYSIS (MAH337-T)**
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of discrete mathematics required for solving the mathematical problems and their applications.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Pigeonhole principle, Basic counting principles, Permutations and Combinations of sets and multisets, Binomial and multinomial theorems, Combinatorial identities, Inclusion and Exclusion principle.

SECTION B

Recurrence relations, Generating functions solution of recurrence relations using difference equations and generating functions, Catalan numbers, Difference sequences and Sterling numbers. Partitions as associated to distribution identical objects in identical boxes.

SECTION C

Elements of Graph Theory, Eulerian and Hamiltonian paths and cycles. Bipartite multigraphs.

SECTION D

Trees, Spaning Trees, Algorithms for BFS and DFS trees weighted Graphs, Greedy algorithm

and Prim's Algorithm for generating minimum weight spanning graphs, Digraphs, Planer graphs, Euler formula and Chromatic numbers.

DISCRETE MATHEMATICS AND GRAPH ANALYSIS LAB (MAH337-P)
LAB EXERCISE:

1. Introduction to set theory using Maple procedure and programming for the same.
2. Basic set operations using Maple procedure.
3. Introduction to propositional logic and logical equivalence using Maple.
4. To draw the Hasse diagram of the relations.
5. Creation of graph generates a circle graph and a complete graph.
6. Transverse the graph adjacent nodes.
7. Transfers a square matrix in to a directed graph.
8. Plot a graph in a bipartite layout, Plot a graph in a grid layout.
9. To find shortest paths from and to all vertices, find shortest paths from one single vertex.
10. Create a Minimal Spanning Tree.

RECOMMENDED BOOKS:

1. Brualdi: Introductory Combinatorics, 3rd Edition.
2. Malt, Kandal and Baker: Discrete Mathematics for Computer Scientists and Mathematicians

MAU01- Semester VI

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CREDITS
MAH339-T	LINEAR ALGEBRA	MA	HARD	CORE	3	1	0	0	4
MAH339-P	LINEAR ALGEBRA LAB				0	0	2	0	1
MAH340-T	METRIC SPACES	MA	HARD	CORE	3	1	0	0	4
MAH340-P	METRIC SPACES LAB				0	0	2	0	1
MAH341-T	INTEGRAL TRANSFORMS & APPLICATION	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	5
MAH341-P	INTEGRAL TRANSFORMS & APPLICATION LAB				0	0	2	0	
MAH342-T	LINEAR PROGRAMMING & GAME THEORY				3	1	0	0	
MAH342-P	LINEAR PROGRAMMING & GAME THEORY LAB				0	0	2	0	
	ECONOMETRICS	MC			3	1	2	0	
MAN343	PROJECT	MA	NTCC		0	0	0	5	5

DETAILED SYLLABUS
MAU01- SEMESTER VI

Course Title/ Code	**LINEAR ALGEBRA (MAH339-T)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of Vector Space, Linear Transformation and inner product Space required for solving the mathematical problems and their applications.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Vector spaces, Subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vector space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension.

SECTION B

Homomorphism and isomorphism of vector spaces, Linear transformations and linear forms on vector spaces, Null Space, Range space of a linear transformation, Rank and Nullity Theorem, Algebra of Linear Transformation, Minimal Polynomial of a linear transformation, Singular and non-singular linear transformationsVector space of all the linear transformations Dual Spaces, Bi dual spaces, Annihilator of subspaces of finite dimensional vector spaces, Matrix of a linear Transformation, Change of basis.

SECTION C

Eigen values and Eigen vectors of linear transformations, Eigen space, Similar matrices, Diagonalisation, Bilinear and quadratic forms.

SECTION D

Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthogonal complements, Orthogonal sets and Basis, Bessel's inequality for finite dimensional vector spaces, Gram-Schmidt, Orthogonalization process, Adjoint operator of a linear transformation and its properties.

