MANAV RACHNA UNIVERSITY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS

PROGRAM STRUCTURE

&

DETAILED SYLLABUS

B.Sc. (Hons.) Mathematics

BATCH: 2020-2023

				MANAV RACHNA UNIVERSITY						
				DEPARTMENT OF MATHEMATICS						
				B.Sc. (Hons.) Mathematics (MAU01)						
				SCHEME - B						
				SEMESTER - 1						
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
MAH107B	ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH108B	CALCULUS-I	MA	HARD	CORE	3	1	0	0	4	4
CSH111B - T	PROGRAMMING FOR PROBLEM SOLVING USING C	CS	HARD	CORE	2	1	0	0	5	4
CSH111B - P	PROGRAMMING FOR PROBLEM SOLVING USING C LAB				0	0	2	0		
PHH106B -T	ESSENTIALS OF PHYSICS	PH	HARD	CORE	3	1	0	0	6	5
PHH106B -P	ESSENTIALS OF PHYSICS LAB				0	0	2	0		
MAH109B	MATHS LAB - I	MA	HARD	CORE	0	0	2	0	2	1
HLS102	COMMUNICATIVE ENGLISH	HL	SOFT	CORE	1	0	2	0	3	2
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				12	4	8	0	24	20
				SEMESTER - 2						
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
MAH115B	CALCULUS-II	MA	HARD	CORE	3	1	0	0	4	4
MAH111B	STATISTICS - I	MA	HARD	CORE	3	1	0	0	4	4
MAH112B	ORDINARY DIFFERENTIAL EQUATIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH113B	GEOMETRY OF TWO AND THREE DIMENSIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH114B	MATH LAB - II	MA	HARD	CORE	0	0	2	0	2	1
CHH137	ENVIRONMENTAL SCIENCE	CH	HARD	UNIVERSITY COMPULSORY	2	0	0	2	2	4
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				14	4	2	2	20	21
MAO116B	VALUE ADDED SUMMER COURSE - POST 2nd SEMESTER									2

				SEMESTER - 3						
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
MAH204B	REAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH205B	STATISTICS - II	MA	HARD	CORE	3	1	0	0	4	4
MAH206B	GROUP THEORY	MA	HARD	CORE	3	1	0	0	4	4
MAH207B	PARTIAL DIFFERENTIAL EQUATIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH208B	MATH LAB - III	MA	HARD	CORE	0	0	2	0	2	1
EDS288/ EDS289/ EDS290/ MCS231/ MCS232/ CDO203/ MAN209B	APPLIED PHILOSOPHY/ APPLIED PSYCHOLOGY/APPLIED SOCIOLOGY/ BASICS OF ECONOMICS/ INTRODUCTION TO FINANCE/ QUANTITATIVE APTITUDE - I/ MINI PROJECT – I	ED/MC/ CDC/MA	SOFT/ NTCC	ELECTIVE (ANY ONE)	1	0	2	0	3	2
FLS103	FRENCH - I	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	2	2
FLS101	SPANISH - I									
FLS102	GERMAN -I									
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				14	5	4	0	23	21
				SEMESTER - 4						
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
MAH210B	ADVANCED ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH211B	ADVANCED ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH212B	MECHANICS-I	MA	HARD	CORE	3	1	0	0	4	4
MAH213B	INTEGRAL TRANSFORMS & APPLICATION	MA	HARD	CORE	3	1	0	0	4	4
MAH214B	SET & NUMBER THEORY	MA			3	1	0	0	4	
CSH218B -T	DATA STRUCTURES	CS			3	0	0	0	5	

Code	Course	Dept		Type	L	T	P		Credits	
CSH218B -P	DATA STUCTURES LAB	CS			0	0	2	0	3	
MAH215B	ACTUARIAL STATISTICS	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	4
MAH216B	SURVEY SAMPLING & INDIAN OFFICIAL STATS	MA			3	1	0	0	4	

SUBJECT	SUBJECT NAME	**OFFERIN	*COURSE	COURSE TYPE	L	T	P	O	NO. OF	NO. OF
CHS234/ ECS306B/ CDO204/LWS323 MAN218B	ESD/ E-WASTE/ QUNATITATIVE APTITUDE-II/ CYBER LAWS MINI PROJECT-II	CH/EC/CDC /LW/MA	SOFT/ NTCC	ELECTIVE (ANY ONE)	1	0	2	0	3	2
CDO205	CAREER SKILLS - I	CDC	SOFT	AP/ AF	2	0	0	0	2	0
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					16	4 OR 5	2 OR 4	0	21 OR 22	22

SEMESTER - 5										
SUBJECT	SUBJECT NAME	**OFFERIN	*COURSE	COURSE TYPE	L	T	P	O	NO. OF	NO. OF
MAH301B	NUMERICAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH302B	LINEAR ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH303B	METRIC SPACES	MA	HARD	CORE	3	1	0	0	4	4
MAH304B	INFORMATION THEORY & CODING	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	4
CSH326B-T	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	CS	HARD	ELECTIVE (ANY ONE)	3	0	0	0	5	4
CSH326B-P	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS LAB	CS	HARD	ELECTIVE (ANY ONE)	0	0	2	0	5	4
MAH305B	MATHEMATICS OF FINANCE	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	
MAH306B	STATISTICAL INFERENCES	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	
MAH307B	MATH LAB - IV	MA	HARD	CORE	0	0	2	0	2	1
CDO303	CAREER SKILLS - II	CDC	SOFT	AP/ AF	2	0	0	0	2	0
MAN308B	MINOR PROJECT	MA	NTCC	CORE	0	0	0	2	2	2
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					13	3 OR 4	4 OR 6	2	22 OR 23	19

SEMESTER - 6										
SUBJECT	SUBJECT NAME	**OFFERIN	*COURSE	COURSE TYPE	L	T	P	O	NO. OF	NO. OF
MAH309B	LINEAR PROGRAMMING & GAME THEORY	MA	HARD	ELECTIVE (ANY TWO)	3	1	0	0	8	8
MAH310B	MECHANICS-II	MA	HARD	ELECTIVE (ANY TWO)	3	1	0	0	8	8
MAH311B	DISCRETE MATHEMATICS	MA	HARD	ELECTIVE (ANY TWO)	3	1	0	0	8	8
MAH312B	MATHEMATICAL MODELING	MA	HARD	ELECTIVE (ANY TWO)	3	1	0	0	8	8

Code	Course				L	T	P	O	Contact Hours/Credits	Credits
MAH313B	APPLICATIONS OF ALGEBRA									
MAH314B	INDUSTRIAL MATHEMATICS									
MAH315B	BIO MATHS									
MAH316B	CRYPTOGRAPHY	MA			3	1	0	0	4	
CSE322B-T	FUNDAMENTALS OF MACHINE LEARNING	CS			3	0	0	0	5	
CSE322B -P	FUNDAMENTALS OF MACHINE LEARNING LAB				0	0	2	0		
MCH393	MANAGEMENT OF BANKING & INSURANCE	MC	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	4
MAH317B	ECONOMETRICS	MA			3	1	0	0	4	
MCH109	ENTREPRENEURSHIP THEORY & PRACTICE	MC			3	1	0	0	4	
MAN318B	PROJECT	MA	NTCC	CORE	0	0	0	6	2	6
CDO305	CAREER SKILLS - III	CDC	SOFT	AP/ AF	2	0	0	0	2	0
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)				**9**	**2 OR 3**	**0 OR 2**	**6**	**16 OR 17**	**18**
									GRAND TOTAL OF CREDITS	**123**

MANAV RACHNA UNIVERSITY

Faculty of Applied Sciences

Department of Mathematics

Scheme & Syllabus
B.Sc. (H) Mathematics (2020-23)
Scheme B

MANAV RACHNA UNIVERSITY

Vision:

To educate students in frontier areas of knowledge enabling them to take up challenges as ethical and responsible global citizens.

Mission:

- To impart outcome based holistic education
- To disseminate education in frontier areas
- To produce globally competitive, ethical and socially responsible human resources
- To produce human resources sensitive to issues of Environment and Sustainable Development
- To develop Environment and Sustainable development as a thrust area of research and development.

Quality Policy

To continuously learn from the best practices, study role models and develop transparent procedures for empowerment of stakeholders.

Strategic Objectives

- To facilitate, enhance & promote innovation in curriculum design and delivery and have Outcome-oriented Learning Culture.
- To promote Research Environment and Management Practices.
- To enhance the quality of the student learning experience.
- To provide Resources and Infrastructure for Academic Excellence.

DEPARTMET OF MATHEMATICS

Vision:

To create an integrated teaching and research department to enhance the impact of mathematics.

Mission:

- To provide a niche he where students can learn, apply and become proficient in mathematical concepts   and their applications.
- To facilitate mathematical research and develop lifelong learners.
- To produce human resources that excel sin their chosen profession and function as responsible citizens.
- To assist in application of Mathematical Sciences in different disciplines.

PEO's of Department of Mathematic:

PEO1: Preparation: To prepare graduates with strong fundamentals required for higher education, teaching or other jobs.

PEO2: Core Competence: Ability to approach problems in an analytical and rigorous way and apply appropriate mathematical skills in solving them.

PEO3: Breadth: To utilize the wide range of mathematical concepts along with pure, applied, mathematical statistics and numerical techniques equipped with mathematical software.

PEO4: Professionalism: To work as team with professional ethical practices.

PEO5: Learning Environment: To develop confidence for lifelong learning.

PROGRAMME OUTCOMES

PO1: **Disciplinary knowledge:** Capability of demonstrating comprehensive knowledge of mathematics and understanding of one or more disciplines which form a part of an undergraduate programme of study.

PO2: **Communications skills:** Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations. Ability to communicate ideas effectively.

PO3: **Critical thinking and analytical reasoning:** Ability to employ critical thinking in understanding the concepts, to analyse the results and apply them in various problems appearing in different branches of mathematics.

PO4: **Problem solving:** Capability to solve problems in mathematics and its applications arising in different fields of science & engineering, related to the curriculum.

PO5: **Research-related skills:** Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics and to know about the advances in various branches of mathematics.

PO6: **Information/digital literacy:** Capability to use appropriate software's to perform mathematical investigations and problem solving.

PO7: **Self-directed learning:** Ability to work independently and do in-depth study of various notions of mathematics.

PO8: **Moral and ethical awareness/reasoning:** Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects.

PO9: **Lifelong learning:** Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

PO10: **Professional skills:** Ability to work as team with professional ethical practices.

PO11: **Application skills:** Ability to apply one's disciplinary knowledge and skills in mathematics in newer domains and uncharted areas.

PO12: **Experimental learning:** Ability to identify challenging problems in mathematics and obtain well-defined solutions.

PO13: **Employability options:** To apply for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

DEPARTMENT OF MATHEMATICS
B.SC(H) IN MATHEMATICS
B.SC(H) (MAU01) SESSION -2020-2023

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
MAH107B	ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH108B	CALCULUS-I	MA	HARD	CORE	3	1	0	0	4	4
CSH105B-T	PROGRAMMING FOR PROBLEM SOLVING USING C	CS	HARD	CORE	2	1	0	0	5	4
CSH105B-P	PROGRAMMING FOR PROBLEM SOLVING USING C - LAB				0	0	2	0		
PHH106B-T	ESSENTIALS OF PHYSICS	PH	HARD	CORE	3	1	0	0	6	5
PHH106B-P	ESSENTIALS OF PHYSICS LAB				0	0	2	0		
MAH109B	MATHS LAB –I	MA	HARD	CORE	0	0	2	0	2	1
HLS102	COMMUNICATIVE ENGLISH	HL	SOFT	CORE	1	0	2	0	3	2
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					12	4	8	0	24	20

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
MAH115B	CALCULUS-II	MA	HARD	CORE	3	1	0	0	4	4
MAH111B	STATISTICS-I	MA	HARD	CORE	3	1	0	0	4	4
MAH112B	ORDINARY DIFFERENTIAL EQUATIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH113B	GEOMETRY OF 2D AND 3D	MA	HARD	CORE	3	1	0	0	4	4
MAH114B	MATHS LAB – II	MA	HARD	CORE	0	0	2	0	2	1
CHH137	ENVIRONMENTAL SCIENCE	CH	HARD	UNIVERSITY COMPULSORY	2	0	0	2	2	4
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					14	4	2	2	20	21
MAO116B	VALUE ADDED SUMMER COURSE - POST 2nd SEMESTER									02

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
MAH204B	REAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH205B	STATISTICS-II	MA	HARD	CORE	3	1	0	0	4	4
MAH206B	GROUP THEORY	MA	HARD	CORE	3	1	0	0	4	4
MAH207B	PARTIAL DIFFERENTIAL EQUATIONS	MA	HARD	CORE	3	1	0	0	4	4

SUBJECT CODES	SUBJECT NAME	Offering Dept	Course Nature	Course Type	L	T	P	O	No. of Contact Hours Per Week	No. of Credits
MAH208B	MATHS LAB - III	MA	HARD	CORE	0	0	2	0	2	1
EDS288/ EDS289/ EDS290/ MCS231/ MCS232/ CDO203/ MAN209B	APPLIED PHILOSOPHY/ APPLIED PSYCHOLOGY/APPLIED SOCIOLOGY/ BASICS OF ECONOMICS/ INTRODUCTION TO FINANCE/ QUANTITATIVE APTITUDE – I / MINI PROJECT -I	ED/MC/ CDC/MA	Soft/ NTCC	ELECTIVE (Any one)	1	0	2	0	0	2
FLS103	FRENCH - I	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	2	2
FLS101	SPANISH - I									
FLS102	GERMAN -I									
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					**14**	**5**	**4**	**0**	**23**	**21**

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
MAH210B	ADVANCED ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH211B	ADVANCED ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH212B	MECHANICS-I	MA	HARD	CORE	3	1	0	0	4	4
MAH213B	INTEGRAL TRANSFORMS & APPLICATION	MA	HARD	CORE	3	1	0	0	4	4
MAH214B	SET THEORY & NUMBER THEORY	MA			3	1	0	0	4	
CSH210B-T	DATA STRUCTURES	CS	HARD	CORE	3	0	0	0	5	4
CSH210B-P	DATA STRUCTURES LAB				0	0	2	0		
MAH215B	ACTUARIAL STATISTICS	MA			3	1	0	0	4	
MAH216B	SURVEY SAMPLING & INDIAN OFFICIAL STATISTICS	MA			3	1	0	0	4	

SUBJECT CODES	SUBJECT NAME	OFFERING DEPT	COURSE NATURE	COURSE TYPE	L	T	P	O	CONTACT HOURS	CREDITS
CHS234/ ECS249/LWS 323 CDO204/ MAN218B	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT/ E-WASTE: ENVIRONMENTAL PROBLEMS AND MANAGEMENT /CYBER CRIMES & LAWS/ QUANTITATIVE APTITUDE II/ MINI PROJECT-II	CH/EC/ CDC/LW /MA	Soft	ELECTIVE (Any one)	1	0	2	0	0	2
CDO205	CAREER SKILLS-I	CDC	SOFT	AP/AF	3	0	0	0	2	0
	TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)				15	4 OR 5	2 OR 4	0	23 OR 24	22

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
MAH301B	NUMERICAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH302B	LINEAR ALGEBRA				3	1	0	0	4	4
MAH303B	METRIC SPACES				3	1	0	0	4	4
MAH304B	INFORMATION THEORY AND CODING	MA		ELECTIVE (ANY ONE)	3	1	0	0	4	4
CSH321B-T	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	CS			3	0	0	0	5	4
H321B- P	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS LAB				0	0	2	0		
MAH305B	MATHEMATICS OF FINANCE				3	1	0	0	4	4
MAH306B	STATISTICAL INFERENCES	MA			3	1	0	0	4	4

					L	T	P	O		
MAS307B	MATHS LAB-IV				0	0	2	0	2	1
MAN308B	MINOR PROJECT		NTCC	CORE	1	0	2	0	3	2
CDO303	CAREER SKILLS-II	CDC	SOFT	AP/AF	3	0	0	0	2	0
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					13	3/4	4/6	0	21/22	19

SEMESTER-VI

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft / Workshop/ NTCC)	COURSE TYPE (Core/El ective / Universit y Compuls ory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH309B	LINEAR ROGRAMMING & GAME THEORY	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	4
MAH310B	MECHANICS-II				3	1	0	0	4	
MAH311B	DISCRETE MATHEMATICS				3	1	0	0	4	
MAH312B	MATHEMATICA L MODELING	MA			3	1	0	0	4	
MAH313B	APPLICATIONS OF ALGEBRA	MA			3	1	0	0	4	
MAH314B	INDUSTRIAL MATHEMATICS				3	1	0	0	4	
MAH315B	BIO MATHS				3	1	0	0	4	
MAH316B	CRYPTOGRAPH Y			ELECTI VE (ANY ONE)	3	1	0	0	4	4
CSH322B-T	FUNDAMENTALS OF MACHINE LEARNING	CS			3	0	0	0	5	
CSH322B-P	FUNDAMENTALS OF MACHINE LEARNING LAB				0	0	2	0		
MCH393	MANAGEMENT OF BANKING & INSURANCE	MC			3	1	0	0	4	
MAH317B	ECONOMETRICS	MA			3	1	0	0	4	

MAN318B	PROJECT	MA	NTCC	CORE	0	0	0	6	2	6
CDO305	CAREER SKILLS-III	CDC	SOFT	AP/AF	3	0	0	0	2	0
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					9	2/3	0/2	6	14/15	18

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
MAH107B	ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH108B	CALCULUS-I	MA	HARD	CORE	3	1	0	0	4	4
CSH105 B-T	PROGRAMMING FOR PROBLEM SOLVING USING C	CS	HARD	CORE	2	1	0	0	5	4
CSH105 B-P	PROGRAMMING FOR PROBLEM SOLVING USING C -LAB				0	0	2	0		
PHH106B T	ESSENTIALS OF PHYSICS	PH	HARD	CORE	3	1	0	0	6	5
PHH106B P	ESSENTIALS OF PHYSICS LAB				0	0	2	0		
MAH109 –B	MATHS LAB –I	MA	HARD	CORE	0	0	2	0	2	1
HLS102	COMMUNICATIVE ENGLISH	HL	SOFT	CORE	1	0	2	0	3	2
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					12	4	8	0	24	20

Course Title/Code	ALGEBRA (MAH107B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concepts of set theory, congruence's, theory of equations & matrices.	
Course Outcomes (COs)		**Mapping**
CO1	Understand and apply the basic concepts of sets, relations, functions, mathematical induction and division algorithm.	**Skill Development**
CO2	Understand and apply the concepts of congruence in the study of algebraic structures.	**Skill Development**
CO3	Find the solution and transformation of polynomial equations .	**Skill Development**
CO4	Understand and apply the concepts hyperbolic functions, direct and inverse circular functions and Gregory series to further applications.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Sets, Relations & Functions: Sets, Relations, Equivalence relations, Functions, 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: Congruence's and their properties, Linear congruences and their solutions, Chinese Remainder Theorem, Fermat's Theorem and Wilson's Theorem ,Diophantine equation ax+by=c (a,b,c are integers).

Section C

Algebraic Equations: Fundamental Theorem of Algebra, General properties of equations, Descartes rule of sign, Relation between coefficient and roots of the equation, Cube roots of unity.
Transformation of equations: Roots with sign changed, Roots multiplied with given quantities, Reciprocal roots, Increase or diminish the root by given quantity, Binomial coefficient,.

Section D

Solution of cubic and Bi-quadratic equations: Use Cardon's Method to solve cubic equation.Descartes Method, Ferrari's Method &

Euler's Method to solve Biquadratic equation.
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.

