Manav Rachna University

Faculty of Applied Sciences

Department of Mathematics

Scheme & Syllabus

B. Sc (H) Mathematics (2018-21)

MANAV RACHNA UNIVERSITY
FACULTY OF APPLIED SCIENCES
DEPARTMENT OF MATHEMATICS
SYLLABUS & SCHEME

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 CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH113-T	ESSENTIALS OF MATHEMATICS	MA	HARD	CORE	3	1	0	0	4	4
MAH113-P	ESSENTIALS OF MATHEMATICS LAB				0	0	2	0	2	1
PHH107-T	ESSENTIALS OF PHYSICS	PH	HARD	CORE	3	1	0	0	4	4
PHH107-P	ESSENTIALS OF PHYSICS LAB				0	0	2	0	2	1
CHH101-T	GREEN CHEMISTRY	CH	HARD	CORE	3	1	0	0	4	4
CHH101-P	GREEN CHEMISTRY LAB				0	0	2	0	2	1
CSH101-T	STRUCTURED PROGRAMMING	CS	HARD	CORE	3	1	0	0	4	4
CSH101-P	STRUCTURED PROGRAMMING LAB				0	0	2	0	2	1
HLS101	BUSINESS ENGLISH	HL	SOFT	CORE	1	0	2	0	3	2
CSW151	COMPUTING WORKSHOP	CS	WORK SHOP	CORE	0	0	3	0	3	1.5
CHH137	ENVIRONMENTAL SCIENCE	CH	HARD	UNIVERSITY COMPULSORY	3	0	0	1	3	4
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					15	4	13	2	32	27.5

DETAILED SYLLABUS
MAU01 – FIRST SEMESTER

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

	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.

Section B

Differential Calculus: Successive Differentiation, Leibnitz Theorem, Taylor's and Maclaurin's Series, Curvature, Radius of curvature for Cartesian , parametric and Polar Curves, Radius of Curvature at the Origin, Evolutes.

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.

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, Gregory's series. Summation of Trigonometric series.

Lab Exercises:

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, PHH 107-P)**
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 3. lasing in gases and solids 4. quantum mechanics and its simple application

	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 rings and its applications, Michelson Interferometer and its applications.

Diffraction of Light: Fraunhofer diffraction at a 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.

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.

Section C

Laser and Fiber Optics: Laser: Stimulated absorption, Spontaneous and stimulated emission, Population inversion, Conditions for lasing/theory 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.

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 find the wavelength of sodium light by Newton's rings experiment. Observe the interference pattern when a polychromatic source is used.
2. To find the wavelength of sodium light by Fresnel's biprism experiment.
3. To find the wavelength of various colours of white light with the help of a plane transmission diffraction grating.
4. Determination of dispersive power of the given grating#
5. To find the refractive index and Cauchy's constants of a prism by using spectrometer.
6. To find the wavelength of sodium light by Michelson interferometer.

7. To find the resolving power of a telescope.
8. To find the pitch of a screw using He-Ne laser
9. To find the specific rotation of sucrose solution by using Laurent's half shade polarimeter.

Reference Books:

1. Fundamentals of Engineering Physics : M S Khurana, MR Pub, Delhi (Text Book)
2. Modern Physics for Engineers : S P Taneja; R Chand Publication (Text Book)
3. Engineering Physics : Satya Prakash, Pragati Prakashan.
4. Concepts of Modern Physics : Beiser
5. Optics, : A. Ghatak,
6. Optics : Eugene Hecht
7. Fundamentals of Optics : Jenkins & White
8. Lectures on Physics : Feynman

Practical Books:

1. Fundamentals of Engineering Physics – M. S. Khurana, MR Pub, Delhi
2. Advanced Practical Physics – B.L. Worshnop and H.T. Flint

Course Title/Code	GREEN CHEMISTRY (CHH101-T, CHH101-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	3-1-2-0
Objectives	• To introduce concept and discipline of green chemistry • To demonstrate the necessity and viability of the methods of green chemistry • To demonstrate how to evaluate a reaction or process and determine "greener" alternatives • To focus on the application of innovative technology for the development of "greener" routes to improve industrial processes and to produce important products.

Syllabus	Sections	Weightage
	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 Feedstock's, 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.

Reference Books:

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

Lab Experiments:

1. To determine the alkalinity of given water sample.
2. To determine Total, Permanent and temporary hardness of water sample.
3. To determine total dissolved oxygen in a given sample of water.
4. To determine Viscosity index of given lubricating oil by Redwood viscometer no 1.
5. To determine flash point and fire point of lubricating oil by Pensky's Marten's apparatus .
6. To prepare (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin.
7. To determine the concentration of given $KMnO_4$ solution using a Digital Photo-colorimeter.
8. To determine total residual chlorine in water sample.
9. To determine free carbon di oxide in given water sample.
10. To analyse the TDS and TSS in a given sample of water.

Course Title/ Code	STRUCTURED PROGRAMMING (CSH101-T, CSH101-P)
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.

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

Course Title/ Code	BUSINESS ENGLISH (HLS101-T)
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.
Learning Outcomes	students will be well-versed in the basics of English Language grammar and communication skills. The lab-activities that go hand-in-hand with the lessons will help in enhancing the interactive aspect of the paper.

	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 (Allied)
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 SCIENCE (CHS102-T)**
Course Type	Core (Allied)
Course Nature	Hard
L-T-P-O Structure	(2-0-0-2)
Objectives	1. To make the student identify the areas of environmental degradation 2. To make the student identify the impact of environmental degradation on the surroundings 3. To enable student apply the concept of sustainable development in real life 4. To help the student to correlate his/her field with various aspects of environment

Section A

Multidisciplinary nature of environmental studies: Definition, scope and importance; Need for public awareness.
Renewable and non-renewable resources :Natural resources and associated problems.
Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
Energy resources : Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Section B

Ecosystems: Concept of an ecosystem**,** Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries.
Biodiversity and its conservation: Introduction – Definition : genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-sports of biodiversity. Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Section C

Environmental Pollution: Definition, Cause, effects and control measures of:- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.

Solid waste Management : Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management : floods, earthquake, cyclone and landslides. Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies: Environmental ethics : Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution)Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Section D

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference books:

1. Environmental Chemistry C. Baird and M. Cann W.H. Freeman and Company, New York, 2012.
2. Green Chemistry and engineering: A practical Design Approach C.J-Gonzalez and D.J.C. Constable A John Wiley & Sons, INC., publication, New Jersey, 2011
3. Environmental Chemistry S.E. Manahan CRC Press, 2005
   Perspectives in Environmental Studies Kaushik & Kaushik New age international publishers Ltd.-New Delhi
4. The Green marketing Manifesto John Grant Wiley Pub.

Environmental Sciences practical (CHS102) –field work:

- Visit to a local area to document environmental assets- river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

Recommended Books:

a) Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
b) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
c) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
d) Clark R.S., Marine Pollution, Clander son Press Oxford (TB)
e) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
f) De A.K., Environmental Chemistry, Wiley Eastern Ltd.