LINEAR ALGEBRA LAB (MAH339-P)
LAB EXERCISE

1. To construct vectors and find their dimensions.
2. To perform mathematical operations on vectors.
3. To graph various vectors and their linear combinations in $R^2$and R^3.
4. To graph various vectors and their linear combinations in the complex plane.
5. To generate various special type of vectors with real, complex or symbolic entries.
6. To generate matrices of various forms and construct their sub matrices.
7. To find Eigen values of a matrix.
8. To perform mathematical operations on Matrices.
9. To perform elementary row and column operations on a matrix.
10. To observe various visual forms of a matrix in R^2 and R^3.
11. To construct and observe various special type of matrices.
12. To find determinant, rank, co-rank, adjoint, cofactors, minors and inverse of a matrix.
13. To evaluate matrix powers and verify basic properties of matrix powers.
14. To find various matrix functions and constructing a polynomial with matrix coefficients.
15. To find bases for the vector space.
16. To find basis for row space, column space and null space of the matrix A.
17. To find dimensions of the vector space and find basis for the direct sum and intersection of the vector space.
18. To determine the dimension, the row dimension and the column dimension of the matrix.
19. To find Euclidean norms of the vectors and the matrix.
20. To obtain Inner product, orthogonal vectors and the matrices. To find angle between the vectors.
21. To find vector projection of a vector space and finding an orthonormal set of vectors in the Gram-Schmidt orthonormalization process.

22. To generate a non-homogeneous system of linear equations and constructing a corresponding augmented matrix.
23. To find exact and parameterized solution of a non-homogeneous system of linear equations.
24. To find the approximate solution of the non-homogeneous system of linear equations (for singular case) using the method of least squares.
25. To find parameterized solution of a homogeneous system of linear equations (for singular case).
26. To show that a given transformation is linear.
27. To find characteristic polynomial, Eigen values, Eigen vectors and trace of a matrix. Also verifying Cayley- Hamilton Theorem.
28. To perform the diagonalization and diagonal factorization of a matrix.
29. To find the solution of system of linear equations using matrix decompositions: Gauss Elimination, Gauss-Jordan, LU Decomposition and QR decomposition.
30. To generate the real and hermitian bilinear forms and for a bilinear form generate a matrix notation.
31. To solve the linear system of equations over the field using the function *linearsolve* and verify the solution.

RECOMMENDED BOOKS:

1. Joseph A. Gallian, Contemporary Abstract Algebra(4^{th} Edition), Narosa Publishing House
2. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence, Linear Algebra (4^{th} Edition),Prentice- Hall of India Pvt. Ltd, New Delhi

Course Title/ Code	METRIC SPACES / MAH340-T
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of Metric Spaces and their properties required for solving the mathematical problems and their applications.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Metric Space-Basic Concepts: Definition and examples of metric spaces, Diameter, Isolated points, Accumulation and boundary points, Closure and interior, Open and closed sets, Cantor's intersection theorem, Open and closed balls, Convergence, Cauchy sequence and boundedness, Metric induced by norm. Sequences in metric spaces, Complete metric space.

SECTION B

Limit and Continuity: Limit and continuity of a function defined on a metric space, Uniform continuity, Homeomorphism, Lipschitz continuous function, contraction, Isometry, Completeness, Contraction mapping theorem, Baire's category theorem.

SECTION C

Compactness: Open and closed cover, Compactness of a Metric , Compact subsets, Compactness of products, Compactness and sequential compactness, The Heine-Borel theorem, Separebility, Baire Category Theorem.

SECTION D

Connectedness:: Connected set, Interval, Connected subsets, Intermediate Value Theorem, connected component, Totally disconnected set pathwise connectedness.

METRIC SPACES LAB (MAH340-P)

LAB EXERCISE:

1. Calculate d(x,y)for the following metrics
   (a) X=R, d(x,y)=|X-Y|,
   X: 0, 1, π, e
   Y: $1, 2, \frac{1}{2}, \sqrt{2}$
   (b) X=$R^3, d(x,y) = (\sum(x_i - y_i)^2)^{1/2}$
   X: (0, 1, -1), (1, 2, π), $(2, -3, 5)$
   Y: (1, 2, 0.5), (e, 2, 4), (-2, -3, 5)
   (c) X=C[0,1], d(f,g)=sup |f(x)-g(x)|
   f(x): x^2, sin x , tan x
   g(x): x, |x|, cos x
2. Draw open balls of the above metrics with centre and radiud of your choice.
3. Find the fixed points for the following functions
   $F(x)= x^2$, g(x)=sin x, h(x)=cos x in X=[-1,1],
   F(x,y)=(sin x, cos y), $g(x,y)=(x^2 , y^2)$ in $X=\{(x,y): x^2+y^2<=1\}$,
   Under the Euclidean metrics on R and R^2 respectively.
4. Determine the compactness and connectedness by drawing sets in R^2.