TEXTBOOKS

1. Chandrika Prasad: Text Book on Algebra and Theory of equation, Pothishala Pvt Ltd, 1978.
2. C. C. MacDuffee: Theory of Equations, John Wiley & Sons Inc., 1954

REFERENCE BOOKs

1. W.S. Burnside and A.W. Panton:The Theory of Equations, Dublin University Press, 1954.
2. K.Prakash,O.P Chug & P.Gupta: Algebra and Trigonometry, University Science press, 2009.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH107B	ALGEBRA	CO1	3	3	3	3	1	-	2	-	2	-	1	-	-
		CO2	3	3	3	3	2	-	2	-	2	-	-	-	-
		CO3	3	3	3	3	2	-	2	-	2	-	1	-	-
		CO4	3	3	1	3	1	-	2	-	2	-	-	-	-

Course Title/Code	CALCULUS–I(MAH108B)	
Course Type	Core (Departmental)	
L-T-P Structure	**3-1-0**	
Credits	4	
Course Objective	Students will be able to understand and apply the concepts of Continuity, Differentiability and its applications.	
Course Outcomes (COs)		**Mapping**
CO1	Develop a foundation of elementary tools in Calculus: limit, continuity, differentiability & curve tracing.	**Skill Development**
CO2	Apply the concepts of limits, continuity & differentiability to pure and applied mathematics problems.	**Skill Development**
CO3	Use the properties of limits and the derivative to analyze graphs of various functions of single & several variable.	**Skill Development**
CO4	demonstrate concepts of curve tracing and curvature in various mathematical & engineering problems.	**Skill Development**
CO5	Recognize the appropriate tools of calculus to solve applied mathematical & engineering problems.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Limit & Continuity:
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

Successive Differentiation & Curvature: 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

Tracing of Curves : Asymptotes (Parallel and Oblique) of Cartesian, Polar and Parametric Curves, Intersection of Curve and its Asymptotes.Concavity & Convexity, Points of Inflexion, Multiple Points (Singular Points), Tracing of Curves in Cartesian, Parametric and Polar Form.

Section D

Functions of Several Variables : 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 .

TEXT BOOKS

1. Shanti Narayan, Differential Calculus, S.Chand & Co.

REFERENCE BOOKS

1. B. S. Grewal, Higher Engineering Mathematics Khanna Publications.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH108B	CALCULUS – I	CO1	3	3	3	3	2	-	2	-	2	-	-	2	-
		CO2	3	3	3	3	2	-	2	-	2	-	2	2	-
		CO3	3	3	3	3	2	-	2	-	2	-	-	2	-
		CO4	3	3	3	3	2	-	2	-	2	-	2	2	-
		CO5	3	3	3	3	1	-	3	-	2	-	2	2	-

Course Title/Code	PROGRAMMING FOR PROBLEM SOLVING USING C (CSH105B)	
Course Type	Core (Allied)	
L-T-P Structure	2-1-2	
Credits	4	
Course Objective	Students are able to construct a program of moderate complexity from a specification	
Course Outcomes (COs)		**Mapping**
CO1	Analyse and apply Test Driven Development approach to design programs.	**Skill Development**
CO2	Understand and apply programming language constructs as per given problems	**Skill Development**
CO3	Understand and apply C programming language constructs on opensource platform	**Skill Development**
CO4	learn to work in a team using different online platform for program development	**Skill Development**
Prerequisites (if any)	N.A	

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.

Moving to C: Data 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

Arrays; 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 .

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.

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, Break, Continue and Goto, Type Conversion; Enumerations; Macros. Students will be able to use these techniques to develop programs

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. 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,

Software Configuration Management, Modules, CUnit, GIT, SCRUM, MAKE. Dynamic Memory Allocation.

LIST OF EXPERIMENTS:

1. Scratch : Covering Concepts of
     I.   Sequential Statements
     II.   Variables
     III. Blocks
2. Unix Commands: pwd, mkdir, cd, ls, less, touch, cp,move, cat, rm, rmdir –r etc.
3. Moving to C Using nano and gcc.
4. Project on Calculator Using Agile Methodology, Nano, Cunit, Git, Scrum , Agile Methodology, Nano, Gcc, Make. Covering Conepts :
     I.   Statements
     II.   Functions
     III. Arrays
     IV.   Structures
     V.   Pointers
     VI.   File Handling.

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

Help Pages

1. Eclipse C/C++ Development Guide

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

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

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

TEXT BOOKS

1. The C Programming Language, Brian Kernighan and Dennis Ritchie.
2. The Unix Programming Environment

REFERENCE BOOKS

1. Pro Git Help Page
2. Eclipse C/C++ Development Guide

e-Resources (websites/Wikipedia pages/webtutorials/online courses, etc.)

1. Eclipse, https://eclipse.org/users/
2. Git, https://git.com
2. Harvard's CS50, https://courses.edx.org/courses/HarvardX/CS50x3/2015/info

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CSH105B	PROGRAMMING FOR PROBLEM SOLVING USING C	CO1	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO2	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO3	3	2	3	3	2	-	2	-	2	2	2	2	-

| | | CO4 | 3 | 2 | 3 | 3 | 2 | - | 2 | - | 2 | 2 | 2 | 2 | - |

Course Title/Code	ESSENTIALS OF PHYSICS (PHH106B) T & P	
Course Type	Core (Allied)	
L-T-P Structure	3-1-2	
Credits	5	
Course Objective	To apply the concepts of physics to different optical phenomena, devices based on these phenomena, lasing in gases and solids, quantum mechanics and its applications and develop and analyze electromagnetic wave equations in different media	
Course Outcomes (COs)		**Mapping**
CO1	Produce and analyze the interference pattern due to division of amplitude & wave front	**Skill Development**
CO2	Produce required quality Spectrum and analyze it using appropriate diffraction grating.	**Skill Development**
CO3	Measure the concentration/purity of optically active materials using optical devices	**Skill Development**
CO4	Explain the construction, working and applications of Lasers.	**Skill Development**
CO5	To solve problem of one dimensional box using concepts of Quantum Mechanics	**Skill Development**
CO6	Apply electromagnetic wave equations for different media and find out different parameters	**Skill Development**
Prerequisites (if any)	**N.A**	

Section-A

Physical Optics: Interference, Interference by Division Of Wave front and Amplitude, Interference in Thin Films (Uniform and Variable Thickness), Newton's Ring and its Applications, Michelson Interferometer and its Applications. Fraunhofer Diffraction at Single Slit, Plane Transmission Grating, Dispersive and Resolving Power of a Grating,

Section-B

Polarization and Laser: Polarized and Un-Polarized Light, Malus Law, Double Refraction, Nicol Prism, Quarter and Half Wave Plates, Laurent's Half Shade Polarimeter and its applications. Stimulated Absorption, Spontaneous and Stimulated Emission, Population Inversion, Conditions for Laser Action, Laser Properties and Laser Applications, Types of Laser: He-Ne Laser, Semiconductor Laser.

Section - C

Quantum Mechanics: Introduction to Quantum Mechanics, Planck's radiation law, Photoelectric Effect, Dual nature of matter, Schrodinger wave equations-time dependent and time independent, Physical significance of wave function, Particle in one dimensional box, Schrodinger Equation in Spherical Polar Coordinates, Hydrogen Atom, Vibrational and rotational spectra of molecules.

Section – D

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.

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

TEXT BOOKS

1. M S Khurana, Fundamentals of Engineering Physics, MR Pub, Delhi (Text Book)
2. S P Taneja, Modern Physics for Engineers I & II, R Chand Publication (Text Book)
3. Satya Prakash, Engineering Physics, Pragati Prakashan.

REFERENCE BOOKS

4. A. Ghatak, Optics
5. C N Banwell & E M Mccash, Fundamentals of Molecular Spectroscopy.
6. H E White, Introduction to Molecular Spectra.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
PHH106B(T & P)	ESSENTIALS OF PHYSICS	CO1	3	2	3	3	2	-	2	-	2	-	1	2	-
		CO2	3	3	2	2	2	-	2	-	2	-	2	2	-
		CO3	3	2	3	3	2	-	3	-	2	-	2	2	-
		CO4	2	3	2	2	2	-	2	-	2	-	2	2	-
		CO5	2	2	2	2	1	-	2	-	2	-	2	2	-
		CO6	3	2	3	3	2	-	2	-	2	-	1	2	-

Course Title/Code	MATHS LAB–I (MAH109B)	
Course Type	Core (Departmental)	
L-T-P Structure	**0-0-2**	
Credits	1	
Course Objective	To introduce students with the mathematical software & its usage to solve mathematical problems. Computation of statistical parameters using software	
Course Outcomes (COs)		**Mapping**
CO1	To perform basic mathematical calculations plotting the graphs and matrix operation using OCATVE	**Skill Development**
CO2	To evaluate derivative and its application using mathematical software	**Skill Development**
CO3	To understand and apply concept of integration to evaluate area and volume using Mathematical software	**Skill Development**
CO4	To compute the roots of quadratic, cubic & biquadratics equations and transformation of equations	**Skill Development**
Prerequisites (if any)	**N.A**	

LAB EXERCISE Using Software OCTAVE/ MATLAB/ ALTAIR/SCI LAB

1. Introduction to mathematical software and use of some simple E commands.

2. Define matrices and compute matrix operations

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. Transformation of an equation

5. Roots of cubic and bi-quadratic equations

6. Limit & continuity of function of single variable

7. Differentiability of function of single variable

8. Asymptotes of given curves

9. Curvature of given cartesian curves

10. Curvature of given parametric and polar curves

11. Trace the cartesian curve

12. Trace the parametric curve

13. Trace the polar curve (r)

14. Maxima and minima of several variables

TEXT BOOKS

1. Amos Gilat, MATLAB : An Introduction with Applications.

REFERENCE BOOKS

1. Engineers,B.D Hahn, Essential Matlab for Scientists.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH109B	MATHS LAB –I	CO1	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO2	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO3	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO4	1	-	-	3	3	-	-	-	-	2	-	-	-

Course Title/Code	COMMUNICATIVE ENGLISH(HLS102)	
Course Type	Core (Allied)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To equip the students with effective communication skills, nuances of technical writing and deal extensively with the requirements of Industry.	
Course Outcomes (COs)		**Mapping**
CO1	To know about all the words and phrases of English language.	**Skill Development**
CO2	To build the basic skills of effective communication	**Skill Development**
CO3	To know about the importance of Listening	**Skill Development**
CO4	To know about the importance of verbal and non-verbal movements.	**Skill Development**
Prerequisites (if any)	N.A	

Section A

Lexis: Homonyms, Homophones, Homographs, Words often confused, One word Substitutes, Synonyms and Antonyms, Foreign Words, Phrasal Verbs & Idioms and Phrases

Section B

Oral Communication: Importance of Speech Sounds, Organs of Speech, Vowel Sounds, Consonant Sounds, IPA Symbols, Phonetic Transcription, Phoneme and Syllables, Intonation, Word Stress, Sentence Stress.

Section C

Presentation Skills: Body Language and Paralanguage, Gestures and Postures, Kinesics, Proxemics, Importance of Body Language in Presentation, Etiquette of the Telephone Handling and Business Meetings, Professional Presentation, Hearing and Listening, Essentials of Effective Listening, Importance of Effective Listening, Visual Presentation – How to prepare slide presentation.

Section D

Technical Writing-II: Business Letters, Job Application and Resume Writing, Developing Outlines, Circular, Memos, Blog Writing and Comments on Media.

TEXT BOOKS

1. A Practical Course for Developing Writing Skills in English. J K Gangal: PHI Learning Pvt.
3. A Textbook of English Phonetics for Indian Students. T.Bala Subhrmaniam: Macmillan

REFERENCE BOOKS

1. M.A. Pink and A.C. Thomas, English Vocabulary in Use. MaCarthy: Foundation Books, OUP. Print.English Grammar, Competition and Correspondenc, S. Chand and Co. Print.
2. Reading Between the Line: Students Book. MacRae: Foundation Books. CUP, New Delhi.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
HLS102	COMMUNICATIVE ENGLISH	CO1	2	3	1	-	-	-	-	1	2	3	-	-	-
		CO2	2	3	1	-	-	-	-	1	2	3	-	-	-
		CO3	2	3	1	-	-	-	-	1	2	3	-	-	-
		CO4	2	3	1	-	-	-	-	1	2	3	-	-	-

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
MAH115B	CALCULUS-II	MA	HARD	CORE	3	1	0	0	4	4
MAH111B	STATISTICS-I	MA	HARD	CORE	3	1	0	0	4	4
MAH112B	ORDINARY DIFFERENTIAL EQUATIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH113B	GEOMETRY OF 2D AND 3D	MA	HARD	CORE	3	1	0	0	4	4
MAH114B	MATHS LAB – II	MA	HARD	CORE	0	0	2	0	2	1
CHH137	ENVIRONMENTAL SCIENCE	CH	HARD	UNIVERSITY COMPULSORY	2	0	0	2	2	4
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					14	4	2	2	20	21
MAO116B	VALUE ADDED SUMMER COURSE - POST 2nd SEMESTER									02

DETAILED SYLLABUS
MAU01 – SECOND SEMESTER

Course Title/Code	CALCULUS – II (MAH115B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concepts of reduction formulae, application of single integrals , multiple integrals and vector calculus.	
Course Outcomes (COs)		**Mapping**
CO1	Explain physical meaning of gradient of a scalar field, curl, and divergence in terms of fluid flow and apply its concepts.	**Skill Development**
CO2	Understand and apply reduction formulae and calculate length of an arc, area of a curve and volume &surface area of solid of revolution.	**Skill Development**
CO3	Understand and apply the concept of beta and gamma functions to evaluate integrals.	**Skill Development**
CO4	Evaluate line integrals, surface integrals and volume integrals and relate Stokes, Divergence and Green's Theorems in other branches of Mathematics.	**Skill Development**
Prerequisites (if any)	**Calculus-I(MAH108B)**	

Section A

Applications of Single Integral: 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

Multiple Integrals: 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, Dirichlet Integral.

Section C

Vector Differentiation: Limit & Continuity of vector functions, differentiation of vector functions, tangent and normal components of vector functions, vector fields and scalar fields, gradient of a scalar field and directional derivative. Divergence and Curl of a vector field and their physical interpretations, Irrotational and Solenoidal fields. Laplacian operator

Section D

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

TEXTBOOKS

1. Shanti Narayan, P.K.Mittal, Integral Calculus, S. Chand.
2. Shanti Naryan, Vector Calculus ,S. Chand.

REFERENCE BOOKS

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH 115 B	CALCULUS – II	CO1	3	2	3	3	2	-	2	-	2	2	2	1	-
		CO2	3	3	3	3	2	-	2	-	2	2	2	1	-
		CO3	3	3	3	3	2	-	2	-	2	2	2	2	-
		CO4	3	2	3	3	2	-	2	-	2	2	2	2	-

Course Title/Code	STATISTICS – I(MAH111B)

Course Type	Core (Departmental)
L-T-P Structure	3-1-0
Credits	4
Course Objective	To equip the students with the concepts of Measures of Central Tendency, Measures of Dispersion, Skewness, Moments & Kurtosis and Correlation & Regression Analysis.

Course Outcomes (COs)		Mapping
CO1	Compute measures of central tendency and solve related problems in real world	**Skill Development**
CO2	Apply measures of dispersion to solve real world problems	**Skill Development**
CO3	Assess the shape and peakness of data and calculate the various methods of measurements	**Skill Development**
CO4	Apply correlation and regression techniques to check the dependency in data	**Skill Development**
CO5	Develop confidence for self-education and ability for life- long learning	**Skill Development**
Prerequisites (if any)	N.A	

SECTION A

Measures of Central Tendency: Introduction, types of averages- Mean, Median, Mode, Geometric mean, Harmonic mean, Relationship among averages, Quartile, Percentile

SECTION B

Measures of Dispersion: Introduction, Significance of measuring variations, Range, Quartile deviation, Mean deviation, Standard deviation, Relation between them, Coefficient of variation, Relation between coefficient of variation and standard deviation

SECTION C

Skewness, Moments & Kurtosis: Introduction, Difference between dispersion and skewness, Measures of skewness, Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness, Kelly's coefficient of skewness, Moments, Moments about arbitrary origin, about zero, about mean, Measures of Kurtosis.

SECTION D

Correlation & Regression Analysis: Introduction, Types of correlation, Karl Pearson's coefficient of correlation, Probable error, Rank correlation, Spearman's correlation coefficient, Concurrent deviation method, Introduction to regression analysis, Difference between correlation and regression analysis, Regression lines and Regression equations.

Textbooks

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. S.C. Gupta, Fundamentals of Statistics, Himalaya Publishing House.
3. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

REFERENCE BOOKS

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
2. S. P. Gupta, Statistical Methods, Sultan Chand & Sons, Educational publishers, New Delhi

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH111B	STATISTICS – I	CO1	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO2	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO3	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO4	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO5	-	-	-	-	2	-	2	-	2	2	2	-	2

Course Title/Code	ORDINARY DIFFERENTIAL EQUATIONS (MAH112B)
Course Type	Core(Departmental)

L-T-P Structure	3-1-0
Credits	4
Course Objective	To equip the students with the concepts of Ordinary differential equations and it's applications.

Course Outcomes (COs)		Mapping
CO1	Describe the concepts of ordinary differential equations and different types ODEs.	Skill Development
CO2	Effectively write mathematical derivation/ solutions of all types of ODEs in a clear and concise manner	Skill Development
CO3	Explain and apply various forms of Ordinary differential equations in the different areas of day to day life problems and solve them.	Skill Development
CO4	Derive and apply the concept of method of variation of parameter, simultaneous linear differential equations in arising the physical problems.(Orthogonal trajectories, electric circuits, etc.)	Skill Development
Prerequisites (if any)	N.A	

Section A

Basic concepts and genesis of ordinary differential equations, Formulation, Order and degree of a differential equation, equations of first order and first degree, solutions of equations by separable of variables, homogeneous equations, Linear equations and Bernoulli equations, Exact differential equations, integrating factors, application of first order differential equations to orthogonal trajectories, simple electric circuits and Newton's law of cooling.

Section -B

Existence and uniqueness theorem for linear differential equations, linear differential equations with constant coefficient, auxiliary equation, methods of finding the complementary function and particular integral. Particular integral of the forms when X = e^{ax}, $\sin ax$/ $\cos ax$, x^m, $e^{ax}.V$ and X is any other function. Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients. Applications of linear differential equations to simple harmonic motion, simple pendulum and oscillatory electric circuit.

Section-C

Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and

non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy and Legendre's linear equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method

Section-D

Introduction-Definition &Simple situations for Mathematical Modeling, Technique of Mathematical Modeling, Classification of Mathematical Models, Some characteristic of Mathematical Models, compartmental models. Mathematical modeling through ordinary differential equations (Lotka-Volterra pollution model, drug assimilation into the blood of a single cold pill, growth and decay model).

TEXTBOOKS

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.

REFERENCE BOOKS

1. M.D. Rai Singhania: Advanced differential equations.
2. J.N.Kapoor:MathematicalModeling.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH112B	ORDINARY DIFFERENTIAL EQUATIONS	CO1	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO2	2	1	1	2	2	-	2	-	2	2	2	2	-
		CO3	3	3	2	1	2	-	2	-	2	2	2	2	-
		CO4	3	3	3	1	3	-	2	-	2	3	2	2	-

Course Title/Code	GEOMETRY OF TWO AND THREE DIMENSIONS (MAH113B)

Course Type	Core (Departmental)
L-T-P Structure	3-1-0
Credits	4
Course Objective	To familiarize students with the concept of second degree eqns, sphere, cone and cylinder.

Course Outcomes (COs)		Mapping
CO1	Analyse general equation of second degree and apply concept focii, length & eqns of axes of to trace the conics.	**Skill Development**
CO2	Apply the concept of confocal conics for classification of different conics	**Skill Development**
CO3	Apply the concepts of sphere and Cone to solve related mathematical problems	**Skill Development**
CO4	Understand and analyse the properties of cylinder and central conicoids.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

General equation of second degree: Introduction, Condition for a pair of straight line, Condition for general eqn of second degree to be a circle ,parabola ,hyperbola and ellipse.

Tracing of conics: Standard form of conics, Reduction of general equation of second degree into a conic, determination of the length, positive and direction of axis of the central conic, eccentricity of a central axis, asymptotes of the 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 confocals 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 conicoids. Polar plane of a point. Enveloping cone of a conicoid. Enveloping cylinder of a coincoid , Paraboloids.

TEXTBOOKS

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.

REFERENCE BOOKS

1. P.R Vittal: Analytical Geometry:2D and 3D, Pearson

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH113B	GEOMETRY OF TWO AND THREE DIMENSIONS	CO1	2	1	-	2	-	-	-	-	2	2	-	-	-
		CO2	2	1	-	2	-	-	-	-	2	2	-	-	-
		CO3	2	1	-	2	-	-	-	-	2	2	-	-	-
		CO4	2	1	-	2	-	-	-	-	2	2	-	-	-

Course Title/Code	MATHS LAB–II(MAH114B)
Course Type	Core (Departmental)

L-T-P Structure	0-0-2
Credits	1
Course Objective	To familiarize students with programming and computation of integral calculus problems using mathematical software.