MAU01- Semester-II

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH115-T	ALGEBRA		CORE	HARD	3	1	0	0	4	4
MAH115-P	ALGEBRA LAB				0	0	2	0	2	1
MAH116-T	CALCULUS-I		CORE	HARD	3	1	0	0	4	4
MAH116-P	CALCULUS-I LAB				0	0	2	0	2	1
CHH108-T	ESSENTIALS OF CHEMISTRY		CORE	HARD	3	1	0	0	4	4
CHH108-P	ESSENTIALS OF CHEMISTRY LAB				0	0	2	0	2	1
PHH108-T	MODERN PHYSICS		CORE	HARD	3	1	0	0	4	4
PHH108-P	MODERN PHYSICS LAB				0	0	2	0	2	1
HLS102	COMMUNICATIVE ENGLISH		CORE	SOFT	1	0	2	0	3	2
MAW119	STATISTICS USING EXCEL		CORE	WORKSHOP	0	0	3	0	3	1.5
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					13	4	13	0	30	23.5

DETAILED SYLLABUS
MAU01 – SECOND SEMESTER

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

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

Section A

Sets, Relations, Equivalence relations, Function

s, Composition of functions, Bijective functions, Invertible functions, Principle of mathematical induction, Well-ordering property of positive integers, Division algorithm, Greatest Common Divisor and Least Common Multiple ,Statement of fundamental theorem of arithmetic.

Section B

Congruences and their properties, Solution of congruences, Linear congruences, The equation ax+by=c (a,b,c are integers), Chineese Remainder Theorem, Fermat's Theorem and Wilson's Theorem.

Section C

Fundamental Theorem of Algebra, General properties of equations, Descartes rule of sign, Relation between coefficient and roots of the equation, Cube roots of unity.

Section D

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 Bi-quadratic 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 Bi-quadratic equations: Use Cardon's Method to solve cubic equation. Use Descartes Method, Ferrari's Method & Euler's Method to solve Biquadratic equation.

Lab Exercises:

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, MAH116-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of Continuity, Differentiability and its applications.
Learning Outcomes	The students would be able to apply the concepts of Continuity, Differentiability for solving the mathematical problems and their applications.
Pre-requisites	Basic knowledge of limit, continuity and differentiability.

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

Section A

Limit, Continuity, Continuous functions: Properties and theorems, Differentiability of a function of single variable. Indeterminate forms. Mean value theorems: Rolle's Theorem, Cauchy's theorem and Lagrange theorem.

Section B

Tangents and Normals: Equation of the Tangent and Normal (Cartesian Equations; Parametric Equations), Angle of intersection of two curves, length of tangent, Sub tangent, Normal and Sub Normal at any point of a curve, Angle between the radius vector and tangent, Length of perpendicular from pole to the tangent, Pedal equation of a curve. Asymptotes (Parallel and Oblique) of Cartesian, Polar and Parametric Curves, Intersection of Curve and its Asymptotes.

Section C

Concavity & Convexity, Points of Inflexion, Multiple Points (Singular Points), Tracing of Curves in Cartesian, Parametric and Polar Form.

Section D

Limit, Continuity and Differentiability of a function of two variables, Partial Differentiation, Euler's theorem, Total Derivative, Maxima Minima of a function of two Variables, Jacobians, Taylor's theorem for a function of two variables, Differentiation under the Integral Sign .

Lab Exercises:

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 curve.

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 & Maclaurin'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, CHH108-P)**
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

ψ2. 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.

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_3COOH) 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 PHYSICS (PHH108-T, PHH108-P)**
Course Type:	Core(Allied)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	• To study and analyze different types spectrum. • To study the relativistic effects.

	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, quantum numbers, and selection rules (qualitative). Stern-Gerlach experiment, spin as an intrinsic quantum number, Fine structure. (12 L)

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 (10L)

Section D

Diatomic molecules–rotational and vibrational energy levels. Basic ideas about molecular spectra. Raman effect and its application to molecular spectroscopy (qualitatively).

Free electron model of solids, Energy Band Formation in solids, intrinsic and extrinsic carrier concentration in semiconductors, Hall effect (12 L)

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 superposing 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 Experiment
7. Energy Band Gap of intrinsic semiconductor by Four Probe Method
8. Hall effect
9. Thermal emission of electron
10. Energy band measurement for semiconductor diode/ diode laser.

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
4. Fundamentals of Molecular Spectroscopy-C N Banwell & E M Mccash

Course Title/Code	**Communicative English (HLS102-T)**
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.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	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 Exercises:

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 CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH221-T	REAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH221-P	REAL ANALYSIS LAB				0	0	2	0	2	1
MAH222-T	CALCULUS-II	MA	HARD	CORE	3	1	0	0	4	4
MAH222-P	CALCULUS-II LAB				0	0	2	0	2	1
MAH223-T	DIFFERENTIAL EQUATIONS & MM I	MA	HARD	CORE	3	1	0	0	4	4
MAH223-P	DIFFERENTIAL EQUATIONS & MM I LAB				0	0	2	0	2	1
MAH224-T	GEOMETRY OF TWO AND THREE DIMENSIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH224-P	GEOMETRY OF TWO AND THREE DIMENSIONS				0	0	2	0	2	1
EDS288	APPLIED PHILOSOPHY	EDS	SOFT	ELECTIVE	1	0	2	0	3	2
EDS289	APPLIED PSYCHOLOGY									
EDS290	APPLIED SOCIOLOGY									
MCS231	BASICS OF ECONOMICS	MC	SOFT	ELECTIVE	1	0	2	0	3	2
MCS232	INTRODUCTION TO FINANCE									
MAW225	LaTeX	MA	WORKSHOP	CORE	0	0	3		3	1.5
FLS211	FRENCH	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	2	0
FLS209	SPANISH									
FLS210	GERMAN									
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					15	5	15	0	2	0

DETAILED SYLLABUS
MAU01 – THIRD SEMESTER

Course Title/ Code	REAL ANALYSIS (MAH221-T, MAH221-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of real numbers, sequences and series of real numbers.
Learning Outcomes	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.
Pre-requisites	Knowledge of number system and set theory.

	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, Equivalence of the definition of Dedekind & Cantor. Suprema and infima, the completeness property of R, the Archimedean property, density of rational numbers in R, characterization of intervals, neighborhoods, open sets, closed sets, limit points of a set, isolated points, closure, complements ,idea of uncountability of R, Boundedness of 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, integral test, alternating series, Leibniz test.

Section D

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

Lab Exercises:

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 <a_n>, 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 Int. Edition (3rd)
2. Robert G. Bartle and Donald R. Shebert- Introduction to Real Analysis - Wiley Indi a, 3rd ed.
3. Sterling K. Berberian - A First course in Real Analysis -1994 , Springer Verlag, Ny .Inc.
4. S.C. Malik, Principle of Real Analysis, New Age International Publishers .
5. Shanti Narayan & M.D Raisinghania -Elements of Real Analysis- S. Chand.
6. S. C. Malik & Savita Arora, Mathematical Analysis- New Academic Science.