RECOMMENDED BOOKS:

1. E. T. Copson, Metric Spaces- Cambridge University Press
2. MícheálO'Searcoid, Metric Space-Springer Verlag, Ny . Inc.
3. P. K. Jain, Khalil Ahmad, Metric Space, Alpha Science International, New Delhi.

Course Title/ Code	**INTEGRAL TRANSFORMS & APPLICATION(MAH341-T)**
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of Laplace transforms, Fourier transforms and Z-transforms required for solving the mathematical problems and their applications.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Laplace Transforms and its Applications: Laplace transforms of elementary functions, Properties of Laplace transforms, Existence conditions, Transforms of derivatives, Transforms of integrals, Multiplication by t^n, Division by t. Evaluation of integrals by Laplace transforms. Laplace transform of unit step function, Unit impulse function and periodic function. Inverse transforms, Convolution theorem, Application to linear differential equations and Simultaneous linear differential equations with constant coefficients and applications to integral equations.

SECTION B

Application of Laplace Transforms: Application to linear differential equations and simultaneous linear differential equations with constant coefficients and Applications to integral equations.

Fourier Series: Euler's formulae, Conditions for a Fourier expansion, Change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, Rectangular wave, Saw-toothed wave, Half and full rectified wave, Half range sine and cosine series.

SECTION C

Fourier Transforms : Fourier integrals, Fourier transforms, Shifting theorem (both on time and

frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac-delta function.

SECTION D

Z-TRANSFORMS: Introduction, Basic Theory of Z-transforms, Z-transforms of various sequences, Existence of Z-transforms, Properties of Z-transforms, Inverse Z-transforms, Differentiation of Z -transforms, Convolution of sequences, Solution of difference equations using Z-transforms.

INTEGRAL TRANSFORMS & APPLICATION LAB (MAH341-P)
LAB EXERCISE:

1. To find the Laplace Transform of a function f(t) and plot the same.
2. To find the Laplace Transform of Integrals and some special functions, to find the Inverse Laplace Transform of a function F(s).
3. To find the Z-Transform of a sequence (Discrete time signal).
4. To find the Inverse Z-Transform and plot the graph.
5. To solve Difference equation by MATLAB and plot the solution
6. To find the Fourier transforms.
7. To find the inverse Fourier Transforms.
8. To find the Fourier Sine Transforms and inverse Fourier Sine Transforms
9. To find the Fourier Cosine Transforms and inverse Fourier Cosine Transforms
10. To verify the Convolution Theorem.

RECOMMENDED BOOKS:

1. Higher Engineering Mathematics: B. S. Grewal
2. Advanced Engineering Mathematics: Jain and Iyenger

Course Title/ Code	**LINEAR PROGRAMMING & GAME THEORY(MAH342-T)**
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	The students would be able to apply the concepts of Linear Programming, Transportation problems and Game theory required for solving the mathematical problems and their applications**.**

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Introduction to linear programming problem, Formulation, Solution by graphical, Theory of simplex method, Optimality and unboundedness, The simplex algorithm, Simplex method in tableau format.

SECTION B

Introduction to artificial variables, Twophase method, Big M method and their comparison. Duality, Formulation of the dual problem, Primal-dual relationships, Economic interpretation of the dual.

SECTION C

Transportation problem and its mathematical formulation, North-west corner method least cost method and Vogel approximation method for determination of starting basic solution, Algorithm for solving transportation problem, Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem, Travelling salesman problem.

SECTION D

Game theory: Formulation of two person zero sum games, Solving two person zero sum games,

games with mixed strategies, Graphical solution procedure, Linear programming solution of games.

LINEAR PROGRAMMING & GAME THEORY LAB (MAH342-P)

LAB EXERCISE:

1. Finding solution of LPP graphically.
2. Formulating and solving (simplex method) linear programming models on a spreadsheet using excel solver.
3. Formulating and solving (Big M method) linear programming models on a spreadsheet using excel solver.
4. Formulating and solving (two phase method) linear programming models on a spreadsheet using excel solver.
5. Finding solution by solving its dual using excel solver and giving an interpretation of the dual
6. Using the excel solver table to find allowable range for each objective function coefficient and the allowable range for each right hand side.
7. Formulating and solving transportation and assignment models on a spreadsheet using solver.
8. Formulating and solving assignment models on a spreadsheet using solver.

RECOMMENDED BOOKS:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows (2nd edition), John Wiley and Sons, India, 2004.
2. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research (9th Edition), Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, Operations Research, An Introduction (8th edition), Prentice - Hall India, 2006.
4. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.