Course Outcomes (COs)		Mapping
CO1	To construct the programming codes for solving mathematical problems.	Skill Development
CO2	To analyze the statistical data by plotting the graph, pi-chart etc.	Skill Development
CO3	To analyze the statistical data in terms of measure of central tendency, dispersion, skewness, kurtosis and corelation regression.	Skill Development
Prerequisites (if any)	MATHS LAB – I(MAH109B)	

LAB EXERCISE: Using Software OCTAVE/ MATLAB/ SCILAB/ALTAIR

1. Introduction to programming - Creating script file or m-files

2. Introduction to Conditional statements –if and else using mathematical software

3. Introduction to Conditional statements –if and else using mathematical software (Continued).

.4. . Introduction to iteration based programming – for loop

5 . Introduction to iteration based programming – while loop

6. Introduction to switch and break statements.

7. Introduction to functions and function files

8. Application of integrals- Compute arch length of a given curve.

9. Application of integrals- Compute area under a given curve.

10. Application of integrals- Compute Volume & Surface Area solid of revolution.

11. Special Integrals –Beta –Gamma Functions

12. Muiltiple Integrals

13. Muiltiple Integrals

TEXTBOOKS

1. Amos Gilat., MATLAB : An Introduction with Applications.

REFERENCE BOOKS

1. B. D. Hahn, Essential Matlab for Scientists and Engineers

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH114B	MATHS LAB –II	CO1	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO2	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO3	1	-	-	3	3	-	-	-	-	2	-	-	-

Course Title/Code	ENVIRONMENTAL SCIENCE (CHH137)
Course Type	Core (Allied)

L-T-P Structure	2-0-0-2	
Credits	4	
Course Objective	To make the student identify the areas of environmental degradation, identify the impact of environmental degradation on the surroundings, apply the concept of sustainable development in real life and correlate his/her field with various aspects of environment	
Course Outcomes (COs)		**Mapping**
CO1	Explain the multidisciplinary dimension of environmental issues	**Skill Development**
CO2	Explain the environmental issues and suggest potential solutions	**Skill Development**
CO3	Discuss about the various types of organisms and draw inferences about their interactions in different	**Skill Development**
CO4	Defend the principles governing the interactions between social and environmental factors	**Skill Development**
CO5	Environmental settings Organize or create an environmental awareness event/article/campaign/eco-friendly product	**Skill Development**
Prerequisites (if any)	**N.A**	

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.
  a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
  b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
  c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
  d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
  e) Energy resources : Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
  f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
  g) Role of an individual in conservation of natural resources.

h) Equitable use of resoureces 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:
  a. Forest ecosystem
  b. Grassland ecosystem
  c. Desert ecosystem
  d. 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
- Inida 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 :-
  a. Air pollution
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution

g. 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 rahabilitation 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.

ENVIRONMENTAL SCIENCES–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)

TEXTBOOKS

1. K.C. Agarwal, Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.
3. R.C. Brunner, Hazardous Waste Incineration, McGraw Hill Inc.1989.
4. R. S. Clark, Marine Pollution, Clanderson Press Oxford (TB)
5. W. P. Cunningham, T. H. Cooper, E. Gorhani, M. T. Hepworth, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 2001.

REFERENCE BOOKS

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

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CHH 137	Environmental Science	CO1	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO2	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO3	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO4	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO5	-	2	-	-	-	-	-	-	2	2	-	-	-

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
MAH204B	REAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH205B	STATISTICS-II	MA	HARD	CORE	3	1	0	0	4	4
MAH206B	GROUP THEORY	MA	HARD	CORE	3	1	0	0	4	4
MAH207B	PARTIAL DIFFERENTIAL EQUATIONS	MA	HARD	CORE	3	1	0	0	4	4
MAH208B	MATHS LAB - III	MA	HARD	CORE	0	0	2	0	2	1
EDS288/ EDS289/ EDS290/ MCS231/ MCS232/ CDO203/ MAN209B	APPLIED PHILOSOPHY/ APPLIED PSYCHOLOGY/APPLIED SOCIOLOGY/ BASICS OF ECONOMICS/ INTRODUCTION TO FINANCE/ QUANTITATIVE APTITUDE – I / MINI PROJECT -I	ED/MC/ CDC/MA	Soft/ NTCC	ELECTIVE (Any one)	1	0	2	0	0	2
FLS103	FRENCH - I	MRCFL	SOFT	UNIVERSITY COMPULSORY	1	1	0	0	2	2
FLS101	SPANISH - I									
FLS102	GERMAN -I									
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					14	5	4	0	23	21

DETAILED SYLLABUS

Course Title/Code	REAL ANALYSIS (MAH204B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concepts of real numbers, sequences and series of real numbers.	
Course Outcomes (COs)		**Mapping**
CO1	To apply the field, order and completeness properties over the set of real numbers and its subsets.	**Skill Development**
CO2	To apply the properties of open and closed sets to analyze various subsets of R.	**Skill Development**
CO3	To test the convergence of a real sequence.	**Skill Development**
CO4	To test the convergence/divergence behavior of an infinite series.	**Skill Development**
CO5	To test the uniform convergence of sequence of functions and infinite series.	**Skill Development**
Prerequisites (if any)	N.A	

Section A

Real Number System: Algebraic and order properties of $\mathbb{R}$, Absolute value of a real number; Bounded above and bounded below sets, Supremum and infimum of a nonempty subset of $\mathbb{R}$, The completeness property of $\mathbb{R}$, Archimedean property, Density of rational numbers in $\mathbb{R}$, Definition and types of intervals, Nested intervals property; Neighborhood of a point in $\mathbb{R}$, Open, closed and perfect sets in $\mathbb{R}$, Connected subsets of $\mathbb{R}$, Cantor set and Cantor function.

Section B

Sequences 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 and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series; Basic comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's nth root test, Integral test; Alternating series, Leibniz test, Absolute and conditional convergence.

Section D

Uniform Convergence: Pointwise and uniform convergence of sequence and series of functions, Weierstrass's M-test, Dirichlet test and Abel's test for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiability

TEXTBOOKS

1. S.C. Malik and Savita Arora, Mathematical Analysis, New Age Publisher .
2. P.K. Jain, S K Kaushik, Introduction to Real Analysis, S. Chand.

REFERENCE BOOKS

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

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH204B	REAL ANALYSIS	CO1	3	3	3	3	1	-	2	-	1	1	1	-	-
		CO2	3	3	3	3	1	-	2	-	1	1	1	-	-
		CO3	3	3	3	3	2	-	2	-	2	1	1	-	-
		CO4	3	3	3	3	1	-	2	-	2	1	1	-	-
		CO5	3	3	3	3	2	-	2	-	1	1	-	-	-

Course Title/Code	STATISTICS – II (MAH205B)

Course Type	Core (Departmental)
L-T-P Structure	3-1-0
Credits	4
Course Objective	To equip the students with the concepts of Random Variable, Probability Distributions & Mathematical Expectation, Theoretical Distributions, Tests of Hypothesis, Chi square Test F-test, Analysis of Variance.

Course Outcomes (COs)		Mapping
CO1	Apply the concept of probability theory and probability distributions to solve related problems.	**Skill Development**
CO2	Apply the concept of Joint probability theory and Joint probability distributions to solve related problems.	**Skill Development**
CO3	Apply the concepts of some special discrete and continuous distributions to solve related problems.	**Skill Development**
CO4	Apply the knowledge of sampling theory to analyse and interpret given data.	**Skill Development**
Prerequisites (if any)	STATISTICS – I (MAH111B)	

Section A
Random Variable, Probability Distributions & Mathematical Expectation: Random variable, probability distribution of a discrete & continuous random variable, cumulative probability function, moments, Mathematical expectation, Theorems on mathematical expectation, variance of X in terms of expectation, covariance of X in terms of expectation, joint and marginal distributions.

Section B
Theoretical Distributions: Discrete distributions**:** Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; Continuous distributions**:** Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.

Section C
Tests of Hypothesis: Procedure of testing hypothesis, Two-tailed and one-tailed test of hypothesis, Test of significance for large samples- single proportions, difference of proportions, single mean, difference of mean, test of significance of small sampling, t-test of significance of-mean of a random sample and difference of means of two samples.

Section D
Chi-square Test, F-test, Analysis of Variance: Degree of freedom, Chi-square distribution, Constants of chi square distributions, Conditions for applying Chi square test, Uses of chi square test, F-test, Applications of F-test, Analysis of variance-assumptions & techniques.

TEXT BOOKS
1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World

Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

REFERENCE BOOKS

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
2. S. P. Gupta, Statistical Methods, Sultan Chand & Sons, Educational publishers, New Delhi
3. S.C. Gupta, Fundamentals of Statistics, Himalaya Publishing House.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH205B	STATISTICS – II	CO1	2	2	2	3	2	1	-	2	1	1	1	1	-
		CO2	2	2	2	3	2	1	-	2	1	1	1	1	-
		CO3	2	2	2	3	2	2	-	2	1	1	1	1	-
		CO4	3	2	3	3	3	3	-	3	3	2	2	2	1

Course Title/Code	GROUP THEORY(MAH206B)

Course Type	Core (Departmental)
L-T-P Structure	3-1-0
Credits	4
Course Objective	To equip the students with the concepts of groups and their properties.

	Course Outcomes (COs)	Mapping
CO1	Recognize the mathematical objects called groups and link the fundamental concepts of groups and symmetries of geometrical objects.	**Skill Development**
CO2	Explain the significance of the notions of cosets, normal subgroups, and factor groups and analyze consequences of Lagrange's theorem.	**Skill Development**
CO3	Illustrate Permutation group and their applications	**Skill Development**
CO4	Classify structure preserving maps between groups and their consequences.	**Skill Development**
CO5	Understand the basic concepts of group actions and their applications	**Skill Development**
Prerequisites (if any)	**N.A**	

Section – A
Groups and its Elementary Properties: Symmetries of a square, Definition and examples of groups including dihedral, permutation and quaternion groups, Elementary properties of groups, Subgroups and examples of subgroups, Lagrange's theorem, Euler phi function, Euler's theorem, Fermat's little theorem.

Section – B
Cyclic & Normal Subgroups: Cyclic groups, Properties of cyclic groups, Properties of cosets, Normal subgroups, Simple groups, Factor groups, Cauchy's theorem for finite abelian groups; Centralizer, Normalizer, Center of a group, Product of two subgroups; Classification of subgroups of cyclic groups.

Section – C
Permutation Groups & Group Homomorphisms: Cycle notation for permutations, Properties of permutations, Even and odd permutations, alternating groups, Cayley's theorem and its applications. Group homomorphisms, Properties of homomorphisms, Group isomorphisms, Properties of isomorphisms; First, second and third isomorphism theorems for groups.

Section – D

Group Actions: Group actions, Orbits and stabilizers, Conjugacy classes, Orbit-stabilizer theorem, Normalizer of an element of a group, Center of a group, Class equation of a group, Inner and outer automorphisms of a group.

TEXTBOOKS

1. Michael Artin (2014). Algebra (2nd edition). Pearson.
2. John B. Fraleigh (2007). A First Course in Abstract Algebra (7th edition). Pearson.
3. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage.
4. N. Herstein (2006). Topics in Algebra (2nd edition). Wiley India.

REFERENCE BOOKS

1. Nathan Jacobson (2009). Basic Algebra I (2nd edition). Dover Publications.
2. Ramji Lal (2017). Algebra 1: Groups, Rings, Fields and Arithmetic. Springer.
3. I.S. Luthar & I.B.S. Passi (2013). Algebra: Volume 1: Groups. Narosa.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH206B	GROUP THEORY	CO1	3	2	3	1	1	-	3	-	3	2	2	2	
		CO2	3	2	3	1	1	-	3	-	3	2	2	2	
		CO3	3	2	3	1	1	-	3	-	3	2	2	2	
		CO4	3	2	3	1	1	-	3	-	3	2	2	2	
		CO5	3	2	3	1	1	-	3	-	3	2	2	2	

Course Title/Code	PARTIAL DIFFERENTIAL EQUATIONS (MAH207B)

Course Type	Core (Departmental)
L-T-P Structure	3-1-0
Credits	4
Course Objective	To equip the students with the concepts of partial differential equations and mathematical modeling.

	Course Outcomes (COs)	Mapping
CO1	To understand the concepts of Partial differential equations ,order and degree of PDEs	**Skill Development**
CO2	To explain various forms/types of Partial differential equations and their solutions	**Skill Development**
CO3	To apply various tools of Partial differential equations in various engineering problems and solve the problems	**Skill Development**
CO4	To define and apply the concept of method of separation of variable in arising the physical problems (heat and vibration of strings).	**Skill Development**
Prerequisites (if any)	ORDINARY DIFFERENTIAL EQUATIONS (MAH112B)	

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 dimension), Existence and uniqueness of solution of Vibrating string Problem., Heat conduction problem(one and two dimension), 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).

TEXTBOOKS

1. TynMyint-U and Lokenath Debnath, 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. I. N Sneddon, Elements of Partial Differential Equations, Dover Publications

REFERENCE BOOKS

1. M.D. RaiSinghania : Advanced differential equations
2. N.M. Kapur, a Text book of Differential Equations, Pitambar Publishing Company.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH207B	PARTIAL DIFFERENTIAL EQUATIONS	CO1	3	2	3	3	2	-	2	-	3	2	3	3	2
		CO2	3	2	3	3	2	-	2	-	3	2	3	3	2
		CO3	3	2	3	3	2	-	2	-	3	2	3	3	2
		CO4	3	2	3	3	2	-	2	-	3	2	3	3	

Course Title/Code	MATHS LAB III (MAH208B)
Course Type	Core (Departmental)

L-T-P Structure	0-0-2	
Credits	1	
Course Objective	To equip the student with the skill to write scientific or academic document in LaTeX	
Course Outcomes (COs)		**Mapping**
CO1	Install LaTeX and its related components on a home/ personal computer.	**Skill Development**
CO2	Use LaTeX and various templates acquired from the course to compose Mathematical documents, presentations, and reports.	**Skill Development**
CO3	Create mathematical documents containing mathematical expressions & formulas via LaTeX.	**Skill Development**
CO4	Compose articles in different journal styles.	**Skill Development**
CO5	Insert graphs and figures in LaTeX. Customize LaTeX documents.	**Skill Development**
Prerequisites (if any)	NA	

LAB EXERCISE:

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

TEXT BOOKS

- Dilip Datta, LaTeX in 24 Hours: A Practical Guide for Scientific Writing, Springer

REFERENCE BOOKS

- Dilip Datta, LaTeX in 24 Hours: A Practical Guide for Scientific Writing, Springer

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH208B	MATHS LAB-III	CO1	-		-	-	-		-	-	2	-	-	-	-
		CO2	-	3	-	-	-	2	-	-	-	-	-	-	-
		CO3	-	3	-	-	-	2	-	-	-	-	-	-	-
		CO4	-	3	-	-	-	2	-	-	-	-	-	-	-
		CO5	-	3	-	-	-	2	-	-	-	-	-	-	-

Course Title/Code	APPLIED PHILOSOPHY (EDS288)

Course Type	Allied(Elective)
L-T-P Structure	1-0-2
Credits	2
Course Objective	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.

Course Outcomes (COs)		Mapping
CO1	Eamine the philosophical problems implicit in the eperience of self, others and the society	**Skill Development**
CO2	Eplore the philosophy of influential philosophers with respect to society, Science and success in life	**Skill Development**
CO3	Demonstrate the understnding of the concepts and theories of moral philosophy.	**Skill Development**
CO4	Reflect philosophically and ethically on one's own personal, professional and civic lives.	**Skill Development**
CO5	Formulate a philosophy of life or worldview consistent with the objectives of liberal society	**Skill Development**
Prerequisites (if any)	**N.A**	

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.

LAB: (EDS288)

1. Prepare and present a report on 'philosophy of life' from the perspective of a young adult.
2. Quiz and interactive sessions on various philosophical perspectives of contemporary philosophers.
3. 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.
4. 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.
5. Preparation of quotation boards to display quotes of great philosophers in the college premises.
6. Picture interpretation and philosophical reflection on social themes like juvenile crime, begging in India, Social networking etc.
7. Readings from the autobiographies and other publications of great philosophers e.g. 'Wings of Fire' followed by discussion session.
8. Showing Videos on Unique personalities: life and philosophies followed by reflection exercises.
9. Any other suitable activity.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
EDS288	APPLIED PHILOSOPHY	CO1	-	-	1	1	-	-	-	3	2	2	-	-	-
		CO2	-	-	-	1	-	-	-	3	2	2	-	-	-
		CO3	-	-	-	1	-	-	-	3	1	1	-	-	-
		CO4	-	-	-	1	-	-	-	3	2	2	-	-	-
		CO5	-	-	1	1	-	-	-	2	2	3	-	-	-

Course Title/Code	APPLIED PSYCHOLOGY (EDS289)	
Course Type	Allied(Elective)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	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.	
Course Outcomes (COs)		Mapping
CO1	To define psychology and its application across various fields.	**Skill Development**
CO2	To identify major attributes of Personality.	**Skill Development**
CO3	To conceptualize psychology in social and organizational settings	**Skill Development**
CO4	To understand group dynamics	**Skill Development**
CO5	To solve conflicts among the group	**Skill Development**
Prerequisites (if any)	**N.A**	

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

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

TEXT BOOKS

1. K. J. Arrow, Barrier to Conflict Resolution. NY: W. W. Norton.
2. A. Bandra, & R. H. Walters, Social Learning and Personality Development. New York: Holt, Rinehart, & Winston.
3. A. Bandra, Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice- Hall, Inc.
4. R. A. Baron, D. Byrne, Social Psychology (8th Ed.). Boston, MA: Allyn & Bacon.
5. R. A. Baron, Psychology (5th ed.). London: Pearson.
6. R. B. Cialdini, Influence: Science and Practice (4th Ed.). Boston, MA: Allyn & Bacon.

REFERENCE BOOKS

1. R. S. Feldman, Essentials of Understanding Psychology. New Delhi: Tata McGraw Hill.
2. N. Friedkin, A structural theory of social influence. Cambridge: Cambridge University Press.
3. N. L. Gage, D. C. Berliner, Educational Psychology (5th Ed.). Boston, MA: Houghton Mifflin Co.
4. C. S. Hall, G. Lindzey, J. B. Campbell, Theories of Personality (4th Ed.). New York: Wiley.
5. R. R. Hunt, H. C. Ellis, Fundamentals of Cognitive Psychology. New Delhi: Tata McGraw Hill.
6. J. M. McDavid, H. Harari, Social Psychology: Individuals, Groups, and Societies. New Delhi: CBS Publishers.
7. L. Millward, Understanding Occupational and Organizational Psychology. London: Sage Publications.
8. C. T. Morgan, R. A. King, J. R. Weisz, J. Schopler, Introduction to Psychology. (7th Ed.). New Delhi: Tata McGraw Hill.
9. A. E. Woolfork, Educational Psychology (12th Ed.). Boston: Allyn & Bacon.