Course Title/ Code	CALCULUS – II (MAH222-T, MAH222-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of reduction formulae, application of single integrals and vector calculus.
Learning Outcomes	The students would be able to apply the concepts of Integral and Vector calculus required for solving the mathematical problems and their applications.
Pre-requisites	Knowledge of Calculus-I.

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

Section A

Reduction formulae: Derivations and illustrations of reduction formulae.
Rectification: Length of arc of curves(cartesian, parametric and polar form).
Quadrature: Area enclosed by curves(cartesian, parametric and polar form).
Solids of Revolution: Volume and surface area of solids of revolution.

Section B

Beta and Gamma function: Derivations and illustrations. Dirichlet Integral.
Centre of gravity(C.G.): C.G. of an arc, C.G. of a plane area, C.G. of a solid of revolution, C.G. of a surface of revolution, C.G. when density varies, C.G. of any volume.
Moment of Inertia(M.I.): M.I. of a plane lamina, M.I. of a solid, M.I. of a rod, M.I. of a rectangular lamina, M.I. of a rectangular parallelepiped.

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.

Lab Exercises:

1. Evaluation of single integrals .
2. Evaluation of arc length of a curve and plotting the same.
3. Evaluation of area bounded by curve and plotting the same.
4. To find the surface area and volume of solids of revolution and plotting the same.
5. To study limit, continuity and differentiability of a vector point function.
6. To find the gradient of of a scalar point function.
7. To find the divergence and curl of a vector point function.
8. To find the work done using line integral of a vector point function.
9. To find surface and volume integral of a vector point function.
10. To verify Divergence theorem , Green's theorem and Stoke's theorem

Recommended books:

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

Course Title/ Code	DIFFERENTIAL EQUATIONS & MATHEMATICAL MODELLING-I (MAH223-T, MAH223-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objectives	To equip the students with the concepts of Ordinary differential equations and mathematical modeling.
Learning Outcomes	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.
Pre-requisites	Basic Knowledge of Ordinary differential equations.

	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,

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). growth and decay model, exponential growth of population, limited growth of population.

Section C

General solution of homogeneous equation of higher 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, applications of second order differential equations .

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.

Lab Exercises:

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).

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.
5. J. N. Kapoor : Mathematical Modeling.

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

	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, Condition for general equation of second degree to be a 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.

Section B

Confocal conics: Introduction, equation of con-focal to an Ellipse, properties of confocal conics
Polar equation of a conic: Polar equation of a straight line , polar equation of a circle, polar equation of conic, focal chord tangent and normal to the conic, pair of tangents . 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.
Cones: Right circular cone, enveloping cone and reciprocal cone.

Section D

Cylinder: Right circular cylinder and enveloping cylinder.
Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoid. Polar plane of a point. Enveloping cone of a conicoid. Enveloping cylinder of a conicoid , Paraboloids.
Lab Exercises:

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	**APPLIED PHILOSOPHY** **(EDS 289)**
Course Type	Elective
Course Nature	Soft
L-T-P-O Structure	(1-0-2)
Objectives	To enable students to • confront the philosophical problems implicit in the experience of self, others and the society. • read critically the philosophy of influential philosophers with respect to society, Science and success in life • understand and apply concepts and theories of moral philosophy. • reflect philosophically and ethically on their own personal, professional and civic lives. • formulate for himself or herself a philosophy of life or world-view consistent with the objectives of liberal society.

Section A

Introduction to Philosophy: Philosophy: Meaning, Nature and Scope, Practical uses of Philosophy, Branches of Philosophy

Section B

Thoughts of philosophers and their implications: General Philosophy of John Dewey, Swami Vivekananda and Rabindra Nath Tagore. Philosophy of life and success: Steve Jobs, N.R. Narayana Murthi, Dr. A.P.J. Abdul Kalam and Muhammad Yunus. Philosophy of Science and technology- Francis Bacon and Martin Heidegger.

Section C

Philosophical perspectives of socio-political scenario in India: Nature of Democracy and its implications. Meaning and requirements of National Integration. Universal Human Rights.

Section D

Philosophical perspectives of religious scenario in India: Secularism—its nature and implications, Moral Philosophy of religion with special reference to Hinduism, Jainism, Buddhism, Islam, Christianity, Sikhism. Religious pluralism and Religious tolerance.

Reference Books and Readings:

1. Bhatia, K. & Bhatia, B. (1974) The Philosophical and Sociological Foundations of Education. Delhi: Doaba House.
2. Brubacher, John. S. (1969). Modern Philosophies of Education, New Delhi: Tata McGraw-Hill
3. Dewey, J. (1966). Democracy in Education, New York: Macmillan.
4. Ferre, F.(1995). Philosophy of Technology. University of Georgia Press.
5. Gandhi, M. K. (1956). Basic Education. Ahmedabad, Navajivan.
6. Goel, A. & Goel S. L. (2005). Human values and Education. New Delhi: Deep and Deep Publications Pvt. Ltd.
7. Palmer, Joy A. et.al. (2001). Fifty major thinkers on education from confucious to Dewey. New Delhi: Rutledge.
8. Rajput, J.S. (2006). Human Values and Education. New Delhi: Paragon Publications.
9. Walia, J.S. (2011). Philosophical, Sociological and Economic Bases of Education. Jalandhar: Ahim Paul Publishers.

Suggested activities:

•Prepare and present a report on 'philosophy of life' from the perspective of a young adult.

•Quiz and interactive sessions on various philosophical perspectives of contemporary philosophers.

•Organization of and participation in street plays /dramas/ declamation/ debates/ any other suitable activity on any theme of Philosophical perspectives of Socio-Political scenario in India.

•Group discussions on any suitable topics concerning contemporary society like aggression among youth, Over-ambitiousness in young generation, misuse of democracy, implications of secularism etc. and to reflect upon different viewpoints.

•Preparation of quotation boards to display quotes of great philosophers in the college premises.

•Picture interpretation and philosophical reflection on social themes like juvenile crime, begging in India, Social networking etc.

•Readings from the autobiographies and other publications of great philosophers e.g. 'Wings of Fire' followed by discussion session.

•Showing Videos on Unique personalities: life and philosophies followed by reflection exercises.

•Any other suitable activity.

Course Title/Code	APPLIED PSYCHOLOGY (EDS 288)
Course Type	Elective
Course Nature	Soft
L-T-P-O Structure	(1-0-2-0)
Objectives	-To define psychology and its application across various fields. -To understand the conceptual framework of attitude and personality along with cherishing out their attitude and personality development. -To conceptualize psychology in social and organizational settings. -To maintain and reform group dynamics.