Course Title/ Code	**FUNDAMENTALS OF MATHEMATICS – I /MAH114-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objectives	The students would be able to apply the concepts of matrices, trigonometry, differential and integral calculus required for solving the mathematical problems and their applications**.**

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

Matrices and its Applications: Algebra of Matrices, Determinants and their properties, Adjoint and Inverse of a Matrix, Solution of simultaneous linear equations.

SECTION B

Trigonometry: Trigonometric functions, Identities, Values of Trigonometric functions at 0°, $30^\circ, 45^\circ, 60^\circ, 90^\circ, 180^\circ, 270^\circ$ and 360°.Operations on Trigonometric functions ,Trigonometric functions of sum of two angles, Trigonometric equations , Graph of Trigonometric functions, Introduction to Inverse Trigonometric functions.

SECTION C

Differentiation: Introduction, Differentiation by 1^{st} principle, Geometrical meaning of derivative at a point, Fundamental Rules of Differentiation: Derivative of sum of two functions, Product Rule, Quotient Rule , Derivative of function of a function (Chain Rule). Logarithmic differentiation, Derivative of an infinite series.

SECTION D

Integration: Primitive or Anti-derivative, Indefinite integrals, Fundamental integration formulas, Geometrical interpretation of indefinite integrals, Integrals of some special form. Integration by Parts. Definite Integrals.

FUNDAMENTALS OF MATHEMATICS LAB (MAH114-P)

LAB EXERCISE:

1. Introduction to MATLAB and use of some simple MATLAB commands.
2. Introduction to some of the fundamentals of MATLAB: Variables, operators, expressions and Arrays(including vectors and matrices)
3. To create sub arrays and perform element by element operations.
4. To perform arithmetic operations on Matrices, determinant, inverse and solution of equations.
5. Introduction to graphics: Basic Two-Dimensional Graphs along with labels.
6. Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
7. To verify trigonometric identities.
8. To find derivatives of function and verification of basic rules of differentiation.
9. To integrate the functions and geometrical interpretation of integration.
10. To find the definite integral of the function.

RECOMMENDED BOOKS :

1. Mathematics for class XI-XII- By R D Sharma
2. Mathematics for class XI- XII – NCERT

Course Title/ Code	FUNDAMENTAL OF MATHEMATICS – II / MAH118-T
Course Type:	Core
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objectives	The students would be able to apply the mathematical concepts of differential equations, set theory, probability and statistics required for solving the mathematical problems and their applications.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

SECTION A

DIFFERENTIAL EQUATIONS:

Introduction, definition, Order and degree of a differential equation, Formation of a D.E., Solution of a D.E., D.E. of 1^{st} order and 1^{st} degree and their solution .Linear differential equations, Application of ODE of 1^{st} order and 1^{st} degree.

SECTION B

PERMUTATION & COMBINATION:Introduction to the Set theory, Permutation and Combination.

SECTION C

PROBABILITY THEORY: Introduction, Random experiments, Event, Axiomatic approach to probability. Conditional probability and Baye's theorem.

SECTION D

STATISTICAL TECHNIQUES: Frequency distribution and frequency table, Graphical representation of frequency distribution: Bar diagrams, Pie diagrams, measure of location: Arithmetic mean , Median ,Mode ,Measure of dispersion: Variance and Standard deviation, Mean deviation ,Quartile, Percentile. Correlation and Regression analysis.

FUNDAMENTAL OF MATHEMATICS – II LAB (MAH118-P)

LAB EXERCISE :

1. To solve ordinary differential equations of 1^{st} order and 1^{st} degree using MATLAB.
2. To solve linear differential equations using MATLAB.
3. To perform basic Set operations using MATLAB.
4. To present the data by tables and by diagrams.
5. To study the frequency distributions by histogram and frequency polygon.
6. To find mean, median, mode, quartiles, deciles and percentiles for the data.
7. To find mean deviation, standard deviation, coefficient of mean deviation and coefficient of variation. Comparison of various measures of dispersion.
8. Bivariate data scatter diagram and to find coefficient of correlation.
9. To find rank correlation.
10. To find regression coefficients and lines of regression.

RECOMMENDED BOOKS:

1. Engineering Mathematics by Dr. B.S.Grewal.
2. Mathematics for class XII by Dr. R. D. Sharma
3. Business Statistics by S.C.Gupta
4. Ordinary Differential Equations by Shanti Narayan
5. Probability and Mathematical statistics by S.C.Gupta and V.K. Kapoor