LAB: (EDS289)
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:
15. Sociometry test
16. Personality testing (16PF)
17. Vineland Social Maturity Scale
18. Rorschach inkblot test
19. Thematic Appreciation Test
20. Color personality Test
21. Any other suitable activities.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
EDS289	APPLIED PSYCHOLOGY	CO1	-	3	-	-	-	-	-	2	2	3	-	-	3
		CO2	-	3	-	-	-	-	1	2	1	3	-	-	3
		CO3	-	3	-	-	-	-	-	3		3	-	-	2
		CO4	-	3	-	-	-	-	-	2	1	2	-	-	3
		CO5	-	3	-	-	-	-	-	2	1	2	-	-	3

Course Title/Code	APPLIED SOCIOLOGY (EDS290)	
Course Type	Allied(Elective)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	• To know and understand about the fundamental concepts of sociology and its applications. • To develop the analytical skills of students about ways in which social processes affect our everyday lives. • To understand the impact of various processes of social change and assess their impact on society. • To understand and analyze the social cultural dynamics that contribute to transformation of Indian reality • To study the various contemporary issues of society. • To develop basic research skills in area of sociology.	
Course Outcomes (COs)		**Mapping**
CO1	Analyze the social cultural dynamics that contribute to transformation of Indian Society	**Skill Development**
CO2	Develop the necessary skills of social processes which affect our everyday lives.	**Skill Development**
CO3	Study and analyse various contemporary issues of society and able to provide solutions of social barrier and benefiting the masses.	**Skill Development**
CO4	Develop basic research skills in the area of sociology and help to find possible solution of specific social barriers of the society	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Introduction and Applications of Sociology:
- Society, Community, Social Institutions, Social Groups, Introduction to Applied Sociology
- Sociology and Social Processes
- Sociology and Social Change
- Sociology and Social Problems
- Clinical Sociology

Section B

Sociological Processes:
- Social Stratification, Social Mobility and their impact on society
- Socialization, Agents of Socialization, Assessing the effects of Socialization
- Social Movements: Concept, Impact of Environmental Movements in India: Chipko Movement, Narmada Bachao Andolan

Section C

Processes and Issues of Social Change:
- Social Change: Westernization, Urbanization, Privatization, Globalization, Sustainable development
- Issues in urban development-Population, poverty, unplanned growth and ecological issues
- Conflict management:
  - Intergroup: Causes, Resolutions
  - Organizational Conflict, Conflict Management and Grievance Handling

Section D

Field Survey & Report Writing:
- Need, Meaning of Survey
- Types of Survey
- Steps in Conducting Survey
- Data Collection Methods
- Salient Features of Report Writing

LAB:
1. Showing Videos on the life and philosophies of Famous sociologists and to acquaint the students about their different theories
2. Preparation of quotation board with the help of displaying the pictures and quotes of famous sociologists
3. Choose a theme of your interest- for e.g., crime, technology environmental concerns or any other and look through the Sunday editorials of any national daily of the last 3 months to locate related articles.
4. Role Play: Gender issues in everyday life, students will form small groups and present skits to address this issue creatively; this will be followed by discussions.
5. Students may be given the assignment of taking pro-active role in initiating social change in a local field
6. Visit a shopping mall and observe the interaction between employees and customers/visitors. Identify themes based on your observation and prepare a questionnaire based on this experience.
7. Look at a set of published letters of Gandhi, Nehru, C.F. Andrews and Tagore etc. and identify key social issues that are discussed in the contents of the letters and prepare a report on it.
8. Students will be asked to write a short essay on the pressures they feel of the experience in performing masculinity or femininity, Presentations and discussions based around the essays.
9. Debate or discussion on "Is the family the site of love and care" or "Is the family democratic?"
10. Discuss the impact of modernization, industrialization and globalization on the day-today life.
11. Students may be asked to apply any applied research technique
12. Design a survey on factors effecting marriage choices of young people.

13. Any other suitable activity

TEXT BOOKS

1. W. Andrew, Introduction to the Sociology of Development. New Jersey, Palgrave Macmillan.
2. L. B. Berg, Qualitative Research Methods for the Social Sciences (4th edition). Boston: Allyn and Bacon
3. H. Bhatia, Elements of Social Psychology. Bombay: Somaiyya Publications Pvt Ltd.
4. Dastupta Driskle, Discourse on Applied Sociology Volume-II, 2007
5. B. Desai, Human Development in India: Challenges for a Society in Transition. OUP
6. S. Deshpande, Contemporary India: A Sociological View. New Delhi: Viking.
7. R. H. Hall *Organizational Structures, Processes & outcomes, Asia*: Pearson Education Publications.
8. R. M. Hodegetts *Organizational Behavior*, Macmillan.

REFERENCE BOOKS

1. P. Mc Michael, Development and Social change: A global perspective. California Thousand Oaks.
2. R. Merton, Nisbet, Contemporary Social Problems, New York: Harcourt, Brace and World.
3. S. Metha, Women and Social Change, Jaipur: Sage.
4. E. Michael, Civil Society in India, edited The Oxford Handbook of Civil Society, Oxford, Oxford University Press
5. Mitra, Democracy, Agency and Social Change in India, New Delhi: Sage
6. H. F. Pratt, Outline of Applied Sociology, 2009
7. R. T. Schaefer, Sociology a Brief Introduction, (5thed.) New York: McGraw-Hill Inc..
8. M. Sirclaus, G. Kalton, Survey Methods in Social Investigation, Heinemann Educational Books, London.
9. Sanderson, Social Psychology, New York: John Wiley.
10. L. Tepperman, L. J. Curtis, Principles of Sociology: Canadian perspectives. Don Mills, ON: Oxford University Press.
11. K. Young, Handbook of Social Psychology, London: Routledge and Kegal Paul Ltd.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
EDS290	APPLIED SOCIOLOGY	CO1	-	2	-	-	-	-	-	-	-	-	-	-	-
		CO2	-	3	-	-	-	2	-	-	1	-	-	-	-
		CO3	-	-	-	-	-	-	-	3	1	-	-	-	-
		CO4	-	-	-	-	-	2	-	-	-	2	-	-	2

Course Title/Code	BASICS OF ECONOMICS (MCS231)	
Course Type	Allied(Elective)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To equip the students with the knowledge of economics to solve related applications	
Course Outcomes (COs)		Mapping
CO1	To comprehend the economic problems of the society.	**Skill Development**
CO2	To enlighten the laws of utility, demand and supply and their measurement.	**Skill Development**
CO3	To explain the laws of production and various concepts of costs.	**Skill Development**
CO4	To elaborate the various market forms and the nature and characteristics of Indian economy	**Skill Development**
Prerequisites (if any)	**N.A**	

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. P.N. Chopra, Principles of Economics, Kalyani Publishers.

2. T R Jain & O P Khanna, Economics for Engineers.
3. M.L. Jhingan, Micro Economic Theory, S.Chand.
4. H.L. Ahuja, Micro Economic Theory, S.Chand.

REFERENCE BOOKS

1. S.K. Mishra Modern Micro Economics, Pragati Publications.
2. A.B.N. Kulkarni & A.B. Kalkundrikar, Economic Theory, R.Chand & Co.
3. Rudar Dutt & K.P.M. Sundhram, Indian Economy.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MCS231	BASICS OF ECONOMICS	CO1	-	-	1	1	-	-	-	1	1	1	1	1	1
		CO2	-	-	1	2	-	-	-	1	2	1	2	-	1
		CO3	-	-	1	2	-	-	-	1	1	1	1	-	1
		CO4	-	-	1	2	-	-	-	1	2	1	2	-	1

Course Title/Code	INTRODUCTION TO FINANCE (MCS232)	
Course Type	Allied(Elective)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective		
	Course Outcomes (COs)	**Mapping**
CO1	To take an overview of Financial management and its need to take financial decisions.	**Skill Development**
CO2	To understand financial statements and distinguishes between profit & loss and Balance sheet of different business organizations.	**Skill Development**
CO3	To identify the different sources of long term finance and differentiate amongst equity, preference and Debt	**Skill Development**
CO4	To elaborate and apply various techniques of capital budgeting and analyse cost of capital and capital structure	**Skill Development**
Prerequisites (if any)	**N.A**	

SECTION-A

Introduction to Finance ; Forms of Business Organization ; Overview to financial statements , Balance Sheet, Profit and Loss Account , Cash Flow Statement.

SECTION-B

Financial Analysis and Planning; Financial Ratios, Break Even Analysis Sources of Long term Finance – Equity Capital, Preference Capital, Terms Loans, Debentures; Raising Long term Finance.

SECTION-C

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

SECTION-D

Working Capital: Introduction, Components of Current Assets and Current Liabilities, Operating Cycle, Estimation of Working Capital; Operating Income , Earning Before Interest and Tax (EBIT).

TEXT BOOKS

1. Arthur J. Keown, Martin, D. John, J. William Petty, David F. Scott, Financial Management, Pearson Education
2. Prasanna Chandra, Financial Management, TMH, New Delhi
3. James C. Van Horne, Financial Management and Policy, Prentice Hall of India
4. Brigham, Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.

REFERENCE BOOKS

1. R. Kishore, Financial Management, Taxman's Publishing House, New Delhi
2. I. M. Pandy, Financial Management, Vikas Publishing House, New Delhi
3. M.Y. Khan, P. K. Jain, Financial Management, Tata McGraw Hill, New Delhi

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MCS232	INTRODUCTION TO FINANCE	CO1	-	-	1	1	-	-	-	1	1	1	1	1	1
		CO2	-	-	1	2	-	-	-	1	2	1	2	-	1
		CO3	-	-	1	2	-	-	-	1	1	1	1	-	1
		CO4	-	-	1	2	-	-	-	1	2	1	2	-	1

Course Title/Code	QUANTITATIVE APTITUDE - I (CDO203)	
Course Type	Elective (Allied)	
L-T-P Structure	2-0-0	
Credits	**2**	
Course Objective	To prepare students with the concepts of quantitative techniques required in aptitude test of various competitive exams & placements.	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to analyze various forms of data	**Skill Development**
CO2	Students will be able to solve complex problems based on arithmetic reasoning.	**Skill Development**
CO3	Students will be able to apply short tricks on complex problems of number system.	**Skill Development**
Prerequisites (if any)	**N.A**	

Unit 1: Number System

1.1   Simplification

    1.1.1   BODMAS rule
    1.1.2   Fractions and recurring decimals
    1.1.3   Surds and indices

1.2   Numbers
    1.2.1   Types of numbers and number tree
    1.2.2   Divisibility Rule
    1.2.3   HCF & LCM
Unit 2: Arithmetic I
2.1   Percentages
2.2   Ratio & Proportion
    2.2.1   Proportionality
    2.2.2   Variations
    2.2.3   Partnership
2.3   Profit & Loss

4.5   Direction Sense Test

Text Books/Reference Books:
1.   Quantitative Aptitude for Competitive Examinations: R S Aggarwal, S Chand & Company Pvt Ltd, Edition 2017
2.   A Modern Approach to Verbal & Non Verbal Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd, Edition 2018

Instructions for paper setting: Fifty MCQ will be set in total. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

TEXTBOOKS
1. Quantitative Aptitude for Competitive Examinations: R S Aggarwal, S Chand & Company Pvt Ltd, Edition 2017

REFERENCE BOOKS
1. A Modern Approach to Verbal & Non Verbal Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd, Edition 2018

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO203	QUANTITATIVE APTITUDE - I	CO1	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO2	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO3	1	2	3	-	-	-	-	-	-	-	-	-	3

Course Title/Code	MINI PROJECT –I(MAN209B)	
Course Type	Core (Deptt./Allied)/Elective (Deptt./Allied)/Audit	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To develop the research acumen.	
Course Outcomes (COs)		**Mapping**
CO1	The student shall be able to describe research and its impact.	**Skill Development**
CO2	The student shall be able to identify broad area of research & analyze the processes and procedures to carry out research.	**Skill Development**
CO3	The student shall be able to use different tools for literature survey	**Skill Development**
CO4	The student is able choose specific area/problem of research	**Skill Development**
CO5	To understand and adopt the ethical practice that is to be followed in the research activities	**Skill Development**
CO6	To prepare a draft of review/ research article.	**Skill Development**
Prerequisites (if any)	**N.A**	

Unit 1: What is Research and its impact?

1.1 Capturing the current research trends

1.2 Insight about scientific research performed by renowned experts in the related field (case studies)

1.3 Do's and Don'ts pertaining to research

Unit 2: Identification of Broad Area of research

2.1 Identification of thrust area of research for deciding broad area

2.2 Framing the research questions and hypothesis

2.3 Identification of the research gap based on feasibility of problem

2.4 Exploration of in-house and commercially available facilities related to broad area

Unit 3: Understanding the tools for Literature Survey

3.1 Finding research papers related to a topic

3.2 Understanding the different aspects of Literature search

3.3 Usage of different sources like Google scholar, WoS, SCI/ SCIE, PubMed, Scopus.

3.4 Search for online journals relevant to research area

3.5 Indexing of Journals

3.6 Usage of scholarly networking sites like Research Gate, Mendeley, and Academia.edu etc.

3.6 Demo sessions on the usage of above mentioned sources

Unit 4: Review of research papers pertaining to broad area and specific area of research

4.1 Selection of relevant papers

4.2 Finding specific research problem from broad area of research

4.3 Literature survey and justification of specific research problem

4.4 Experimentation and data cleaning and verification

4.5 Understanding and selection of the research domain

4.6 Seeking information through published work w.r.t the problem

4.7 Reading & categorizing the downloaded/referred papers and structuring of the idea

4.8 Model design about framing the research questions

Unit 5: Report Writing and Presentation skill Development

5.1 Report making on the surveyed literature to cater the basic idea of the research papers

5.2 Compiling and analyzing the published results to justify and understand the proposed ideas

5.3 Usage of MS-PowerPoint and other technical resources for the presentation

5.4 Development of presentation skills and group addressing

5.5 Scientific/technical writing and ethical practice, project report

Stages	Time line	Weightage	Conditions
Stage 1	4 weeks (PT1)	25% (25 MARKS)	Students shall be required to provide: 1. Background information of project work.

Stage 2	8Weeks (PT2)	25% (25 MARKS)	Students shall be required to provide: 1. Initial results and further work required to complete the objectives.
Pre-Project report	12 Weeks	On satisfactory recommendation of concerned faculty members students will be allowed for final evaluation (stage 3)	
Stage 3	At the end of semester (PT3)	50% (50 MARKS)	Evaluation will be based on following components: 1. Submission of Project report 2. Viva- Examination (By External Examiner)

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAN209B	MINI PROJECT –I	CO1	-	-	-	-	3	-	-	-	-	-	-	-	-
		CO2	2	-	2	2	3	-	--	-	2	-	2	2	-
		CO3	-	-	-	-	2	3	-	-	-	-	-	-	-
		CO4	2	-	2	2	3	-	-	-	-	-	2	2	-
		CO5	-	-	-	-	-	-	-	3	-	2	-	-	-
		CO6	-	3	-	-	-	-	-	-	2	2	2	2	-

Course Title/Code	FRENCH-I(FLS103)	
Course Type	Audit (University Compulsory)	
L-T-P Structure	1-1-0	
Credits	2	
Course Objective	Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi	
Course Outcomes (COs)		Mapping
CO1	Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.	**Skill Development**
CO2	Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes.	**Skill Development**
CO3	Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.	**Skill Development**
CO4	Students will be able to understand audio text and comprehend to the same. They will be able to form paragraph using auxilary verb and basic verbs.	**Skill Development**
CO5	Students will be introduced to French culture and civilization. They will be able to describe various places and locations of Francophonic countries.	**Skill Development**
Prerequisites (if any)	**N.A**	

SECTION-A

Unit - Saluer et épeler l'alphabet
1.1 Les Salutations & forms of politeness
1.2 Alphabets
Unit 2- Usage de Vous et de Tu
2.1 Taking leave expressions
2.2 Les pronoms sujets
2.3 Basic Questions

SECTION-B

Unit 3- Présentez-vous
3.1 Les verbes ER
3.2 Self introduction

3.3 Décrivez votre ami(e)

<div align="center">**SECTION-C**</div>

Unit 4- Identifier un nombre, compter
4.1 Les noms
4.2 Verbes Avoir, Etre, Aller & Faire
4.3 Les nombres
Unit 5- Demander/ donner l'explications
5.1 Les articles define et indefini
5.2 Les mois de l'annee
5.3 Les jours de la semaine

<div align="center">**SECTION-D**</div>

Unit 6- Parler des saisons et demander l'heure
6.1 Time
6.2 Weather
6.3 Unseen Passage

<div align="center">**TEXTBOOKS**</div>

1. Alter Ego Level One Textbook, Annie Berthet, Catherine Hugot, Hachette Publications

<div align="center">**REFERENCE BOOKS**</div>

1. Apprenons Le Francais II & III, Mahitha Ranjit, 2017, Saraswati Publications

<div align="center">**e-Resources (websites/Wikipedia pages/webtutorials/online courses, etc.)**</div>

- www.bonjourfrance.com
- www.allabout.com

<div align="center">**CO-PO Mapping**</div>

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
FLS103	FRENCH-I	CO1	-	3	-	-	-	-	1	3	2	1	-	-	
		CO2	1	3	1	-	1	-	1	-	1	-	-	1	
		CO3	2	3	2	-	2	-	3	-	1	-	-	1	-
		CO4	2	3	-	-	1	-	2	-	-	-	-	1	
		CO5	1	1	-	-	2	-	1	2	2	-	-	-	

Course Title/Code	SPANISH-I(FLS101)	
Course Type	Audit (University Compulsory)	
L-T-P Structure	1-1-0	
Credits	2	
Course Objective	Exchange greetings and do introductions using formal and informal expressions, Understand and use interrogative and answer simple questions, Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed	
Course Outcomes (COs)		Mapping
CO1	Students will be able to exchange greetings and introductions using formal and informal expressions and students will be able to ask and answer simple questions.	**Skill Development**
CO2	Students will be able to discuss everyday life and daily routines, using simple sentences and familiar vocabulary and students will be able to discuss likes and dislikes understand simple conversations about familiar topics.	**Skill Development**
CO3	Students will be able to identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed and students will be able to offer basic descriptions of self, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.	**Skill Development**
CO4	Students will be able to provide basic information about familiar situations and topics of interest and students will be able to express or/and justify opinions using equivalents of different verbs.	**Skill Development**
Prerequisites (if any)	**N.A**	

SECTION-A

Unit 1: Introduction to Spanish and SER
1.1 Presentation on Spanish language
1.2 Greetings and goodbyes
1.3 Spanish letters
1.4 Introduction of verbo SER
Unit 2: Verb Ser, Nationality, Profession and Counting
2.1 Uses of verbo SER

2.2 Adjectives related to verbo SER.
2.3 Introduction of Nationality
2.4 Professions and vocabulary related to professions.
2.5 Counting till number 20.

<div align="center">**SECTION-B**</div>

Unit 3: Articles, Interrogative and Estar
3.1 Introduction of Articles and Indefinite articles
3.2 Interrogatives
3.3 Introduction of Verbo Estar

<div align="center">**SECTION-C**</div>

Unit 4: Estar, Preposition, Tener and Self Introduction
4.1 Uses of Verbo ESTAR and adjectives related to it
4.2 Introducton of 'my house' vocabulary
4.3 Prepositions related to the positioning of an object
4.4 Self – introduction

<div align="center">**SECTION-D**</div>

 Unit 5 : Day, Month and Regular AR verb
5.1 Days
5.2 Months
5.3 Introduction to regular –AR verbs
Text Books/Reference Books:
   1. ¡Ole!-Langers
   2. ¡Uno, dos, tres…………
Weblinks:
http://studyspanish.com/

<div align="center">**CO-PO Mapping**</div>

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
FLS101	SPANISH-I	CO1	-	3	-	-	-	-	1	3	2	1	-	-	-
		CO2	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO3	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO4	1	1	-	-	2	-	1	2	2	-	-	-	-

Course Title/Code	GERMAN-I(FLS102)	
Course Type	Audit (University Compulsory)	
L-T-P Structure	1-1-0	
Credits	2	
Course Objective	Exchange greetings and do introductions using formal and informal expressions, Understand and use interrogative and answer simple questions, Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed	
Course Outcomes (COs)		Mapping
CO1	Students will be able to know the living standard of Germany and can learn the comparison with their native country like the types of houses Germans have and the type of houses they have in their country.	**Skill Development**
CO2	Students will be able to identify belongingness of the objects like what belongs to them	**Skill Development**

	or what belongs to someone else.	
CO3	Students will be able to describe their daily routine in German language. They will be able to learn timings as well.	**Skill Development**
CO4	Students will be able to learn informal letter writing like they can mention their daily routine to their friend.	**Skill Development**
Prerequisites (if any)	**N.A**	

SECTION-A

Unit-1: Begrüßungen
1.1 Salutations/Greetings
1.2 Introduction
Unit-2: sich vorstellen und Zahlen
2.1 Introduction
2.2 Alphabets
2.3 Numbers 1-20

SECTION-B

Unit-3: Berufe/ Pronomen
3.1 Personal pronouns
3.2 Hobbies and professions

SECTION-C

Unit-4: Café
4.1 Café related vocabulary and dialogues
4.2 Revision personal pronouns
Unit-5: Café dialog
5.1 Café related vocabulary and dialogues
5.2 Common verbs and their conjugations

SECTION-D

Unit-6: Zeit und Monate
6.1 Time
6.2 Days
6.3 Months

TEXTBOOKS

1. Studio D A1, Hermann Funk, 2011, Cornelson Publication

2. Tangaram Aktuell A1, Kursbuch & Arbeitsbuch, 2011, Hueber

REFERENCE BOOKS

1. Netzwerk, Stefanie Dengler, Paul Rusch et. Al, 2011, Klett

e-Resources (websites/Wikipedia pages/webtutorials/online courses, etc.)