Section A

Psychology: Attitude Formation: Psychology Meaning, nature, and scope, Role of psychology across multi-disciplinary aspects, Introduction: Attitude, Stereotypes, Prejudice, and Discrimination, Formation of attitude and attitude change

Section B

Personality and personality development: Definition of personality and personality development, State/ Trait approach to personality, Bandura's Social- Cognitive theory of personality.

Section C

Social psychology: Introduction to social identity, social cognition, and social influence, social conflicts and its resolutions, Group dynamics: Introduction, formation, types of groups, cooperation, competition, and conflict in groups.

Section D

Organizational Psychology: Definition, fundamental concepts and importance, Introduction to job satisfaction, work motivation, and organizational commitment. Introduction to participation, empowerment, and team work.

References Books and Readings:

- Arrow, K. J. (1995). Barrier to Conflict Resolution. NY: W. W. Norton.
- Bandra, A., & Walters, R. H. (1963). Social Learning and Personality Development. New York: Holt, Rinehart, & Winston.
- Bandra, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice- Hall, Inc.

- Baron, R. A., Byrne, D. (1997). Social Psychology (8th Ed.). Boston, MA: Allyn & Bacon.
- Baron, R. A. (2001). Psychology (5th ed.). London: Pearson.
- Cialdini, R. B. (2001). Influence: Science and Practice (4th Ed.). Boston, MA: Allyn & Bacon.
- Feldman, R. S. (2008). Essentials of Understanding Psychology. New Delhi: Tata McGraw Hill.
- Friedkin, N. (1998). A structural theory of social influence. Cambridge: Cambridge University Press.
- Gage, N. L., & Berliner, D. C. (1992). Educational Psychology (5th Ed.). Boston, MA: Houghton Mifflin Co.
- Hall, C. S., Lindzey, G. & Campbell, J. B. (2004). Theories of Personality (4th Ed.). New York: Wiley.
- Hunt, R. R., & Ellis, H. C. (2006). Fundamentals of Cognitive Psychology. New Delhi: Tata McGraw Hill.
- McDavid, J. M., & Harari, H. (1994). Social Psychology: Individuals, Groups, and Societies. New Delhi: CBS Publishers.
- Millward, L. (2005). Understanding Occupational and Organizational Psychology. London: Sage Publications.
- Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (1993). Introduction to Psychology. (7th Ed.). New Delhi: Tata McGraw Hill.
- Woolfork, A. E. (2014). Educational Psychology (12th Ed.). Boston: Allyn & Bacon.

Applied Psychology Practical (EDS 289)

1. Prepare a story using different pictures in order to understand the personality
2. Prepare a SWOT Chart to identify strength and weakness of oneself
3. Role of psychology be proved as an asset in professional development
4. Give a brief account of your personality before and after the transaction of course content.
5. Identify different stereotype present in our Society and present your views on it.
6. Collect any five articles on discrimination prevalent in Society
7. List out Company incentives provided to their employee for work motivation.
8. Prepare a street play on social issues to understand the group dynamics
9. Reflection activities to understand the emotions and personality
10. List out the Do's and Don'ts of the Interview
11. Role of body language in attitude formation.
12. Situational Activities: Suppose you are captain of your football team. Draw out inputs to motivate your team, and maintain the team- spirit.
13. Write a brief note on any one attitude you want to change in yourself and the strategies to accomplish it.
14. The psychometric tests to be conducted by learners:
    - Sociometry test
    - Personality testing (16PF)
    - Vineland Social Maturity Scale

- Rorschach inkblot test
- Thematic Appreciation Test
- Color personality Test

15. Any other suitable activities.

Course Title/Code	APPLIED SOCIOLOGY (EDS-290)
Course Type	Elective
Course Nature	Soft
L-T-P-O Structure	(1-0-2)
Objectives	• To develop the skills to think "objectively" and analytically about ways in which social forces affect our everyday lives. • To understand the perspectives of persons with different cultural, ethnic and social background. through Social Change • To be able to identify and discuss the differences between the three major theoretical paradigms used by sociologies in the analysis of society. To be able to know about fundamental concepts of sociology

Section A

Introduction: Sociology: Meaning, Nature and Scope; Relationship of Sociology with other subjects; Application of Sociology in corporate world.

Section B

Social change and social processes: Social Change: Meaning, Concept and nature of Social Change. Processes: Urbanization; Modernization; Globalization; Industrialization; Liberalization.

Section C

Theories and approaches of sociology: Different Theories and approaches: Positivist Approach; Labeling Theory, Structural Function Theory, Social /Conflict Theory, Social Darwinism Theory

Section D

Fundamental concepts: Fundamental Concepts in Sociology: Social Stratification, Social Change, Social Control, Equality, Equity, Co-operation and Conflict, Association, Social Structure, Family, Caste , Ethnicity.

References:

1. Aron.Raaymond.19567(1982 reprint). Main currents in sociological thought (2 volumes).Harmondworth. Middlesex:Penguin Books
2. Barnes,H.E.1959. Introduction to the history of sociology, Chicago: The University of Chicago Press.
3. Coser, Lewis A 1979. Masters of sociological thought. New York: Harcourt Brace Jovanovich.
4. Cotterell.Roger,1992. Oxford University Press, New Delhi
5. Fletcher, Ronald. 1994. The making of sociology (2 volumes) Jaipur:Rawat
6. Freeman, Michael 2006. Law and Sociology. Oxford University Press, New Delhi
7. Lucy Mair, 1997 An Introduction to social anthropology, Oxford University Press, New Delhi (chapter 1 & 2)
8. Marrison, Ken 1995. Marx Durkheim. Weber: Formation of modern social though. London: Sage.
9. Ritzer. George 1996. Sociological theory, New Delhi: Tata MeGraw Hill Singh, Yogendra. 1986. Indian sociology; conditioning and emerging trends, New Delhi: vistaar.
10. Zeitlin, Irving 1998(Indian edition); Rethinking sociology: A critique of contemporary theory; Jaipur:Rawat 90
11. Bottomore, T.B.1986 Introduction to Sociology(Revised edition), London: Alien and Unwin.
12. Firth, R 1056 Human Types:London:Thokas Nelson and Sons Ltd.
13. Giddens, A 1997 Sociology Cambridge: Polity Press
14. Radeliffe Brown A.R.1976 Structure and function in primitive society.
15. London:Routledge and Kegan Paul Merton, R.K.1968, Social theory and social structure Glencoe, III Free Pre3ss and New Delhi:American Publishing Co(Pvt) Ltd.
16. Henslin M.James, 1996 Essential of Sociology: A down to Earth Approach, Allyn and Bacon, Massachussetts.

Applied Sociology Practical:

- Prepare and present a report on "importance of sociology in relation with the corporate sector'' with the perspective of a young adult.
- Preparation of quotation board with the help of displaying the pictures and quotes of famous sociologists
- Case study
- Discuss the impact of modernization, industrialization and globalization on the day-today life.
- Showing Videos on the life and philosophies of Famous sociologists to tell the students about their different theories
- Field Study

Course Title /Code	BASICS OF ECONOMICS (MCS-231)
Course Type	Allied Elective
Course Nature	SOFT
L-T-P-O Structure	1-0-2-0

Section A

Definition of Economics: various definitions, Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical application and importance.

Section B

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, degrees of Price elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Section C

Meaning of production and factors of production, laws of production, various concepts of cost - Fixed cost, variable cost, average cost, marginal cost, money cost, real cost and opportunity cost. Shape of short run cost curves.

Section D

Meaning of Market, Types of Market -Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets). Supply and Law of Supply, Role of Demand & Supply in Price Determination and effect of changes in demand and supply on prices.

Text books:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Economics for Engineers- T R Jain & O P Khanna
3. Micro Economic Theory – M.L. Jhingan (S.Chand) .
4. Micro Economic Theory - H.L. Ahuja (S.Chand) .
5. Modern Micro Economics : S.K. Mishra (Pragati Publications).
6. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co.).
7. Indian Economy: Rudar Dutt & K.P.M. Sundhram.

Course Title/Code	INTRODUCTION TO FINANCE (MCS-232)
Course Type	Allied Elective
Course Nature	SOFT
L-T-P-O Structure	1-0-2-0

Section A

Financial Management : An Overview—forms of business organization, financial decision in a firm, Financial System , Financial Markets and Intermediaries

Section B

Financial Analysis and Planning : Financial Statements-Balance sheet, Statement of Profit and Loss, Taxes and Cash Flow , Financial Ratios, Break Even Analysis.

Section C

Sources of Long term Finance – Equity Capital, Preference Capital, Terms Loans, Debentures; Raising Long term Finance

Section D

Time Value of Money, Capital Budgeting- Techniques of Capital Budgeting, Net Present Value and Payback Period , Capital Structure and Cost of Capital

Suggested Readings:

1. Pandy, I.M., Financial Management, Vikas Publishing House, New Delhi
2. Khan M.Y, and Jain P.K., Financial Management, Tata McGraw Hill, New Delhi
3. Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, Financial Management, Pearson Education
4. Chandra, Prasanna, Financial Management, TMH, New Delhi
5. Van Horne, James C., Financial Management and Policy, Prentice Hall of India
6. Brigham & Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.
7. Kishore, R., Financial Management, Taxman's Publishing House, New Delhi

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 exercises:

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 CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH226-T	ADVANCED ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH226-P	ADVANCED ANALYSIS LAB				0	0	2	0	2	1
MAH227-T	GROUP THEORY	MA	HARD	CORE	3	1	0	0	4	4
MAH227-P	GROUP THEORY LAB				0	0	2	0	2	1
MAH228-T	DIFFERENTIAL EQUATIONS & MM II	MA	HARD	CORE	3	1	0	0	4	4
MAH228-P	DIFFERENTIAL EQUATIONS & MM II LAB				0	0	2	0	2	1
MAH229-T	PROBABILITY & MATHEMATICAL STATISTICS	MA	HARD	CORE	3	1	0	0	4	4
MAH229-P	PROBABILITY & MATHEMATICAL STATISTICS LAB				0	0	2	0	2	1
MAS230	QUANTITATIVE APTITUDE	MA	SOFT	CORE	1	0	2	0	3	2
CHS234	ENVIRONMENTAL ETHICS AND SUSTAINABLE DEVELOPMENT	CH	SOFT	ELECTIVE	1	0	2	0	3	2
ECS249	E-WASTE MANAGEMENT	EC								
MAW231	SPSS	MA	WORKSHOP	CORE	0	0	3	0	3	1.5
FLS215	FRENCH	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	2	0
FLS213	SPANISH									
FLS214	GERMAN									
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					15	5	15	0	35	25.5

DETAILED SYLLABUS
MAU01 – FOURTH SEMESTER

Course Title/ Code	ADVANCED REAL ANALYSIS (MAH226-T, MAH226-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of Riemann Integrals, Improper integrals and fundamentals of Complex Analysis.
Learning Outcomes	The students would be able to apply the concepts of theory of Riemann Integrals, Improper integrals and fundamentals of Complex Analysis required for solving the mathematical problems and their applications.
Prerequisites	Real Analysis.

	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, Mean Value Theorem (First and Second), Change of variable of R-integral. Riemann-Stieltjes Integral, Properties of definite and indefinite integral RS-condition of integrability, RS-sums, Basic inequality of RS-integral, algebraic properties of the RS-integral, Mean Value Theorem (First and Second), Change of variable of RS-integral

Section C

Improper Integrals : 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. Uniform convergence and differentiation, Uniform convergence and integration, Weierstrass approximation theorem.

Section D

Function of Complex Variable: Complex number system, function of Complex variable, Elementary functions, Transformations, Limit, Continuity, Differentiability, Analytic function, Cauchy-Riemann equations, Harmonic functions, Milne-Thomson method, L'Hospital's Rule Taylor's and Maclaurin's Series, Singular points.

Lab exercises:

1. Applications of Function File.
2. Write a MATLAB Programing for Computing a Riemann Sum for the function f on the interval [a,b] with a regular partition. The points on the intervals are chosen as the right or left endpoints.
3. Write a MATLAB Programing for Computing a Riemann Sum for the function f on the interval [a,b] with a regular partition. The points on the intervals are chosen randomly.
4. Write a MATLAB Programing for Computing a RS-Sum for the function f on the interval [a,b] with a regular partition. The points on the intervals are chosen as the right or left endpoints.
5. Write a MATLAB Programing for Computing a RS- Sum for the function f on the interval [a,b] with a regular partition. The points on the intervals are chosen randomly.
6. Using MATLAB discuss the nature of convergence of Improper integrals
7. Write a MATLAB program for the convergence of an improper integrals.
8. Verification of Cauchy Riemann equations and Harmonic equations by using MATLAB.
9. Write a MATLAB program for the verification of C-R Equation.

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, MAH227-P)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of groups and their properties.
Learning Outcomes	The students would be able to apply the concepts of Groups and their properties in mathematical problems and their applications.
Prerequisites	Number system & Set Theory

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

Section A

Binary operation , Algebraic structure, definition and examples of groups, elementary properties of groups, composition-table for finite sets, Addition modulo m, Multiplication modulo p, Order of group and order of elements. Complexes and subgroups and examples of subgroups, subgroup tests, product of two subgroups. Center of a group.

Section B

Permutation group, Cycle notation for permutations, properties of permutations, even and odd permutations, Symmetric group, alternating group.
Cosets, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, Euler's -function. Order of product of two subgroups. Cyclic groups, Properties of cyclic groups, classification of subgroups of cyclic groups.

Section C

Normal subgroups, conjugate elements normalizer, class equation, Factor groups, properties and theorems. Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, isomorphism theorems-I, II and III.

Section D

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Cauchy's theorem for finite abelian groups .