- http://www.nthuleen.com/

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
FLS102	GERMAN-I	CO1	-	3	-	-	-	-	1	3	2	1	-	-	-
		CO2	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO3	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO4	1	1	-	-	2	-	1	2	2	-	-	-	-

MAU-01- 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
MAH210B	ADVANCED ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH211B	ADVANCED ALGEBRA	MA	HARD	CORE	3	1	0	0	4	4
MAH212B	MECHANICS-I	MA	HARD	CORE	3	1	0	0	4	4
MAH213B	INTEGRAL TRANSFORMS & APPLICATION	MA	HARD	CORE	3	1	0	0	4	4
MAH214B	SET THEORY & NUMBER THEORY	MA			3	1	0	0	4	
CSH210B-T	DATA STRUCTURES	CS	HARD	CORE	3	0	0	0	5	4
CSH210B-P	DATA STRUCTURES LAB				0	0	2	0		
MAH215B	ACTUARIAL STATISTICS	MA			3	1	0	0	4	
MAH216B	SURVEY SAMPLING & INDIAN OFFICIAL STATISTICS	MA			3	1	0	0	4	
CHS234/ ECS249/LWS 323 CDO204/ MAN218B	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT/ E-WASTE: ENVIRONMENTAL PROBLEMS AND MANAGEMENT /CYBER CRIMES & LAWS/ QUANTITATIVE APTITUDE II/ MINI PROJECT-II	CH/EC/ CDC/LW /MA	Soft	ELECTIVE (Any one)	1	0	2	0	0	2
CDO205	CAREER SKILLS-I	CDC	SOFT	AP/AF	3	0	0	0	2	0
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					15	4 OR 5	2 OR 4	0	23 OR 24	22

Course Title/Code	ADVANCED ANALYSIS (MAH210B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	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.	
Course Outcomes (COs)		**Mapping**
CO1	Apply the concepts of Riemann Integrals to evaluate definite integrals.	**Skill Development**
CO2	apply various techniques to evaluate different kinds of Improper integrals.	**Skill Development**
CO3	Explain different kinds of functions of complex variables and apply them for solving mathematical problems.	**Skill Development**
CO4	Demonstrate and apply the concept of analytic functions for solving mathematical problems.	**Skill Development**
Prerequisites (if any)	Real Analysis(MAH204B)	

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.

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.

Section C

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.

Section D

L'Hospital's Rule Taylor's and Maclaurin's Series, Singular points. Line integral, Cauchy's theorem , Green's theorem, Morrera's theorem Cauchy's integral formula, Poles and residue's, Cauchy's residue theorem, Evaluation of integrals using Residue theorem.

TEXTBOOKS

1. W. Rudin- Principles of Mathematical Analysis - Mc. Graw Hill Int .Edition (3rd)
2. C. C. Pugh, Real Mathematical Analysis- Springer Verlag, Ny. Inc.

REFERENCE BOOKS

1. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International (P).
2. J. W. Brown and R. V. Churchill, Complex variable and Application.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PO13
MAH210B	ADVANCED ANALYSIS	CO1	3	3	3	3	-	1	2	-	2	-	-	-	-
		CO2	3	3	3	3	-	1	2	-	2	-	-	-	-
		CO3	3	3	3	3	-	-	2	-	2	-	-	-	-
		CO4	3	3	3	3	-	-	2	-	2	-	-	-	-

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Course Title/Code	ADVANCED ALGEBRA(MAH211B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concepts of advanced group theory and ring structure with their properties.	
Course Outcomes (COs)		Mapping
CO1	Recognize and apply the Sylow theorems to characterize certain finite groups.	Skill Development
CO2	Understand & Apply the fundamental concepts of ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.	Skill Development
CO3	Learn in detail about Ring homomorphism, polynomial rings and their applications.	Skill Development
CO4	Understand Fundamental properties of finite field extensions and classification of finite fields useful in advanced mathematical theories	Skill Development
Prerequisites (if any)	GROUP THEORY(MAH206B)	

Section A

Sylow Theorems: Cauchy's theorem for finite abelian groups, Finite simple groups, Sylow theorems andapplications including nonsimplicity tests.

Section B

Rings: Definition, examples and elementary properties of rings, Commutative rings, Integraldomain, Division rings and fields, Characteristic of a ring, Ideals and quotient rings. Prime, principal and maximal ideals, Relation between integral domain and field.

Section C

Ring Homomorphism &Polynomial Rings: Homomorphism of rings, Fundamental theorem on Homomorphismof rings. Euclidean rings and their properties, Wilson and Fermat'stheorems.

Polynomial rings over commutative ring and their basic properties,The division algorithm; Polynomial rings over rational field, Gauss lemma and Eisenstein's criterion.

Section D

Integral Domains & Fields: Euclideandomain, principal ideal domain, and unique factorization domain.
Fields, Extension of a field, Algebraic element of a field, Algebraic and transcendental numbers, Perfect field, Classification of finite fields.

TEXTBOOKS

1. David S. Dummit & Richard M. Foote (2008). Abstract Algebra (2nd edition). Wiley.
2. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage.
3. I. N. Herstein (2006). Topics in Algebra (2nd edition). Wiley India.
4. Michael Artin (2014). Algebra (2nd edition). Pearson.

REFERENCE BOOKS

1. P. B. Bhattacharya, S. K. Jain & S. R. Nagpaul (2003). Basic Abstract Algebra (2ndedition). Cambridge University Press.
2. I. S. Luthar & I. B. S. Passi (2013). Algebra: Volume 1: Groups. Narosa.
3. I. S. Luthar & I. B. S. Passi (2012). Algebra: Volume 2: Rings. Narosa.
4. V. K Khanna and S. K Bhambari, A Course In Abstract Algebra, Vikash Publishing

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH211B	Advanced Algebra	CO1	3	2	3	-	2	-	2	-	2	-	-	-	-
		CO2	3	2	3	-	2	-	2	-	2	-	-	-	-
		CO3	3	2	3	-	2	-	2	-	2	-	-	-	-
		CO4	3	2	3	-	2	-	2	-	2	-	-	-	-

Course Title/Code	MECHANICS-I(MAH212B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	The students would be able to apply the concepts of Statics required for solving the mathematical problems and their applications.	
Course Outcomes (COs)		**Mapping**
CO1	Understand the concept and basic terms of Mechanics, Composition and resolution of forces. Parallel forces. Moments and Couples.	**Skill Development**
CO2	Derive the mathematical solutions of all theorems / formulas of all topics in a clear and concise manner.	**Skill Development**
CO3	Explain and solve analytical conditions of equilibrium of coplanar forces, Friction, Centre of Mass and Centre of Gravity, Virtual work, Forces in three dimensions and Poinsots central axis.	**Skill Development**
CO4	Determine and apply mathematical equation of Wrenches, Null lines and planes. Stable and unstable equilibrium and solve the problems.	**Skill Development**
Prerequisites (if any)	**N.A**	

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.

TEXTBOOKS

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

REFERENCE BOOKS

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

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH212B	MECHANICS-I	CO1	3	2	3	3	-	-	2	2	2	2	2	1	2
		CO2	3	3	3	2	-	-	2	2	1	1	2	2	1
		CO3	3	2	2	2	-	-	2	1	1	2	1	2	2
		CO4	2	3	1	2	-	-	1	2	1	2	2	1	1

Course Title/Code	INTEGRAL TRANSFORMS & APPLICATION(MAH213B)	
Course Type	CORE(DEPARTMENTAL)	
L-T-P Structure	3-1-2	
Credits	4	
Course Objective	To equip the student with notion of Laplace transforms, Fourier transforms and Z-transforms and their applications.	
Course Outcomes (COs)		**Mapping**
CO1	Calculate the Laplace and Inverse Laplace transforms and apply the same to solve differential and integral equations.	**Skill Development**
CO2	Find the Fourier series expansion of a function.	**Skill Development**
CO3	Compute the Fourier and Inverse Fourier transforms and apply the same to solve differential and integral equations.	**Skill Development**
CO4	Compute Z-Transform and Inverse Z-Transform and apply the same to solve differential and integral equations.	**Skill Development**
Prerequisites (if any)	**N.A**	

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 , 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,

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. Application of Fourier transforms in initial and boundary value problem.

Section D

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

INTEGRAL TRANSFORMS & APPLICATION LAB (MAH341-P):

Objective: Mini Project encourage students to explore and strengthen the understanding of subject through practical application of theoretical concepts. It also helps students to boost their skills and widen their horizon of thinking.
Students are required to identify the topics for project work related with applications of Integral Transforms and Applications.
Students can work individually or in a group of 2 & 3. Some suggested topics for mini project are; Application of Laplace transforms, Application of Fourier Series, Application of Fourier transforms, Application of Z transforms…etc

TEXTBOOKS

1. Higher Engineering Mathematics: B. S. Grewal

REFERENCE BOOKS

1. Advanced Engineering Mathematics: Jain and Iyenger

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH213B	INTEGRAL TRANSFORMS & APPLICATION	CO1	3	3	2	3	1	1	2	-	2	1	1	-	-
		CO2	3	3	2	2	1	2	2	-	2	1	1	-	-
		CO3	3	2	2	3	1	1	2	-	2	1	1	-	-
		CO4	3	1	2	3	1	1	2	-	2	1	1	-	-

Course Title/Code	SET THEORY AND NUMBER THEORY (MAH214B)	
Course Type	Elective(Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the student the concept of set, set operation, cartesian products of sets, cardinality of set, relation, the basic structure and properties of integers.	
Course Outcomes (COs)		**Mapping**
CO1	Apply the concept of set and relation on pure and applied mathematics.	**Skill Development**
CO2	Prove results involving divisibility and greatest common divisors	**Skill Development**
CO3	Find integral solutions to specified linear Diophantine Equations.	**Skill Development**
CO4	Apply Euler-Fermat's Theorem to prove relations involving prime numbers.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section-A

Cartesian products of sets, equivalence relations and partition, fundamental theorem ofequivalence relation, equivalent set, countable sets and uncountable sets, cantor's theoremCardinal numbers, power of continuum, cardinal arithmetic, inequalities in cardinals,Schoeder-Bernstein theorem, partially and totally ordered sets.

Section-B

Linear Diophantine equation, prime counting function, statement of prime numbertheorem, Goldbach conjecture, linear congruencies, complete set of residues, Algebraiccongruencies Chinese Remainder theorem, Fermat's Little theorem, Lagrange theorem,Wilson's theorem.

Section-D

Number theoretic functions, sum and number of divisors, totally multiplicative functions,definition and properties of the Dirichlet product, the Mobius Inversion formula, thegreatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues,some properties of Euler's phi-function.

Section-D

Order of an integer modulo n, primitive roots for primes, composite numbers havingprimitive roots, Euler's criterion, the Legendre symbol and its properties, quadraticreciprocity, quadratic congruencies with composite moduli. Fibonacci Numbers, sequences and Fibonacci Identities, Pell number.

TEXTBOOKS

1. David M. Burton: Elementary Number Theory, 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.

REFERENCE BOOKS

1. U. Dudley: Elementary Number Theory , Dover Publication.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH214B	SET THEORY AND NUMBER THEORY	CO1	3	3	2	3	2	1	2	-	2	1	2	-	-
		CO2	3	3	3	3	2	2	2	-	2	1	2	-	-
		CO3	3	2	3	2	1	1	2	-	2	1	1	-	-
		CO4	3	2	3	2	1	-	2	-	2	1	1	-	-

Course Title/Code	DATA STRUCTURES (CSH210 B- T & P)	
Course Type	Core (Allied)	
L-T-P Structure	3-0-2	
Credits	4	
Course Objective	The course should assess how the choice of data structures and algorithm design methods impacts the performance of programs and choose the appropriate data structure and algorithm design method for a specified application.	
Course Outcomes (COs)		Mapping
CO1	Tounderstand the concept of Dynamic memory management, algorithms and their complexity ; demonstrate the abstract properties and operations of Linear data structures (using Static Memory Allocation) : Array ; To apply different Searching and Sorting algorithms.	**Skill Development**
CO2	Demonstrate the abstract properties and operations of Linear data structures (using Dynamic Memory Allocation) : Link List and variations of Linked List.	**Skill Development**
CO3	Demonstrate the abstract properties and operations of Linear data structures (using Static & Dynamic Memory Allocation) : Stacks, Queues	**Skill Development**
CO4	Demonstrate the abstract properties and operations of Non Linear data structures (using Static & Dynamic Memory Allocation) : Trees, Graphs	**Skill Development**
Prerequisites (if any)	**N.A**	

Section-A

Data structures and Algorithms: Introduction to Data structure: Concept of data structure, choice of right data structures, types of data structures, Introduction to algorithms, how to design and develop an algorithm: stepwise refinement, algorithm analysis, complexity of algorithms

Arrays: Introduction, One Dimensional Arrays, two dimensional array, address calculation of a location in arrays operations defined: traversal, selection, searching, insertion, deletion, Searching: linear search, binary search, Sorting: selection sort, bubble sort, insertion sort

Section-B

Pointers: Introduction to pointers, Pointer variables, Pointer and arrays, array of pointers, pointers and structures, Dynamic allocation. Linked Lists: Concept of a linked list, operations on Singly linked lists: traversal, selection, searching, insertion, deletion, and sorting, overview of circular and doubly linked list. Applications of linked lists.

Section-C

Stacks: Introduction to Stacks, array representation of stack, operations on stack: PUSH, POP, Evaluation of Expression: Concept of precedence and associatively in expressions, Resolving precedence of operators and association of operands, postfix & prefix expressions, conversion of expression from one form to other form using stack (with & without parenthesis),Recursion, Linked list representation of stack, Applications of stacks. Queues: Queues, array representation of Queues, operations on queue: insertion and deletion, Linked list representation of queue, Overview of priority queue, circular and dequeue, Applications of Queues.

Section-D

Non-Linear Structures: Trees definition, characteristics concept of child, sibling, parent child relationship etc, binary tree: different types of binary trees based on distribution of nodes, operation on binary tree: insertion, deletion, searching and traversal, traversing: Preorder, Postorder and Inorder,Introduction to binary search tree, operations on BST: insertion, deletion, searching, Application of trees.
Graphs: Definition, Relation between tree & graph, directed and undirected graph, connected and disconnected graph, Depth first and breadth first traversal of graphs, Applications of Graph.

List of Experiments:

1. Programs on C language
2. Write a program on Linear search and Binary search Using C
3. Write a program to implement bubble sort, insertion sort, selection sort
4. Programs on Link list
5. Programs on stack
6. Programs on queues
7. Programs on binary trees
   - Traversal
   - Insertion

TEXT BOOKS

1. Data Structures with C by Seymour Lipschutz ,McGraw Hill Education(India) Private Limited.
2. Data Structures using C by A. K. Sharma, Pearson Publication.
3. Data Structures using C-Yashwant Kanetkar Publication.

REFERENCE BOOKS

4. Data Structures using C by A. M. Tenenbaum, Langsam, Moshe J. Augentem, PHI Pub.
5. Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman Publisher.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CSH210 B- T & P	DATA STRUCTURES	CO1	3	3	2	2	1	2	1	1	1	1	1	1	2
		CO2	3	3	2	2	1	2	1	1	1	1	1	1	1
		CO3	3	3	2	2	1	2	1	1	1	1	1	1	1
		CO4	3	3	2	2	1	2	1	1	1	1	1	1	-

Course Title/Code	ACTUARIAL STATISTICS (MAH215B)	
Course Type	Elective(Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip students with theoretical and practical knowledge, develop and apply techniques of mathematics, statistics, probability and finance to solving real business problems.	
Course Outcomes (COs)		**Mapping**
CO1	understand the role of statistical principles and their application in actuarial science	**Skill Development**
CO2	Demonstrate the necessary analytical skills for interpreting and analyzing actuarial and statistical information	**Skill Development**
CO3	Justify and communicate the necessary management skills for dealing with organizations, teams and policy issues, so as to be able to work independently and collaboratively to collect, process, interpret and communicate the outcomes of actuarial and statistical problems	**Skill Development**
CO4	Demonstrate the skills necessary to critically engage with and evaluate actuarial and statistical problems	**Skill Development**
Prerequisites (if any)	Statistics I(MAH111B)	

Section - A

Distribution and order statistics: Chebyshev's inequality, W.L.L.N,S.L.L.N and their applications, De-Moivre Laplace theorem, Central Limit Theorem for i.i.d variates – statement and application, Distribution of rth order statistics, Joint distribution of rth and sth order statistics, distribution of sample median and sample range.

Section - B

Data analysis: Exploratory data analysis, Principal Components Analysis, Random sampling and sampling distributions.

Section - C

Estimation: Concepts of estimation, estimators, efficiency, bias and mean square error of estimators, asymptotic distribution, Confidence intervals, Hypothesis testing and goodness of fit.

Section – D

Regression theory and applications: Linear regression, Generalized linear models, Bayesian statistics, multiple linear regression models, Pearson's chi-square test and likelihood ratio test.

TEXTBOOKS

1. D.S Borowiak: Financial and Actuarial Statistics,CRC Press Taylor and Francis Group

REFERENCE BOOKS

1. P.J Boland: Statistical and Probabilistic Methods in Actuarial Science, CRC Publications.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH215B	ACTUARIAL STATISTICS	CO1	1	2	3	2	3	2	2	1	1	2	2	1	1
		CO2	1	2	3	2	3	2	2	1	1	2	2	1	1
		CO3	2	2	3	2	3	2	2	1	1	2	2	1	1
		CO4	2	2	3	2	3	2	2	1	1	2	2	1	1

Course Title/Code	SURVEY SAMPLING AND INDIAN OFFICIAL STATISTICS (MAH216B)	
Course Type	Elective(Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To familiarize students with survey sampling theory, techniques and present official statistical system in India.	
Course Outcomes (COs)		**Mapping**
CO1	understand the concept of population and sample and estimate statistical attributes of both like mean, variances etc.	**Skill Development**
CO2	apply Stratified random sampling technique	**Skill Development**
CO3	apply Ratio and regression methods of estimation	**Skill Development**
CO4	understand the methods of collection of official statistics and data handling.	**Skill Development**
Prerequisites (if any)	STATISTICS – I (MAH105B) & STATISTICS – II(MAH202B)	

Section A

Concept of population and sample, complete enumeration versus sampling, sampling and nonsampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination.

Section B

Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision, post stratification and its performance. Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates (N=nxk). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections.

Section C

Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size), variances of these estimates and estimates of these variances, variances in terms of correlation coefficient for regression

method of estimation and their comparison with SRS. Cluster sampling (equal clusters only) estimation of population mean and its variance, comparison (with and without randomly formed clusters). Relative efficiency of cluster sampling with SRS in terms of intra class correlation. Concept of sub sampling

Section D

Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission.Government of India's Principal publications containing data on the topics such as population, industry and finance.

TEXTBOOKS
1. Cochran W.G. (1984):Sampling Techniques(3rd Ed.), Wiley Eastern.
2. Sukhatme,P.V., Sukhatme,B.V. Sukhatme,S. Asok,C.(1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics

REFERENCE BOOKS
1. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.
2. Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House.
3. Goon A.M., Gupta M.K. and Dasgupta B. (2001): Fundamentals of Statistics (Vol.2), World Press.
4. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.

e-Resources (websites/Wikipedia pages/webtutorials/online courses, etc.)
1. http://mospi.nic.in/

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH216B	SURVEY SAMPLING AND INDIAN OFFICIAL STATISTICS	CO1	3	1	2	-	3	-	1	-	3	3	3	2	3
		CO2	3	1	2	-	3	-	1	-	3	3	3	2	3
		CO3	3	1	2	-	3	-	1	-	3	3	3	2	3
		CO4	3	1	2	-	3	-	1	-	3	3	3	2	3

Course Title/Code	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT(CHS234)	
Course Type	Elective (Allied)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	The students would be able to describe, explain and analyses the sustainable development concerns and challenges	
Course Outcomes (COs)		**Mapping**
CO1	Develop an inter-disciplinary understanding of sustainable development concerns and challenges	**Employment**
CO2	propose and implement sustainable solutions to environmental issues (grow oyster mushrooms, develop a composting bin)	**Skill Development**
CO3	understand the concept of sustainability initiatives & sustainability reporting and defend, criticize or compare the sustainability initiatives adopted by different enterprises and initiate a sustainability initiative/develop the sustainability report of the institute	**Skill Development**
CO4	ustify the importance of contemporary issues like consumption, indigenous knowledge, gender issues, population in achieving sustainable development	**Skill Development**
Prerequisites (if any)	**N.A**	

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.