Lab exercises:

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 (4th 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, MAH228-P)**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of partial differential equations and mathematical modeling.
	The students would be able to apply the concepts of partial differential equations and mathematical modeling required for solving the mathematical problems and their applications.
Prerequisites	Differential Equations & Mathematical Modeling - I

	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 Nonlinear First Order PDE : Charpit's Method, Standard Forms-I, II, III and IV.

Section B

Boundary Value Problems: Introduction , Method of separation of variables for PDE, Vibrating string Problem -Wave Equation (one and two dimention), Existence and uniqueness of solution of Vibrating string Problem., Heat conduction problem(one and two dimention), existence and uniqueness of solution of heat conduction problem.

Section C

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 D

Second Order Partial Differential Equation with Variable Coefficients: Introduction, Type-I, Type-II, Type-III, and Type-IV. Reduction of PDE to Canonical form by using methods (Parabolic to Canonical, Hyperbolic to Canonical and Elliptic to Canonical form).

Lab exercises:

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 ∂2u∂t2-c2∂2u∂x2=0 for any two of the following associated conditions:
   u(x,0)=Ø(x),ut(x,0)=φ(x), x∈R,t>0.
   u(x,0)=Ø(x), ut(x,0)=φ(x), u(0,t)=0, x∈(0,∞), t>0.
   u(x,0)=Ø(x), ut(x,0)=φ(x), ux(0,t)=0, x∈(0,∞), t>0.
   u(x,0)=Ø(x), ut(x,0)=φ(x), u(0,t)=0, u(l,t)=0, 0<x<l, t>0.
5. Solution of one-dimensional heat equation ut=kuxx ,for a Homogeneous rod of length l i.e. to solve the IBVP:

$$u_t = ku_{xx}, \quad 0<x<l, t>0$$

$$u(0,t)=0, u(l,t)=0, t\geq 0,$$

$$u(x,0)=f(x), 0\leq x\leq l$$

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, MAH229-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective	To equip the students with the concepts of probability and mathematical statistics.
Learning Outcomes	The students would be able to apply the concepts of probability and mathematical statistics required for solving the mathematical problems and their applications.
Prerequisites	Basics of probability and statistics.

	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

Section B

Discrete distributions: Binomial, Poisson, Geometric, Negative Binomial, Continuous distributions: Uniform, Normal, Exponential.

Section C

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 D

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

Lab exercises:

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. To find coefficient of correlation and rank correlation.
8. To find regression coefficients and lines of regression.
9. 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	To equip the students with the concepts of quantitative techniques required for solving mathematical problems and their applications.
Learning outcomes	The students would be able to apply the concepts of quantitative techniques 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 exercises:

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	Environmental Sustainable Strategies (CHS234)
Course Type	Domain Elective
Course Nature	SOFT
L-T-P-O Structure	(1-0-2-0)
Objectives	The students would be able to describe, explain and analyse the sustainable development concerns and challenges.
Outcomes	At the end of the course, the students would be able to • develop an inter-disciplinary understanding of sustainable development concerns; • recognise the challenges of sustainable development; the opportunities and limits in meeting these challenges; and • defend or criticise the sustainability initiatives adopted by different enterprises.

Section A

Introduction to Sustainable Development: Definition of Sustainable Development; Triple Bottom Line, Components of TBL, Changing Perspective & Debates in Sustainable Development - Need for Sustainable Development, Evolution of the concept of Sustainable Development: Stockholm Conference, The Brundtland Commission, Earth Summit, Agenda 21; Millennium Development Goals

Section B

Challenges to Sustainable Development and Sustainable Development Goals (SDGs): Challenges to Sustainable Development - Agriculture, Population & Food Security, Public Health and Nutrition, Education, Natural Resources (Forests, Energy, Water), Climate Change Sustainable Development Goals (SDGs) - Introduction, Challenges to SDGs, Indian Scenario.

Section C

Sustainability Strategies & Reporting : Sustainability Strategies & Reporting - Introduction, Rationale and Mechanisms, Key Principles, Sustainability Strategies Adopted by Different Enterprises – Case Studies

Section D

Sustainable Development and Contemporary Issues: Sustainable Consumption, Indigenous Knowledge, Gender Issues, Population & Sustainable Agriculture, Sustainable Tourism.
Tools: Video lecture; research papers or articles, survey, presentations, white board

Lab experiments/activities:

1. Survey- Business and non-business students' perception towards TBL (based on the readings listed above); inferences on the basis of survey; http://www.aabri.com/manuscripts/121249.pdf

2. Workshop based - Sustainable agriculture- Mushroom farming

3. Workshop based - Back to nature - DIY composting bin

4. Review - Sustainable Consumption in India: Challenges and Opportunities; Divesh Kumar,Praveen Goyal, Zillur Rahman, Ishwar Kumar; IJMBs Vol. 1, Issue 3, September 2011; http; ://www.ijmbs.com/13/devesh.pdf

5. Calculate Carbon Footprint/Ecological footprint

6. Stimulus Activity (Piece of writing) - Sustainable Consumption

7. CSR - Workshop for Village school children

8. Simulation Activity - Challenges to Sustainable Development

9. Case Studies - Sustainability initiatives @ TATA Motors, CAIRN INDIA, Mahindra & Mahindra, Subaru Isuzu, Disney, Novo Nordisk, etc.

Video lectures:

- Triple Bottom Line (TBL) - https://www.youtube.com/watch?v=2f5m-jBf81Q
- How Humans Made Malaria So Deadly - https://www.youtube.com/watch?v=64pvlCtH-O
- Ocean Confetti! - https://www.youtube.com/watch?v=qVoFeELi_vQ&spfreload=5
- Sustainability explained through animation - https://www.youtube.com/watch?v=B5NiTN0chj0
- SDGs - https://www.youtube.com/watch?v=uHEfRAooih8
- Micro-plastics - https://www.youtube.com/watch?v=UpGt5L3GC7o
- Sustainable Consumption - http://www.ijmbs.com/13/devesh.pdf.

Books/reading material:

1. Environmental Management for Sustainable Development; C.J. Barrow; Routledge Publishers
2. Roberts, J.T., and Hite, A., 2000, From Modernization to Globalization - Perspectives on Development and Social Change, Blackwell Publishing
3. Sachs, J., 2004, Stages of Development, Speech at the Chinese Academy of Arts and Sciences
4. Giddings, B., Hopwood, B., and Geoff O'Brien, 2002, Environment, Economy and Society: Fitting Them Together into Sustainable Development, Published online in Wiley Inter Science (www.interscience.wiley.com). DOI: 10.1002/sd.199
5. IPCC, Adaptation to Climate Change in the context of Sustainable Development and Equity, www.ipcc.ch/ipccreports/tar/wg2/pdf/wg2TARchap18.pdf
6. Brundtland Commission, 1987, "Our Common Future", Oxford University Press
7. Food Insecurity Atlas of Rural India (2001) MS Swaminathan Research Foundation and World Food Programme. http://home.wfp.org/stellent/groups/public/documents/ena/wfp076968.pdf.
8. Maternal and Child Undernutrition 1 Maternal and child undernutrition: global and regional
9. exposures and health consequences http://www.who.int/nutrition/topics/Lancetseries_Undernutrition1.pdf.

Course/ Title/ Code	**E-Waste: Environmental Problems and Management (ECS249)**
Course Type	Domain Elective
Course Nature	Soft

L-T-P-O	(1-0-2-0)
Structure	
Objectives	• Gain a better understanding and appreciation for the challenges related to waste management. • Create awareness about environmental impacts of e-waste. • Identify various components of e-waste

Section A

Introduction: E-Waste, Indian and global scenarioof e-Waste, Growth of Electrical and Electronics industry in India, E-waste generation in India, Composition of e-waste, Possible hazardous substances present in e-waste, Environmental and Health implications.

Section B

E-waste legislation: Regulatory regime for e-waste in India, The hazardous waste(Management and Handling) rules 2003, E- waste management rules 2015, Regulatory compliance including roles and responsibility of different stakeholders – producer, manufacturer, consumer etc., Proposed reduction in the use of hazardous substances(RoHS)& REACH, Extended producer responsibility (EPR).

Section C

End of life management of e-waste: Historic methods of waste disposal – dumping, burning, landfill; Recycling and recovery technologies – sorting, crushing, separation; Life cycle assessment of a product – introduction; Case study – optimal planning for electronic waste.

Section D

Environmentally sound e-waste management: Emerging recycling and recovery technologies, Guidelines for environmentally sound management of e-waste, Environmentally sound treatment technology for e-waste, Guidelines for establishment of integrated e-waste recycling and treatment facility, Case studies and unique initiatives from around the world.

Reference books:

S.No.	Book	Author	Publisher
1.	Electronic Waste Management	R E Hester, R M Harrison	RSC
2.	E-waste: Implications, regulations, and management in India and current global best practices	RakeshJohri	TERI PRESS

Lab experiments:

1. Video Lecture:
   - E-Waste: A Big Issue- https://www.youtube.com/watch?v=d5oi4QOeQ3I&t=21s
   - The Electronic Wasteland- https://www.youtube.com/watch?v=cVORBbZBbOk
   - E Waste in India- https://www.youtube.com/watch?v=sFfaYc_pIx8
2. Reading (articles/research papers):
   - Step: Solving the E-Waste Problem. White Paper: One Global Definition of E- waste. http://www.step-initiative.org
   - E-waste management in India – Electronics For You, http://electronicsforu.com/technology-trends/e-waste-management-india
3. Identify the hazardous materials present in printed circuit boards.
4. Extraction of copper of printed circuit boards in etching solution.
5. Demo of recycling process through videos.
6. Invited guest lecture.
7. Field visit to a waste management initiative in NCR.
8. Activity based learning: survey of the household practice of e-waste disposal and awareness.
9. Case study – presentation and group discussion.

Tools:

Video lectures; Research papers & articles, Survey, Presentations, Group discussions.

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 exercises:
1. Introduction SPSS software, open and save an SPSS data file, define codes for categorical variables
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 CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH333-T	RING THEORY	MA	HARD	CORE	3	1	0	0	4	4
MAH333-P	RING THEORY LAB				0	0	2	0	2	1
MAH334-T	NUMERICAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH334-P	NUMERICAL ANALYSIS LAB				0	0	2	1	2	2
MAH335-T	MECHANICS	MA	HARD	ELECTIVE (ANY TWO)	3	1	0	0	4	10
MAH335-P	MECHANICS LAB				0	0	2	0	2	
MAH336-T	NUMBER THEORY				3	1	0	0	4	
MAH336-P	NUMBER THEORY LAB				0	0	2	0	2	
MAH337-T	DISCRETE MATHEMATICS AND GRAPH ANALYSIS				3	1	0	0	4	
MAH337-P	DISCRETE MATHEMATICS AND GRAPH ANALYSIS LAB				0	0	2	0	2	
MOOC-18O-MAH-301	DISCRETE MATHEMATICS	SWAYAM / NPTEL COURSES			5	0	0	0	5	
MOOC-18O-MAH-302	TRANSFORM TECHNIQUES FOR ENGINEERS				5	0	0	0	5	
MAN338	SEMINARS/PRESENTATIONS	MA	NTCC		0	0	0	1	2	1
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					12 or 16	2-4	4, 6 or 8	2	24-26	22

DETAILED SYLLABUS
MAU01 – FIFTH SEMESTER

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

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

Section-A

Ring Definition, Elementary properties of a ring, Rings with or without zero divisors, Integral domain, Field, Division ring or skew field, Isomorphism of rings, Subrings, Characteristic of a ring, The field of quotients.

Section-B

Ideals, Principal ideal, Principal ideal ring, Divisibility in an integral domain, Units, Associates, Prime elements, Greatest common divisor. Polynomial rings, Polynomials over an Integral domain and over a field, Divisibility of polynomials over a field, Division Algorithm for polynomials over a field, Euclidean algorithm for polynomials over a field, Unique Factorization domain, Unique Factorization theorem for polynomials over a field, Remainder Theorem.

Section-C

Homomorphism of rings, Fundamental theorem on homomorphism of rings, Quotient rings, Maximal ideal, Prime ideals.

Section-D

Euclidean rings, Properties of Euclidean rings, Polynomial rings over Unique Factorization domain, Content of a polynomial, Primitive polynomial, Field of Quotients of a Unique factorization domain - Gauss Lemma, Eisenstein's Criterion of Irreducibility.

Lab exercises :

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(4th 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, MAH334-P)
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.
Learning Outcomes	Students will be able to 1. Distinguish between types of errors in numerical computation and computing them. 2. Identify and compute the interpolating polynomial for equispaced and unequispaced intervals. 3. Differentiate and integrate numerical data. 4. Find roots of algebraic and transcendental equation. 5. Solve system of linear equation by using direct and iterative methods. 6. Compute Eigen values and Eigen vectors for symmetric and non-symmetric matrices. 7. Solutions of Initial value problems of differential equations by single and multiple steps methods. 8. Compute solution of heat wave, Laplace and Poisson equations 9. Solutions of the problems through MATLAB.
Pre-requisite	Knowledge of Number System

Syllabus	Sections	Weightage
	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.

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

Section-B

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

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

Section-C

Solution of linear systems: Direct methods, Gaussian elimination, Gauss Jordan, Matrix inversion, UV factorization, Iterative methods for linear systems (Gauss Seidel & Gauss Jacobi), LU decomposition. Eigen value problems: Jacobi and Given'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(Bender Schmidt and Crank Nicolson Method) and elliptic equations.

Lab exercises:

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

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-I (MAH335-T, MAH335-P)
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 required for solving the mathematical problems and their applications.
Learning Outcomes	Students will be able to solving the mathematical problems of Composition and resolution of forces , Virtual work and Friction .