TEXTBOOKS

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

REFERENCE BOOKS

1. Brundtland Commission, 1987, "Our Common Future", Oxford University Press
2. 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.
3. Maternal and Child Undernutrition 1 Maternal and child undernutrition: global and regional exposures and health consequences http://www.who.int/nutrition/topics/Lancetseries_Undernutrition1.pdf.

e-Resources (websites/Wikipedia pages/webtutorials/online courses, etc.)

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

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CHS234	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT	CO1	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO2	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO3	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO4	-	2	-	-	-	-	-	-	2	2	-	-	-

Course Title/Code	E-WASTE: ENVIRONMENTAL PROBLEMS AND MANAGEMENT(ECS306B)	
Course Type	Elective (Allied)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	Gain a better understanding and appreciation for the challenges related to waste management, create awareness about environmental impacts of e-waste and identify various components of e-waste	
Course Outcomes (COs)		**Mapping**
CO1	Appreciate the scale of the e-waste problem and the legal framework for managing e-waste in your geographical or professional context.	**Skill Development**
CO2	Recognize the environmental, health and climate-related risks posed by e- waste as well as the potential value of e-waste.	**Skill Development**
CO3	Develop a project proposal to address an e-waste problem or opportunity that demonstrates some positive impact on environment, health, and climate change	**Skill Development**
CO4	Consider practical actions to take your learning from the course into the real world and help to raise public awareness.	**Skill Development**
Prerequisites (if any)	**N.A**	

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 the establishment of integrated e-waste recycling and treatment facility, Case studies and unique initiatives from around the world.

LAB EXPERIMENTS:
 1. Identify the hazardous materials present in printed circuit boards.
 2. Extraction of copper of printed circuit boards in the etching solution.
 3. Demo of the recycling process through videos.
 4. Extraction of precious metal from e Waste.
 5. Invited guest lecture.
 6. Field visit to a waste management initiative in NCR.
 7. Activity based learning: a survey of the household practice of e-waste disposal and awareness.
 8. Case study – presentation and group discussion.

TEXTBOOKS

 1. Electronic Waste Management, R E Hester, R M Harrison, RSC publishing.

REFERENCE BOOKS

 2. E Waste: Implications, Regulations and Management in India and current global practices, Rakesh Johri, TERI PRESS

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
ECS306B	E-Waste: Environmental Problems and Management	CO1	1	1	3	-	-	-	-	2	2	3	2	1	1
		CO2	1	1	3	-	-	-	-	2	2	3	2	1	1
		CO3	1	1	3	-	-	-	-	2	2	3	2	1	1
		CO4	1	1	3	-	-	-	-	2	2	3	2	1	1

Course Title/Code	QUANTITATIVE APTITUDE-II (CDO204)	
Course Type	Elective(Allied)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	To prepare students with the concepts of quantitative techniques required in aptitude test of various competitive exams & placements.	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to analyze various forms of data	**Skill Development**
CO2	Students will be able to solve complex problems based on arithmetic reasoning.	**Skill Development**
CO3	Students will be able to apply short tricks on complex problems of number system.	**Skill Development**
Prerequisites (if any)	QUANTITATIVE APTITUDE-I (CDO203)	

Unit 1: Number System

    1.1   Factors and Multiples
    1.2   Unit Digits & Cyclicity
    1.3   Remainders
    1.4   Factorials
    1.5   Logarithm

Unit 2: Modern Mathematics

2.1   Permutation and Combination

    2.1.1 Principal of counting and Basic formulas
    2.1.2 Arrangements, Selection and Selection + Arrangement.
    2.1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.

2.2 Probability

    2.2.1 Events and Sample Space, Basic Formulas.
    2.2.2 Problems on Coins, Cards and Dices.
    2.2.3 Conditional Probability, Bayes' Theorem and their Applications.

Unit 3: Data Analytics

3.1 Data Interpretation
    3.1.1 Table and Bar graph
    3.1.2 Line and Pie Charts
    3.1.1 Mixed Charts and Caselets
    3.1.2 Data Sufficiency

Unit 4: Area & Volume

4.1 Mensuration I- Areas

    4.1.1 Different types of Triangles and their area and perimeter.
    4.1.2 Different types of Quadrilateral and their area and perimeter.
    4.1.3 Circumference and Area of Circle, Area of Sector and length of Sector.
    4.1.4 Mixed Figures and their Applications.

4.2 Mensuration II- Surface Areas and Volumes

    4.2.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.
    4.2.2 Prism and Pyramid.
    4.2.3 Mixed Figures and their Applications.

Unit 5: Logical Reasoning
5.1 Seating Arrangement
5.2 Ranking
5.3 Syllogism
5.4 Calendar
5.5 Ages & Numbers

Instructions for paper setting: Fifty MCQ will be set in total. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

TEXTBOOKS

1. R S Aggarwal, Quantitative Aptitude for Competitive Examinations, S Chand & Company Pvt Ltd, Edition 2017

REFERENCE BOOKS

2. R S Aggarwal, A Modern Approach to Verbal & Non Verbal Reasoning, S Chand & Company Pvt Ltd, Edition 2018

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO204	QUANTITATIVE APTITUDE-II	CO1	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO2	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO3	1	2	3	-	-	-	-	-	-	-	-	-	3

Course Title/Code	CYBER CRIMES & LAWS(LWS 323)	
Course Type	Elective(Allied)	
L-T-P Structure	1-1-0	
Credits	2	
Course Objective	To make students understand the concept of Cyber Crimes & Cyber Law and various aspects relating to it, enhance their understanding of problems arising out of online transactions and stimulate them to find solutions, clarify the Intellectual Property issues in the cyber space and the growth and development of the law in this regard, help them understand Information Technology Act, 2000.and Information Technology Amendment Act 2008.	
Course Outcomes (COs)		**Mapping**
CO1	Undertand the concept of Cyber crimes and cyber Law	**Skill Development**
CO2	Critically analyse the problems arising out of online transactions and find solutions	**Skill Development**
CO3	Analyse Intellectual Property issues in the cyber sapace and apply relevant laws to protect or fight infingment	**Skill Development**
CO4	Understand Information Technology Act 2000 and critically analyse various sections to apply such laws appropriately	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Unit 1: Cyber Crimes: Meaning, Categories & Kinds
A. Cyber Crime: Meaning & Categories
B. Nature of Cyber Crime, Cyber Crimes v. Conventional Crimes
C. Kinds of Cyber Crime- hacking, spamming, phishing, cyber stalking, cyber pornography, malware etc.

Section B

Unit 2: Privacy Issues & Access Rights
A. Freedom of speech and expression in Cyberspace.
B. Right to Privacy and Right to Data Protection.
C. Access Rights

Section C

Unit 3: Cyber Space & Legal framework

A. Cyber Security
B. Cyber Space , Concept of Property in Cyber Space
C. Jurisdiction in Cyber Space

Section D

Unit 4: Information and Technology Act 2000 & IT Amendment Act 2008 (Contact Hours - 3)
A. Need of Cyber Law in India
B. Enactment & Scheme of the IT Act
C. Objectives of the IT Act 2000, Amendments to the Act
D. Justice Dispensation System for Cyber Crimes under IT Act

TEXTBOOKS

1. Pavan Duggal, Cyber Law.

REFERENCE BOOKS

1. Sushma Arora & Raman Arora, Cyber Crimes & Laws, Taxmann's

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
LWS 323	CYBER CRIMES & LAWS	CO1	2	1	-	-	-	-	2	-	-	1	-	3	-
		CO2	3	2	-	-	-	-	-	-	2	-	-	1	1
		CO3	3	1	2	-	-	-	-	1	-	-	-	2	1
		CO4	3	1	-	-	-	-	-	-	-	-	-	3	1

Course Title/Code	MINI PROJECT –II(MAN218B)	
Course Type	Elective(Departmental)	
L-T-P Structure	1-0-2	
Credits	2	
Course Objective	The students will be able to critically evaluate the work done by various researchers relevant to the research topic, integrate the relevant theory and practices followed in a logical way and draw appropriate conclusions, understand the research methodologies/approaches/techniques used in the literature and structure and organize the collected information or findings through an appropriate abstract, headings, reference citations and smooth transitions between sections	
Course Outcomes (COs)		**Mapping**
CO1	The students will be able to critically evaluate the work done by various researchers relevant to the research topic	**Skill Development**
CO2	To integrate the relevant theory and practices followed in a logical way and draw appropriate conclusions	**Skill Development**
CO3	To understand the research methodologies/ approaches/ techniques used in the literature	**Skill Development**
CO4	To structure and organize the collected information or findings through an appropriate abstract, headings, reference citations and smooth transitions between sections	**Skill Development**
Prerequisites (if any)	MINI PROJECT – I(MAN209B)	

Unit-1 Literature Survey (LS)/Design of Experiment

1.1 Collection of research papers related to previously identified gap/problem (15 papers or more)
1.2 Comprehend and arrange the literature based on the idea framed
1.3 Presenting the collected data and inferring it with the further scope of expansion and Designing the experiment wherever applicable.

Unit-2 Structuring of Review Paper and setting up of experimental facility

2.1 Analysis of different approach/methodology adopted by various researchers
2.2 Listing out the components of the paper/ setting up experimental facility w.r.t the problem
2.3 Identification of suitable Journal or Conference

2.4 Formatting/Styling the paper according to the respective template

Unit-3 Planning of experiments

3.1 Formulate experimental procedures with Modification of the experimental set-up, if required
3.2 Procurement of materials

Unit-4 Execution of experiments/simulations

4.1 Conduct experiments/ build prototype
4.2 Tabulating and recording data
4.3 Analysis and interpretation of the data
4.4 Comparison of the results with other reported experiments
4.5 Interpretation of observations
4.6 Integration of relevant theory, findings in a structured way and draw appropriate conclusions

Unit-5 Departmental Presentation

5.2 Structuring and preparation of PPT
5.3 Mock presentation
5.4 Review on presentation skills and content delivered both
5.5 Incorporating the review comments in the slides

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAN218B	MINI PROJECT –II	CO1	2	-	2	-	3	-	-	1	2	2	2	2	-
		CO2	2	-	2	-	3	2	2	-	2	-	-	-	-
		CO3	-	2	-	-	3	2	2	-	2	2	2	2	-
		CO4	-	2	-	-	3	-	-	-	2	2	2	2	-

Course Title/Code	CAREER SKILLS –I(CDO205)	
Course Type	Elective (Allied)	
L-T-P Structure	**3-0-0**	
Credits	**0**	
Course Objective	To equip the students with the concepts of Permutation, combination, probability, verbal and non verbal reasoning.	
Course Outcomes (COs)		**Mapping**
CO1	To improve students basic knowledge about Arithmetic Aptitude	**Skill Development**
CO2	To make students solve aptitude problems quickly utilizing the short cuts	**Skill Development**
CO3	To make students have the ability to 'quickly think on their feet'	**Skill Development**
CO4	To strengthen students communication skills	**Skill Development**
Prerequisites (if any)	**N.A**	

Part A – Quantitative Aptitude

Unit 1: Arithmetic Aptitude I
1.1 Mixture & Alligation
1.2 Number System 2
   1.2.1 Unit digit
   1.2.2 Remainders
   1.2.3 Factors
   1.2.4 Factorials
1.3 Data Interpretation

Unit 2: Reasoning
2.1 Number, Ranking & Time sequence Test
2.2 Syllogism
2.3 Logical Reasoning
   2.3.1 Seating Arrangement
   2.3.2 Linear and Circular arrangement puzzle
   2.3.3 Cross Variable puzzle

Part B – Soft Skills

Unit 3: Personality Development
3.1 Concept of personality
3.2 Self awareness
   3.2.1 Different learning styles
   3.2.2 Areas of Self awareness
   3.2.3 Developing self-awareness
3.3 Goal Setting
   3.3.1 Five principles of goal setting
   3.3.2 Setting "SMART" goals
  3.3.3 6P's of goal setting
  3.3.4 SWOT analysis
  3.4.5 Short term & Long term goals

Unit 4: Presentation Skills
4.1 Designing the presentation
4.2 Audience and content analysis
4.3 Delivering the presentation- Preparation, Practice, Performance

Unit 5: Professional Communication
5.1 Email writing
5.2 Diction and Speech Clarity
5.3 LSRW & Introduction to verbal ability as an assessment tool for employability

Instructions for paper setting: Fifty MCQ will be set in total. All questions will be compulsory. Each question will be of 1 marks. There will be no negative marking. Calculator not allowed. Time allotted would be 2 hours.

Assessment Tools:
Sessional tests
Term end examination scores
Class performance
Home assignments
Online assignments
Class attendance

TEXTBOOKS

1. R S Aggarwal, A Modern Approach to Reasoning, S Chand & Company Pvt Ltd
2. M. Tyra, Quicker Maths, BSC publication

REFERENCE BOOKS

1. Arun Sharma, Quantitative Aptitude, Mc Graw Hill Publication.

e-Resources (websites/Wikipedia pages/webtutorials/online courses, etc.)
- http://www.indiabix.com/aptitude/questions-and-answers/
- http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/
- https://www.sawaal.com/

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO205	CAREER SKILLS –I	CO1	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO4	1	-	-	1	-	-	-	-	1	3	-	2	2

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Electi ve / University Compulsor y)	L	T	P	O	NO. OF CONTA CT HOURS PER WEEK	NO. OF CREDI TS
MAH301B	NUMERICAL ANALYSIS	MA	HARD	CORE	3	1	0	0	4	4
MAH302B	LINEAR ALGEBRA				3	1	0	0	4	4
MAH303B	METRIC SPACES				3	1	0	0	4	4
MAH304B	INFORMATION THEORY AND CODING	MA		ELECTIVE (ANY ONE)	3	1	0	0	4	4
CSH321B-T	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	CS			3	0	0	0	5	4
H321B- P	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS LAB				0	0	2	0		
MAH305B	MATHEMATICS OF FINANCE				3	1	0	0	4	4
MAH306B	STATISTICAL INFERENCES				3	1	0	0	4	4
MAS307B	MATHS LAB-IV	MA		CORE	0	0	2	0	2	1
MAN308B	MINOR PROJECT		NTCC		1	0	2	0	3	2
CDO303	CAREER SKILLS-II	CDC	SOFT	AP/AF	3	0	0	0	2	0
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					13	3/4	4/6	0	21/22	19

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Course Title/Code	NUMERICAL ANALYSIS (MAH301B)	
Course Type	Core (Deptt.)	
L-T-P Structure	**3-1-0**	
Credits	**4**	
Course Objective	Students would be able to understand and apply concepts of numerical techniques for solving the mathematical problems and their applications.	
Course Outcomes (COs)		**Mapping**
CO1	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.	**Skill Development**
CO2	Apply numerical methods to obtain approximate solutions to mathematical problems.	**Skill Development**
CO3	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	**Skill Development**
CO4	Analyse and evaluate the accuracy of common numerical methods.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Errors & Interpolation: Errors in numerical calculations introduction, Numbers and their accuracy, Absolute, Relative and Percentage errors and their analysis, General error formula. Introduction to interpolation, Newton's formula for equispacedpoints.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, RegulaFalsi, Newton- Raphson and Secant method.

Numerical differentiation and integration: Approximating the derivatives, Numerical differentiation formulas (forward, backward and central-Gauss Forward, GaussBackward, Stirling), 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.

TEXTBOOKS

1. Numerical Methods in Engineering. & Science : B.S. Grewal.

REFERENCE BOOKS

1. Numerical Methods for Scientific and Engineering. Computations : M.K. Jain, S.R.K. Iyenger and R.K. Jain-Wiley Eastern Ltd.

e-Resources

- **https://nptel.ac.in/courses/111107105**

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH301B	NUMERICAL ANALYSIS	**CO1**	3	1	3	2	3	-	2	-	3	2	3	3	2
		CO2	3	1	3	2	3	-	2	-	3	2	3	3	2
		CO3	3	1	3	2	3	-	2	-	3	2	3	3	2
		CO4	3	1	3	2	3	-	2	-	3	2	3	3	2

Course Title/Code	LINEAR ALGEBRA (MAH302B)	
Course Type	Core (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course 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.	
Course Outcomes (COs)		**Mapping**
CO1	Apply the concepts of vector spaces, subspaces, bases, dimension and their properties in related mathematical problems and spaces.	**Skill Development**
CO2	Find Relationship between matrices and linear transformations apply the same in real world problems.	**Skill Development**
CO3	Understand and apply the properties of inner product spaces and orthogonality in inner product spaces in related mathematical problems and spaces.	**Skill Development**
CO4	Recognise importance of adjoint of a linear transformation and its canonical form.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

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

Section B

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

Section C

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

Section D

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

TEXTBOOKS

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

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

REFERENCE BOOKS

1. Hoffman & Kunze : Linear Algebra

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH302B	LINEAR ALGEBRA	CO1	3	3	3	3	2	1	2	-	2	1	2	-	-
		CO2	3	3	3	3	2	2	2	-	2	1	2	-	-
		CO3	3	2	3	2	1	1	2	-	2	1	1	-	-
		CO4	3	1	3	1	1	-	2	-	2	1	1	-	-

Course Title/Code	METRIC SPACES (MAH303B)	
Course Type	Core (Deptt.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concept of metric spaces, completeness, compactnes and connectedness	
Course Outcomes (COs)		**Mapping**
CO1	understand and solve problems on metric space, open ball, sphere, interior, closed & open set, convergence	**Skill Development**
CO2	analyze and prove, theorems and problems related to completeness and compactness of a metric space.	**Skill Development**
CO3	analyze and prove, theorems and problems related to connectedness of a metric space.	**Skill Development**
CO4	Recognise importance of metric spaces in mathematical sciences	**Skill Development**
Prerequisites (if any)	**N.A**	

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.

TEXTBOOKS

1. E. T. Copson, Metric Spaces- Cambridge University Press
2. Mícheál O'Searcoid, Metric Space-Springer Verlag, Ny . Inc.

REFERENCE BOOKS

1. P. K. Jain, Khalil Ahmad, Metric Space, Alpha Science International, New Delhi.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH303B	METRIC SPACES	CO1	3	2	3	2	3	-	2	-	2	1	1	-	-
		CO2	3	2	3	2	3	-	2	-	2	1	1	-	-
		CO3	3	2	3	2	3	-	2	-	2	1	1	-	-
		CO4	3	2	3	2	3	-	2	-	2	1	1	-	-

Course Title/Code	INFORMATION THEORY AND CODING(MAH304B)	
Course Type	Elective (Dept.)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications, to enhance knowledge of probabilities, entropy, measures of information.	
Course Outcomes (COs)		**Mapping**
CO1	Demonstrate simple ideal statistical communication models.	**Skill Development**
CO2	Explain the development of codes for transmission and detection of information.	**Skill Development**
CO3	Utilize various error control encoding and decoding techniques	**Skill Development**
CO4	Apply information theory and linear algebra in source coding and channel coding	**Skill Development**
CO5	Analyze the performance of error control codes.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Concepts of Information Theory : Communication processes, A model of communication system, A quantitative measure of information, Binary unit of information, A measure of uncertainty, H function as a measure of uncertainty, Sources and binary sources, Measure of information for two-dimensional discrete finite probability schemes.

Section B

Entropy Function : A sketch of communication network, Entropy, Basic relationship among different entropies, A measure of mutual information, Interpretation of Shannon's fundamental inequalities; Redundancy, efficiency, and channel capacity; Binary symmetric channel, Binary erasure channel, Uniqueness of the entropy function, Joint entropy and conditional entropy, Relative entropy and mutual information, Chain rules for entropy, Conditional relative entropy and conditional mutual information, Jensen's inequality and its characterizations, The log sum inequality and its applications.