	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 Mass and Centre of Gravity.

Section-C

Virtual work. Forces in three dimensions. Poinsots central axis

Section-D

Wrenches. Null lines and planes. Stable and unstable equilibrium.

Lab exercises:

1. To find the moment of the force F about the point .
2. To Find gravitational Potential energy.
3. To find the moment of the force F about the point .
4. To Find gravitational Potential energy.
5. To find velocity and acceleration.
6. To find angular momentum.
7. To find the centre of mass and centre of gravity.
8. To find the work done by a variable force and constant force.

Recommended books:

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

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

Course Title/ Code	NUMBER THEORY (MAH336-T, MAH336-P)
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objective:	To equip the students with a rigorous development of Number Theory using axioms, definitions, examples, theorems and their proofs.
Learning Outcomes:	Students will be able to : 1) effectively express the concepts and results of Number Theory. 2) construct mathematical proofs of statements and find counterexamples to false statements in Number Theory. 3) collect and use numerical data to form conjectures about the integers. 4) understand the logic and methods behind the major proofs in Number Theory. 5) work effectively as part of a group to solve challenging problems in Number Theory.
Prerequisite:	Knowledge of number system and congruences.

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

Section-A

Divisibility and Factorization: Division algorithm, Euclid's algorithm for the greatest common divisor, Linear Diophantine equations, Prime numbers, Fundamental theorem of arithmetic, infinitude of primes, Distribution of primes, twin primes, Gold bach conjecture, Fermat and Mersenne primes, Primality testing and factorization, Definition of Euler function, examples and properties, Multiplicative property of Euler's function.

Section-B

Arithmetic functions: Arithmetic function, multiplicative functions: definitions and basic examples, The Mobius function, Mobius 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-C

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.

Section-D

Sum of Powers: Sum of two squares, sum of three squares, Waring's problem, Sum of four squares, Fermat's Last Theorem.

Continued Fractions and Pell's Equation: Finite continued fractions, recurrence relation, Euler's rule, Convergents, infinite continued fractions, representation of irrational numbers, Periodic continued fractions and quadratic irrationals, Solution of Pell's equation by continued fractions.

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 (MAH337-T, MAH337-P)
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)

Objective	To equip the students with the concepts of counting, permutation and combination, Recurrence relations and graph theory required for solving the mathematical problems and their applications.
Learning Outcomes	The students would be able to apply the concepts of counting, permutation and combination, Recurrence relations and graph theory 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's numbers, Difference sequences and Sterling numbers. Partitions as associated to distribution, identical objects in identical boxes.

Section-C

Definitions, Examples and Basic Properties of Graph, Types of Graph, Matrix Representation of Graph, Isomorphic Graph, Path and Cycles, Eulerian and Hamiltonian paths and cycles, Weighted Graph, Travelling Salesman Problem, Shortest Path , Dijkstra's Algorithm.

Section-D

Digraphs, Planer graphs, Euler formula, Graph Colouring, Chromatic numbers.
Tree, Properties of Trees, Spaning Trees, Algorithm for Constructing Spanning Trees (BFS and DFS), Minimal Spanning Tree, Algorithms for Constructing Minimal Spanning Tree (Kruskal's and Prim's)

Lab exercises:

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 CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH339-T	LINEAR ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH339-P	LINEAR ALGEBRA LAB				0	0	2	0	2	1
MAH340-T	METRIC SPACES	MA	HARD	CORE	3	1	0	0	4	4
MAH340-P	METRIC SPACES LAB				0	0	2	0	2	1
MAH341-T	INTEGRAL TRANSFORMS & APPLICATION	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	5
MAH341-P	INTEGRAL TRANSFORMS & APPLICATION LAB				0	0	2	0	2	
MAH342-T	LINEAR PROGRAMMING & GAME THEORY				3	1	0	0	4	
MAH342-P	LINEAR PROGRAMMING & GAME THEORY LAB				0	0	2	0	2	
MAH335-T	MECHANICS-I				3	1	0	0	4	
MAH335-P	MECHANICS-I LAB				0	0	2	0	2	
MAH343-T	MECHANICS-II				3	1	0	0	4	
MAH343-P	MECHANICS-II LAB				0	0	2	0	2	
MAN343	PROJECT	MA	NTCC		0	0	0	5	5	5
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					9	3	6	6	23	20

DETAILED SYLLABUS
MAU01 – SIXTH SEMESTER

Course Title/ Code	**LINEAR ALGEBRA (MAH339-T, MAH339-P)**
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 transformations, Vector 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.

Lab exercises:

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(4th Edition), Narosa Publishing House

2. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence, Linear Algebra (4th Edition),Prentice- Hall of India Pvt. Ltd, New Delhi
3. Hoffman & Kunze : Linear Algebra.

Course Title/ Code	METRIC SPACES (MAH340-T, MAH340-P)
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, Semi metric space, Bounded and unbounded metric space, Sphere or ball, Interior, Neighborhood, open set, limit point, isolated point, Derived set, closed set, Exterior, Frontier

Sequences in a metric space, Convergence in a metric space, Cauchy sequence, Complete metric space, Cantor's intersection theorem.

Section-B

Completeness, First Category space, Second category space, Baire's category theorem, Contraction on a metric space
Continuity in a metric space: Continuous functions, Uniform continuity, Isometry, Homeomorphism, Extension theorem

Section-C

Compactness: Covers, Compact spaces and sets, Sequentially compactness, The Heine- Borel theorem, Countably compact, Continuity and compactness.

Section-D

Connectedness:: Connected set, Connected subsets, Intermediate Value Theorem, connected component, Totally disconnected set, Path wise connectedness.

Lab exercises:

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, MAH341-P)
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.

Lab exercises:

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, MAH342-P)
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, Two phase 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.

Lab exercises:

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	MECHANICS-II (MAH343-T, MAH343-P)
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 Dynamics required for solving the mathematical problems and their applications.
Learning Outcomes	The students would be able to solve the mathematical problems and their applications of Velocity and acceleration, Momentum and Force, Projectile motion and Moment of Inertia .

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

Section-A

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. Conservative forces and Impulsive forces.

Section-B

Collision of smooth spheres: Direct Impact of two elastic spheres, oblique impact of two elastic spheres in a plane, Central Orbits: Motion of a particle under a central force, The differential equation of a central orbit-Reciprocal polar form, The differential equation of a central orbit-Pedal form, Energy equation, some standard central orbit ,Central orbits under various laws.

Section-C

Motion on smooth and rough plane curves. Projectile motion of a particle in a plane. Vector angular velocity. Simple harmonic motion. Elastic strings.

Section-D

Moment of Inertia: Moment of Inertia-some simple cases, Method of composition and Decomposition, Parallel Axes Theorem, Moment of Inertia about any axis through the origin, Motion of a Rigid Body parallel to a fixed plane.

Lab exercises:

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 : An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press, 1956

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

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