Section C

Concepts of Coding: Block codes, hamming distance, Maximum likelihood decoding, Levels of error handling, Error correction, Error detection, Erasure correction, Construction of finite fields, Linear codes, Matrix representation of linear codes, Hamming codes.

Section D

Bounds of Codes: Orthogonality relation, Encoding and decoding of linear codes, the singleton bound and maximum distance separable codes, The sphere-packing bound and perfect codes, The Gilbert-Varshamov bound, MacWilliams' identities.

Cyclic Codes : Definition and examples of cyclic codes, Generator polynomial and check polynomial, Generator matrix and check matrix, Bose-Chaudhuri-Hocquenghem (BCH) code as a cyclic code.

TEXTBOOKS

1. Robert B. Ash, (2014). Information Theory. Dover Publications.
2. Thomas M. Cover & Joy A. Thomas (2013). Elements of Information Theory (2nd edition). Wiley India Pvt. Ltd.
3. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition), Cengage.

REFERENCE BOOKS

1. Fazlollah M. Reza, (2003). An Introduction to Information Theory. Dover Publications.
2. Ron M. Roth (2007). Introduction to Coding Theory. Cambridge University Press.

3. Claude E. Shannon & Warren Weaver (1969). The Mathematical Theory of Communication. The University of Illinios Press.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH304B	INFORMATION THEORY AND CODING	CO1	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO2	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO3	3	3	3	3	-	-	2	-	1	1	1	1	-
		CO4	3	3	3	3	-	-	2	-	2	1	1	2	-
		CO5	3	3	3	3	-	-	2	-	2	1	1	2	-

Course Title/Code	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS(CSH321B-T&P)	
Course Type	Elective (Allied)	
L-T-P Structure	3-0-2	
Credits	4	
Course Objective	To introduce the basic concepts related to DBMS, Relational Database Design and Data Mining	
Course Outcomes (COs)		**Mapping**
CO1	Acquire the knowledge about file systems, database concepts and structured query language.	**Skill Development**
CO2	Design, create and manage/manipulate database systems using SQL, Relational Algebra and Relational Calculus.	**Skill Development**
CO3	Design ER Models and convert the same to relational model	**Skill Development**
CO4	Identify constraints, Design and Decompose the Database using Formal and Informal methods including FD, Normalization	**Skill Development**
CO5	Understand the principles of Transaction Processing, Concurrency control methods and recovery techniques.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section-A

Data Base Concepts: Data base vs. file oriented approach, Data Independence, Data Base Models, General Architecture of a Data Base Management Software Components of a DBMS, Advantages and Disadvantages of DBMS, Introduction to SQL(Insertion of Data, Updating in the data, Alternation in the Schema, Data Fetching, Functions)

Section-B

Relational model – Mathematical formulation, Relation and its properties, domain compatibility, Relational algebra – set operations (union, intersect, difference, cross product), relational operations (select, project, division, joins-cross, inner/outer, theta, natural), Tuple calculus, Relational Calculus, SQL (Set Operations, group by, order by, Joins)

Section-C

Relational Database design: Relational Database Design and ER Model (Entity, Relationship, Strong Entity, Weak Entity, Type of Attributes and their representation), Functional dependencies, Finding keys; 1st to 3rd NFs, BCNF, Lossless Join and Dependency preserving decomposition.

Section-D

Introduction to Data Mining: Data mining definition & task, KDD versus data mining, Data Mining Applications, Data preprocessing, Data mining techniques: Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules(Apriori Algorithm), Mining Multilevel Association Rules, Mining Multidimensional Association Rules, Correlation Analysis.

LIST OF EXPERIMENTS:

Note: MyAccess/MySQL may be used.
- DDL statement: Create table, alter table, drop table

- DML Statement: Select , update, delete, insert statements

- Condition specification using Boolean and comparison operators (and, or, not,=,<>,>,<,>=,<=)
- Arithmetic operators and aggregate function(Count, sum, avg, Min, Max)
- Multiple table queries
- Nested select statements
- Set manipulation using (any, in, contains, all, not in, not contains, exists, not exists, union, intersect, minus, etc.)
- Categorization using group by…
- Arranging using order by
- Introduction to Data mining Tool : Weka

TEXTBOOKS

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems (5th Ed.), Pearson Education. 2010
2. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts (5th Ed.), McGraw Hill. , 2013.
3. Data Mining- Concepts & Techniques; Jiawei Han & Micheline Kamber- 2001, Morgan Kaufmann

REFERENCE BOOKS

1. R. Ramakrishanan, J. Gehrke, Database Management Systems (3rd Ed.), McGraw-Hill. 2002
2. Modern Database Management by Feffray A. lioffcr, Mary B. Prcscotl, Fred R Mefaddcn, 6th edition. Pearson Education.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CSH321B-T&P	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	CO1	2	1	2	1	-	-	-	-	1	-	1	1	-
		CO2	3	1	3	2	3	-	-	-	2	1	3	2	-
		CO3	2	2	3	3	3	-	-	-	3	2	3	2	-
		CO4	3	2	3	2	2	-	-	-	2	1	3	2	-
		CO5	1	1	2	-	-	1	-	1	1	-	2	1	-

Course Title/Code	MATHEMATICS OF FINANCE(MAH305B)	
Course Type	Elective(Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concept of risk evaluation, stocks, price modeling	
Course Outcomes (COs)		**Mapping**
CO1	Communicate the difference in capital budgeting decision tools like Net Present Values, Internal Rates of Return and Discounted Payback Periods; and Explain the details of arbitrage and its use in the valuation of forward contracts, including employing term structure of interest rates to	**Skill Development**
CO2	Derive equations of value and various tools like linear interpolation & annuity tables; Define and describe in detail the use of cash flow models, simple and compound rates of interest and discount as well as compare and distinguish between nominal and effective rates of interest and discount.	**Skill Development**
CO3	Describe in detail the various types of annuities and perpetuities and use them to solve financial transaction problems.	**Skill Development**
CO4	Define interest rate risk in terms of duration and convexity of fixed interest products, using this to define immunisation and assess its use in mitigating interest rate risk.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields, Macaulay and modified duration,

Section B

Term structure of interest rates: Spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds. Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints),

Section C

Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen's index. Forwards and futures, marking to market, value of a forward/futures contract, replicating portfolios, futures on assets with known income or dividend yield, currency futures,

Section D

Hedging (short, long, cross, rolling), optimal hedge ratio, hedging with stock index futures, interest rate futures, swaps. Lognormal distribution, Lognormal model / Geometric Brownian Motion for stock prices, Binomial Tree model for stock prices, parameter estimation, comparison of the models. Options, Types of options: put / call, European / American, pay off of an option, factors affecting option prices, put call parity.

TEXTBOOKS

1. David G. Luenberger, Investment Science, Oxford University Press, Delhi, 1998.
2. John C. Hull, Options, Futures and Other Derivatives (6th Edition), Prentice-Hall India, Indian reprint, 2006.

REFERENCE BOOKS

1. Sheldon Ross, An Elementary Introduction to Mathematical Finance (2nd Edition), Cambridge University Press, USA, 2003

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH305 B	MATHEMATICS OF FINANCE	CO1	3	3	3	3	2	-	2	-	2	1	-	-	1
		CO2	-	3	3	3	2	-	2	-	2	2	2	-	1
		CO3	3	3	3	3	2	-	2	-	2	2	2	-	1
		CO4	3	3	3	3	2	-	2	-	2	2	2	-	1

Course Title/Code	STATISTICAL INFERENCES (MAH306B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the various Statistical Inference Techniques, applications & analysis.	
Course Outcomes (COs)		Mapping
CO1	Test hypothesis for the parameters of normal distribution	Skill Development
CO2	Apply various test for categorical data.	Skill Development
CO3	Apply tests for the significance of correlation coefficient	Skill Development
CO4	Do analysis of variance & design experiments.	Skill Development
Prerequisites (if any)	STATISTICS – I (105B) & STATISTICS – II (MAH202B)	

Section A

Fisher-Neymann Criterion (Statement and applications), Factorization theorem, Complete statistic, Minimum variance unbiased estimator (MVUE), Rao-Blackwell and Lehmann-Scheffe theorems and their applications, Cramer-Rao inequality, MVB estimators and their applications.

Section B

Method of moments, method of maximum likelihood estimation, method of minimum chi-square, tests of association using Chi-square, Yates' correction.

Section C

Tests for the significance of correlation coefficient. Sign test for median, Sign test for symmetry, Wilcoxon two-sample test.

Section D

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block. Analysis of completely randomized design, randomized complete block design.

TEXTBOOKS

1. Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).

2. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).
3. Dass, M. N. &Giri, N. C.: Design and analysis of experiments. John Wiley.

REFERENCE BOOKS

1. Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences .(1964, 1977) by John Wiley.
2. Bancroft, Holdon Introduction to Bio-Statistics (1962) P.B. Hoebar New York.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH306B	STATISTICAL INFERENCE	CO1	1	2	3	3	3	2	1	1	1	2	2	2	2
		CO2	1	2	3	3	3	2	1	1	1	2	2	2	2
		CO3	1	2	3	3	3	2	1	1	1	2	2	2	2
		CO4	1	2	3	3	3	2	1	1	1	2	2	2	2

Course Title/Code	MATHS LAB IV(MAH307B)	
Course Type	Core (Departmental)	
L-T-P Structure	0-0-2	
Credits	1	
Course Objective	This course will enable the students to generate code for various Numerical Techniques using software.	
Course Outcomes (COs)		Mapping
CO1	Obtain numerical solutions of algebraic and transcendental equations.	Skill Development
CO2	Find numerical solutions of system of linear equations and check the accuracy of the solutions.	Skill Development
CO3	Learn about various interpolating and extrapolating methods.	Skill Development
CO4	Solve initial and boundary value problems in differential equations using numerical methods.	Skill Development
CO5	Apply various numerical methods in real life problems.	Skill Development
Prerequisites (if any)	MATHS LAB III(MAH306B)	

LAB EXERCISES

1. Interpolation: 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.
2. Interpolation: 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. 3: To find roots of algebraic and transcendental equations using Bisection method.
4. 4: To find roots of algebraic and transcendental equations using Regula Falsi method.
5. 5: To find roots of algebraic and transcendental equations using Newton Raphson method.
6. 6: Numerical Integration: To find the value of a definite integral using Trapezoidal rule of integration. 7: Numerical Integration: To find the value of a definite integral using Simpson's 1/3 rule of integration.
7. 8: Numerical Integration: To find the value of a definite integral using Simpson's 3/8 rule of integration.
8. 9: To find the solution of an ordinary differential equation of first order by Euler's method. 10: To find the solution of an ordinary differential equation of first order by R-K method.

TEXTBOOKS

1.   M.K Jain, Numerical Methods for Scientist and Engineering Computation, New Age Publications

REFERENCE BOOKS

1.   R.K Jain, SRK Iyengar, R.K Jain, Numerical Methods: Problem and Solutions, New Age International

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH307B	MATHS LAB IV	CO1	1	-	-	2	-	3	-	-	3	-	-	-	
		CO2	1	-	-	2	-	3	-	-	3	-	-	-	
		CO3	1	-	-	2	-	3	-	-	3	-	-	-	
		CO4	1	-	-	-	-	3	-	-	3	-	-	-	
		CO5	-	-	-	-	-	3	-	-	3	-	-	-	

Course Title/Code	MINOR PROJECT(MAN308B)		
Course Type	Core(Departmental)		
L-T-P Structure	0-0-0-2		
Credits	2		
Course Objective	To equip the students to understand apply the advance knowledge of pure and applied mathematics.		
	Course Outcomes (COs)		**Mapping**
CO1	Identify broad area of research		**Skill Development**
CO2	Use different tools for literature survey		**Skill Development**
CO3	Analyze the processes and procedures to carryout research.		**Skill Development**
CO4	Work in groups with guidance.		**Skill Development**
Prerequisites (if any)			

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAN308	MINOR PROJECT (MAN308B)	**CO1**	3	2	3	3	2	2	1		3	2	2	2	-
		CO2	-	-	-	-	-	3	-	-	-	-	-	-	-
		CO3	3	2	3	3	2	2	1	-	3	2	2	2	-
		CO4	-	-	-	-	-	-	-	-	-	3	-	-	-

Course Title/Code	CAREER SKILL-II(CDO303)	
Course Type	Audit	
L-T-P Structure	2-0-0	
Credits	0	
Course Objective	To be able to do mathematical computations on geometry, algebra and develop verbal reasoning	
Course Outcomes (COs)		**Mapping**
CO1	Students will be able to apply the short tricks on geometry & calculation problems.	**Skill Development**
CO2	Students will be able to solve problems on Modern Mathematics & Numbers.	**Skill Development**
CO3	Students will be able to analysis and solve data related problems.	**Skill Development**
CO4	Students will be able to use their vocabulary and grammar to solve complex questions	**Skill Development**
CO5	Students will be able to write formal text with accuracy and ease	**Skill Development**
CO6	Students will be able to develop speed reading	**Skill Development**
Prerequisites (if any)	Career Skill –I(CDO205)	

Part A – Quantitative Aptitude

Unit 1: Geometry and Mensuration
1.1 Geometry
    1.1.1 Basic geometry & Theorems, Lines & Angles
    1.1.2 Polygons, Triangle and Quadrilaterals
    1.1.3 Circles
1.2 Mensuration I- Areas
1.2.1 Different types of Triangles and their area and perimeter.
1.2.2 Different types of Quadrilateral and their area and perimeter.
1.2.3 Circumference and Area of Circle, Area of Sector and length of Sector.
1.2.4 Mixed Figures and their Applications.
1.3 Mensuration II- Surface Areas and Volumes
1.3.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.
1.3.2 Prism and Pyramid.
1.3.3 Mixed Figures and their Applications.
Unit 2: Algebra

2.1 Linear & Quadratic equations

2.2 Mathematical inequalities

2.3 Maximum & Minimum Values

2.4 Integral Solutions

Unit 3: Verbal Reasoning

3.1 Cubes & Dice

3.2 Inserting Missing Characters

3.3 Clocks

Part B - Employability Enhancement & Verbal Ability

Unit 4: Communication Accuracy

4.1 Relevance of Verbal Ability and preparatory guidelines

4.2 Functional Grammar – Subject Verb Agreement

4.3 Tenses – Perfect, Simple, Continuous

4.4 Common Errors and rectification

Unit 5: Word Power Building Skills

5.1 Words: Antonyms, Synonyms, Verbal Analogies

5.2 Compound words: Homophones, Homonyms, Word Families

5.3 Root Word Technique for Prefixes & Suffixes

5.4: Word Power: 7 Tips for Learning New Words

5.5 Practice Vocabulary Exercises

Unit 6: Reading & Writing Skills

6.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading

6.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed

6.3 Practice Exercises: Short & Medium Passages3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing

6.4 Sentences, Phrases, Types of Sentences, Parts of Sentences

6.5 Paragraph Writing: Construction, Linkage & Cohesion

Instructions for paper setting: Fifty MCQ will be set in total. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator not allowed. Time allotted would be 2 hours.

Assessment Tools:

Sessional tests
Term end examination scores
Class performance & Home assignments
Online assignments & Class attendance

TEXTBOOKS

1. Quantitative Aptitude for Competitive Examinations: R S Aggarwal, S Chand & Company PvtLtd, Edition 2017
2. A Modern Approach to Verbal& Non Verbal Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd, Edition 2018

REFERENCE BOOKS

1. Verbal Ability and Reading Comprehension: MVN Enterprises

Weblinks:

http://www.indiabix.com/aptitude/questions-and-answers/
http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/
https://www.sawaal.com/

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO303	CAREER SKILL-II	CO1	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO4	1	-	-	1	-	-	-	-	1	3	-	2	2
		CO5	1	-	-	1	-	1	-	-	1	3	-	2	2
		CO6	1	2	-	1	1	1	1	1	1	3	1	2	2

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft / Workshop/ NTCC)	COURSE TYPE (Core/El ective / Universit y Compuls ory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH309B	LINEAR ROGRAMMING & GAME THEORY	MA	HARD	ELECTIVE (ANY ONE)	3	1	0	0	4	4
MAH310B	MECHANICS-II				3	1	0	0	4	
MAH311B	DISCRETE MATHEMATICS				3	1	0	0	4	
MAH312B	MATHEMATICA L MODELING	MA			3	1	0	0	4	
MAH313B	APPLICATIONS OF ALGEBRA	MA			3	1	0	0	4	
MAH314B	INDUSTRIAL MATHEMATICS				3	1	0	0	4	
MAH315B	BIO MATHS				3	1	0	0	4	
MAH316B	CRYPTOGRAPH Y			ELECTI VE (ANY ONE)	3	1	0	0	4	4
CSH322B-T	FUNDAMENTALS OF MACHINE LEARNING	CS			3	0	0	0	5	
CSH322B-P	FUNDAMENTALS OF MACHINE LEARNING LAB				0	0	2	0		
MCH393	MANAGEMENT OF BANKING & INSURANCE	MC			3	1	0	0	4	
MAH317B	ECONOMETRICS	MA			3	1	0	0	4	
MAN318B	PROJECT	MA	NTCC	CORE	0	0	0	6	2	6
CDO305	CAREER SKILLS-III	CDC	SOFT	AP/AF	3	0	0	0	2	0
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					9	2/3	0/2	6	14/15	18

Course Title/Code	LINEAR PROGRAMMING & GAME THEORY(MAH309B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course 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.	
Course Outcomes (COs)		**Mapping**
CO1	Understanding the concepts and tools of linear programming problem & Game theory.	**Skill Development**
CO2	Solve different problems of linear programming problem & Game theory with real world limitations/applications.	**Skill Development**
CO3	Apply OR techniques constructively to make effective business decisions.	**Skill Development**
CO4	Analyse and construct the mathematical models used in Operations Research and learn to apply the restrictions on problems.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section-A

Introduction to linear programming problem, Formulation, Solution by graphical, Theory of simplex method, Optimality and unbounded-ness, The simplex algorithm, Simplex method in tableau format. Introduction to artificial variables, Two-phase method, Big M method and their comparison. Duality, Formulation of the dual problem, Primal-dual relationships, Dual Simplex, Economic interpretation of the dual.

Section-B

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-C

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.

Section-D

Sequencing: Sequencing problems: Introduction, assumptions, processing of n - jobs through 2 machines, Processing of n - jobs through 3 machines. Processing of n-jobs through m-machines.

TEXTBOOKS

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows (2nd edition), John Wiley and Sons, India, 2004.

REFERENCE BOOKS

1. S. Hillier and G. J. Lieberman, Introduction to Operations Research (9th Edition), Tata McGraw Hill, Singapore, 2009.
2. Hamdy A. Taha, Operations Research, An Introduction (8th edition), Prentice - Hall India, 2006
3. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.

e-Resources

* **https://archive.nptel.ac.in/content/storage2/courses/110106059/Module%201/Lecture%201.pdf**

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH309B	LINEAR PROGRAMMING & GAME THEORY	CO1	3	1	2	3	2	-	-	-	-	2	2	1	1
		CO2	3	1	2	3	2	-	1	1	1	2	2	1	1
		CO3	3	1	2	3	2	-	1	1	1	2	2	1	1
		CO4	3	1	2	3	2	-	1	1	1	2	2	1	1

Course Title/Code	MECHANICS-II (MAH310B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	The students would be able to apply the concepts of Dynamics required for solving the mathematical problems and their applications	
Course Outcomes (COs)		Mapping
CO1	understand and use basic terms for the description of the motion of particles, vector functions and the fundamental laws of Newtonian mechanics	**Skill Development**
CO2	Apply kinetics relationships to systems of particles in curvilinear motion.	**Skill Development**
CO3	Analyze problems dealing with motion relative to rotating axes.	**Skill Development**
CO4	To demonstrate the principles and methods used in analyzing motion of a particle subjected to external forces.	**Skill Development**
Prerequisites (if any)	MECHANICS-I(MAH212B)	

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.

TEXTBOOKS

1. Chorlton : Dynamics, CBS Publishers, New Delhi

REFERENCE BOOKS

1. A.S.Ramsey:DynamicsPart-1&2,CBSPublisher&Distributors.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH310B	MECHANICS-II	CO1	3	2	3	3	-	-	2	2	2	2	2	1	2
		CO2	3	3	3	2	-	-	2	2	1	1	2	2	1
		CO3	3	2	2	2	-	-	2	1	1	2	1	2	2
		CO4	3	2	2	2	-	-	2	1	1	2	1	2	2

Course Title/Code	DISCRETE MATHEMATICS(MAH311B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course 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	
Course Outcomes (COs)		**Mapping**
CO1	To demonstrate concepts of partial order relation and lattices.	**Skill Development**
CO2	Apply basic counting techniques to solve combinatorial problems	**Skill Development**
CO3	Simplify Boolean functions by using the basic Boolean algebraic properties and K-map.	**Skill Development**
CO4	Apply algorithms and theorems that are treated in the course for solving graph theoretical problems.	**Skill Development**
CO5	Solve & analyze the Mathematical problems related to Set POSET and Graph using mathematical software.	**Skill Development**
Prerequisites (if any)	**N.A**	

SECTION A

Ordered Sets: Relations, Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, Dual of an ordered set, Duality principle, Maximal and minimal elements.

Lattice: Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, Examples, and properties of modular and distributive lattices, Complemented lattice.

SECTION B

Boolean algebra: Introduction to Boolean algebra and Boolean functions, Different representations of Boolean functions, Application of Boolean functions to synthesis of circuits. Karnaugh maps. Karnaugh diagrams, switching circuits and applications of switching circuits.

Counting Techniques: Pigeonhole principle, Basic counting principles, Binomial and multinomial theorems, Combinatorial identities, Inclusion and Exclusion principle. Recurrence relations, generating functions, solution of recurrence relations using difference equations and generating functions.

SECTION C

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.

SECTION D

Graph Theory: 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.

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

TEXTBOOKS

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, TMH
4. M.K. Sen , D.S. Malik , Discrete Mathematics: Theory and Applications, Cengage.

REFERENCE BOOKS

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, TMH
2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schum's Outlines Series, Seymour Lipchitz, Marc Lipson,

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH311B	DISCRETE MATHEMATICS	CO1	3	3	3	3	-	-	2	-	2	-	-	-	-
		CO2	3	3	3	3	-	-	2	-	2	-	-	-	-
		CO3	3	3	3	3	1	-	2	-	2	-	1	-	-
		CO4	3	3	3	3	2	-	2	-	2	-	1	-	-
		CO5	-	-	-	-	-	3	1	-	2	-	2	3	-

Course Title/Code	MATHEMATICAL MODELING(MAH312B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concepts of Mathematical Modeling in different physical areas and use of different mathematical tools in mathematical modeling.	
Course Outcomes (COs)		**Mapping**
CO1	Understand the basics concept of Mathematical Modeling	**Skill Development**
CO2	Analyse the different techniques as per required area of modeling	**Skill Development**
CO3	Solve the mathematical problems with the help of modeling tools	**Skill Development**
CO4	Generate the differential mathematical model for different need	**Skill Development**
Prerequisites (if any)	N.A	

Section A

Introduction and the technique of mathematical modeling, Classification and characteristics of mathematical models. Mathematical modeling through algebra, finding the radius of the earth, Motion of planets, Motions of satellites. Linear and Non-linear growth and decay models, Population growth models. Effects of Immigration and Emigration on Population size, Decrease of temperature, Diffusion, Change of price of a commodity, Logistic law of population growth. A simple compartment model. Diffusion of glucose or a Medicine in the bloodstream.

Section B

Mathematical modeling of epidemics, A simple epidemics model, A susceptible–infected-susceptible (SIS) model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration. Mathematical modeling in economics, Domar macro model, Domar first debt model, Domar second debt model, Samuelson investment model, Stability of market equilibrium. Mathematical modeling in medicine, Arms race and battles: A model for diabetes mellitus, Richardson model for arms race, Lamechester combat model.

Section C

Mathematical modeling through partial differential equations: Mass-balance Equations, Momentum- balance Equations, Variation principles, Probability generating function, modeling for traffic on a highway.

Section D

Stochastic models of population growth Need for stochastic models, Linear birth-death-immigration- emigration processes, linear birth-death process, Linear birth-death-immigration process, linear birth- death-emigration process, Non-linear birth-death process.
Recommended Books:

TEXTBOOKS

1. J.N. Kapur, Mathematical Modeling, New Age International Limited.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press (P) Ltd.

REFERENCE BOOKS

1. Mathematical Models in the Social, Management and Life Sciences, D.N. Burghes and A.D. Wood, John Wiley & Sons.
2. Mathematical Modeling, J.G. Andrews & R.R Mclone, Butterworths (Pub.) Inc.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH312B	MATHEMATICAL MODELING-	CO1	3	3	-	3	2	1	-	-	-	2	3	1	-
		CO2	3	3	2	3	2	1	-	-	-	2	3	1	-
		CO3	3	3	2	3	2	1	-	-	-	2	3	1	-
		CO4	3	3	2	3	2	1	-	-	-	2	3	1	-

Course Title/Code	APPLICATIONS OF ALGEBRA(MAH313B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To familiarize students with the applications of Algebra.	
Course Outcomes (COs)		**Mapping**
CO1	Construct Balanced incomplete block designs (BIBD) using various methods	**Skill Development**
CO2	Understand basics coding theory & applications	**Skill Development**
CO3	Apply concepts of group theory on problems related to symmetry & colour patterns	**Skill Development**
CO4	Know about different types of matrices and their applications in image processing & statistics	**Skill Development**
CO5	Understand the applications of linear transformations in various areas and apply the same	**Skill Development**
CO6	Apply linear algorithms for matrix factorization.	**Skill Development**
Prerequisites (if any)	Linear Algebra(MAH302B)	

Section –A

Balanced incomplete block designs (BIBD): definitions and results, incidence matrix of a BIBD, construction of BIBD from difference sets, construction of BIBD using quadratic residues, difference set families, construction of BIBD from finite fields.

Section - B

Coding Theory: introduction to error correcting codes, linear cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.

Symmetry groups and color patterns: review of permutation groups, groups of symmetry and action of a group on a set; colouring and colouring patterns, Polya theorem and pattern inventory, generating functions for non-isomorphic graphs.

Section – C

Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices, Frobenius- König theorem, Birkhoff-theorem.
Positive Semi-definite matrices: positive semi-definite matrices, square root of a positive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric

matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and statistics.

Section – D

Applications of linear transformations: Fibonacci numbers, incidence models, and differential equations. Least squares methods: Approximate solutions of system of linear equations, approximate inverse of an m×n matrix, solving a matrix equation using its normal equation, finding functions that approximate data. Linear algorithms: LDU factorization, the row reduction algorithm and its inverse, backward and forward substitution, approximate inverse and projection algorithms.

Recommended Books:

TEXTBOOKS

1. I. N. Herstein and D. J. Winter: Primer on Linear Algebra, Macmillan Publishing Company, New York, 1990.
2. S. R. Nagpaul and S. K. Jain: Topics in Applied Abstract Algebra, Thomson Brooks and Cole, Belmont, 2005.
3. Richard E. Klima, Neil Sigmon, Ernest Stitzinger: Applications of Abstract Algebra with Maple, CRC Press LLC, Boca Raton, 2000.

REFERENCE BOOKS

1. David C. Lay: Linear Algebra and its Applications. 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
2. Fuzhen Zhang: Matrix theory, Springer-Verlag New York, Inc., New York, 1999.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH313B	APPLICATIONS OF ALGEBRA	CO1	3	3	3	-	1	-	2	-	2	-	2	-	-
		CO2	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO3	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO4	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO5	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO6	3	3	3	2	1	-	2	-	2	-	2	-	-

Course Title/Code	INDUSTRIAL MATHEMATICS (MAH314B)	
Course Type	Elective(Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To familiarize students with the basics of X-ray, CT-scan, Tomography etc using mathematics	
Course Outcomes (COs)		**Mapping**
CO1	have an enhanced knowledge and understanding of calculus differential equations, complex numbers in X-ray and CT scan.	**Skill Development**
CO2	Apply Fourier and inverse Fourier transforms and applications of their properties in image reconstruction	**Skill Development**
CO3	Apply pre-calculus, calculus, Matrices and differential equations in biological systems	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Medical Imaging and Inverse Problems: The content is based on Mathematics and X-ray and CT scan based on knowledge of calculus differential equations, complex numbers and matrices.

Section B

Introduction to Inverse Problems: Why should we teach inverse problems? Illustration of inverse problems through pre-calculus, calculus, Matrices and differential equations. Geological anomalies in Earth interior from measurements and its surface (Inverse problems for Natural disaster) and Tomography.

Section C

X-ray introduction, X ray behaviour and Beers Law (The fundamental question and image construction) Lines in the place. Random Transform: Definition and examples, Linearity, Phantom (Shepp-Logan Phatom-Mathematical phantoms) Back Projection: Definition, Properties and examples.

Section D

CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

TEXTBOOKS

1. Timothy G. Feeman: The Mathematics for Medical Imaging: A beginner's guide, Springer Under graduate Text in Mathematics and Technology, Springer 2010.
2. C.W. Groetsch: Inverse problems. Activities for undergraduates, the Mathematical Association of America, 1999.

REFERENCE BOOKS

1. Andreas Kirsch: An Introduction to the Mathematical Theory of Inverse Problems, springer, 2011.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH314B	INDUSTRIAL MATHEMATICS	CO1	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO2	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO3	3	3	3	3	2	-	2	-	2	2	3	1	2

Course Title/Code	BIO-MATHS(MAH315B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	Scientific study of normal functions in living systems, Exposure to nonlinear differential equations with examples such as heartbeat, chemical reactions and nerve impulse transmission. Apply basic concepts of the probability to understand molecular evolution and genetics	
Course Outcomes (COs)		**Mapping**
CO1	Learn the development, analysis and interpretation of bio mathematical models	**Skill Development**
CO2	Reinforce the skills in mathematical modeling.	**Skill Development**
CO3	Appreciate the theory of bifurcation and chaos.	**Skill Development**
CO4	Learn to apply the basic concepts of probability to molecular evolution and genetics.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Modeling Biological Phenomenon: Population growth, Administration of drugs, Cell division, Systems of linear ordinary differential equations, Heartbeat, Nerve impulse transmission, Chemical reactions, Predatorprey models.

Section B

Mathematics of Heart Physiology and Nerve Impulse Transmission: Stability and oscillations: Epidemics, The phase plane and the Jacobian matrix, Local stability, Stability, Limit cycles, Forced oscillations; Mathematics of Heart Physiology: The local model, The Threshold effect, The phase plane analysis and the heartbeat model, A model of the cardiac pacemaker; Mathematics of Nerve Impulse Transmission: Excitability and repetitive firing, Travelling waves.

Section C

Bifurcation and Chaos: Bifurcation, Bifurcation of a limit cycle, Discrete bifurcation and period-doubling, Chaos, Stability of limit cycles, The Poincaré plane.

Section D

Modeling Molecular Evolution and Genetics: Modeling Molecular Evolution: Matrix models of base substitutions for DNA sequences, The Jukes- Cantor model, The Kimura models, Phylogenetic distances; Constructing Phylogenetic Trees: Phylogenetic trees, Unweighted pair-group method with arithmetic means (UPGMA), Neighbor joining method; Genetics: Mendelian genetics, Probability distributions in genetics.

TEXTBOOKS

1. Allman, Elizabeth S., & Rhodes, John A. (2004). Mathematical Models in Biology: An Introduction. Cambridge University Press.
2. Jones, D. S., Plank, M. J., & Sleeman, B. D. (2009). Differential Equations and Mathematical Biology (2nd ed.). CRC Press, Taylor & Francis Group, LLC. Department of Mathematics, University of Delhi 72
3. Murray, J. D. (2002). An Introduction to Mathematical Biology (3rd ed.). Springer. 2. Myint-U, Tyn (1977). Ordinary Differential Equation. Elsevier North-Holland, Inc.

REFERENCE BOOKS

1. Simmons, George F., & Krantz, Steven G. (2015). Differential Equations. McGrawHill Education. Indian Reprint.
2. Strogatz, Steven H. (2009). Nonlinear Dynamics and Chaos (2nd ed.). Perseus Book Publishing. LLC. Sarat Publication, Kolkata, India.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH315B	BIO-MATHS	CO1	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO2	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO3	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO4	3	3	3	3	2	-	2	-	2	2	3	1	-

Course Title/Code	CRYPTOGRAPHY (MAH316B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	Students would be able to understand the concepts of classical encryption techniques and concepts of finite fields and number theory. Explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms	
Course Outcomes (COs)		**Mapping**
CO1	Understand the aspects of number theory which are relevant to cryptography.	**Skill Development**
CO2	Understand the difference between classical and modern cryptography	**Skill Development**
CO3	Understand and apply the concepts of fundamentals of cryptography, Data and Advanced Encryption Standards (DES & AES) and RSA.	**Skill Development**
CO4	Apply encryption and decryption techniques to encrypt and decrypt messages using block ciphers, sign and verify messages using well-known signature generation and verification algorithms.	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Introduction to Cryptography and Classical Cryptography : Cryptosystems and basic cryptographic tools: Secret-key cryptosystems, Public-key cryptosystems, Block and stream ciphers, Hybrid cryptography, Message integrity: Message authentication codes, Signature schemes, Nonrepudiation, Certificates, Hash functions, Cryptographic protocols, Security; Hybrid cryptography: Message integrity, Cryptographic protocols, Security, Some simple cryptosystems,Shift cipher, Substitution cipher, Affine cipher, Vigenère cipher, Hill cipher, Permutation cipher, Stream ciphers, Cryptanalysis of affine, substitution, Vigenère, Hill and LFSR stream ciphers.

Section B

Cryptographic Security, Pseudo Randomness and Symmetric Key Ciphers: Shannon's theory, Perfect secrecy, Entropy, Spurious keys and unicity distance; Bit generators, Security of pseudorandom bit generators. Substitution-permutation networks, Data encryption standard (DES), Description and analysis of DES; Advanced encryption standard (AES), Description and analysis of AES; Stream ciphers, Trivium.

Section C

Basics of Number Theory and Public-Key Cryptography: Basics of number theory; Introduction to public-key cryptography, RSA cryptosystem, Implementing RSA; Primality testing, Legendre and Jacobi symbols, Solovay-Strassen algorithm, Miller-Rabin algorithm; Square roots modulo n, Factoring algorithms, Pollard p - 1 algorithm, Pollard rho algorithm, Dixon's random squares algorithm, Factoring algorithms in practice; Rabin cryptosystem and its security.

Section D

More on Public-Key Cryptography: Basics of finite fields; ElGamal cryptosystem, Algorithms for the discrete logarithm problem, Shanks' algorithm, Pollard rho discrete logarithm algorithm, Pohlig- Hellman of ElGamal systems, Bit security of discrete logarithms. Hash Functions and Signature Schemes: Hash functions and data integrity, SHA-3; RSA signature scheme, Security requirements for signature schemes, Signatures and Hash functions, ElGamal signature scheme, Security of ElGamal signature scheme, Certificates.

TEXTBOOKS

1. Jeffrey Hoffstein, Jill Pipher & Joseph H. Silverman (2014). An Introduction to Mathematical Cryptography (2nd edition). Springer.
2. Neal Koblitz (1994). A Course in Number Theory and Cryptography (2nd edition). Springer- Verlag.
3. Christof Paar & Jan Pelzl (2014). Understanding Cryptography. Springer.

REFERENCE BOOKS

1. Simon Rubinstein-Salzedo (2018). Cryptography. Springer.
2. Douglas R. Stinson & Maura B. Paterson (2019). Cryptography Theory and Practice (4th edition). Chapman & Hall/CRC Press, Taylor & Francis.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH316 B	CRYPTOGRAPHY	CO1	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO2	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO3	3	3	3	3	-	-	2	-	1	1	1	1	-
		CO4	3	3	3	3	-	-	2	-	2	1	2	2	-

Course Title/Code	FUNDAMENTALS OF MACHINE LEARNING (CSH322B-T & P)	
Course Type	Elective (Allied)	
L-T-P Structure	3-0-2	
Credits	5	
Course Objective	The students should be able to design and implement machine learning solutions to classification, regression, clustering problems and evaluate and interpret the results of the algorithm	
Course Outcomes (COs)		Mapping
CO1	Demonstrate the understanding of a wide variety of supervised learning algorithms to solve classification and regression problems.	**Skill Development**
CO2	Demonstrate the understanding of a variety of unsupervised learning algorithms to solve clustering problems.	**Skill Development**
CO3	understand how to apply supervised learning and unsupervised algorithms to solve real world problems	**Skill Development**
CO4	understand how to perform evaluation of learning algorithms	**Skill Development**
Prerequisites (if any)	**N.A**	

Section-A

Introduction: Introduction to Machine Learning, Supervised/unsupervised/semi-supervised, Regression, classification, Bias Variance Trade off, Training and Testing, Evaluation measures

Section-B

Supervised Learning: Linear Regression, single and Multiple, Gradient Descent, Linear Classification, Logistic Regression, Support Vector Machines, Decision Trees, Loss functions,

Section-C

Neural Networks – Biological Neuron prototype, Multilayer Perceptron, Feed forward and Feedback networks, Back propagation, Applications, Instance based learning, Dimensionality Reduction

Section-D

Bootstrapping and Bagging, Random Forest, Unsupervised Learning: Partitional Clustering, Hierarchical Clustering,

LIST OF EXPERIMENTS:

1. Introduction to machine learning libraries in Python/Matlab/R:
2. Linear Regression
3. Logistic regression
4. Support Vector Machines
5. Decision Trees
6. Neural networks
7. k-nearest neighbor classification
8. K-means clustering

TEXT BOOKS:

1. Tom. M. Mitcheli. Machine Learning, McGraw-Hill Publishing Company Ltd.
2. Ethern Alpaydin. Introduction to Machine Learning, The MIT Press.

REFERENCE BOOK:

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2009.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CSH322B-T & P	FUNDAMENTALS OF MACHINE LEARNING	CO1	3	1	3	2	2	3	2	-	1	-	1	1	1
		CO2	3	1	3	2	2	3	2	-	1	-	1	1	1
		CO3	3	2	3	2	3	3	2	3	1	1	1	2	1
		CO4	3	2	3	2	3	3	2	3	1	1	1	2	1

Course Title/Code	MANAGEMENT OF BANKING & INSURANCE(MCH393)	
Course Type	Elective (Allied)	
L-T-P Structure	**3-1-0**	
Credits	**4**	
Course Objective	To acquaint the students with the understanding of banking Innovations & technology as per the current scenario. To give through knowledge of RBI and its functioning. To enlighten the students regarding the new concepts introduced in the banking system. To make the students familiar with risk, Insurance and its different types and to make them understand the working of the Insurance sector	
Course Outcomes (COs)		**Mapping**
CO1	To understand functions of financial intermediary institutions, including banks, investment banks and institutional investors as an important and contemporary area of financial management.	**Skill Development**
CO2	To train and equip the students with the dextry of skills with which modern banking and insurance is run	**Skill Development**
CO3	To disseminate knowledge among the students inculcate with theoretical structures about banking and insurance.	**Skill Development**
CO4	Making a deep understanding on the workings of new issue market and secondry market	**Skill Development**
Prerequisites (if any)	**N.A**	

Section A

Banking and Innovations in Banking Technology: Bank Computerization, Core Banking, Online Banking, Mobile Banking,Internet-Banking, ATMs,Organization of a Bank Branch, Banking Structure in India & Abroad,Bank Branch Set up, Strong Room, Front Office, Back Office,Security Arrangements in Bank and Clearing Houses, Ancillary Services of Banks- Safe custody of valuables, Lockers,Remittances – RTGS/NEFT/Drafts, Fee based services- Issuing Guarantees and letters of credit,Selling Third Party Products- Insurance and Mutual fund units,Credit Cards, Debit Cards, Brokerage and Demit Services.

Section B

Reserve Bank of India Regulations on Banks: Cash Reserve Ratio, Statutory Liquidity Ratio,Bank Rate, Repo Rate, Reverse Repo Rate, Base Rate, Performa of Final Accounts of Banking Companies- Profit & Loss Account and Balance Sheet, Basics of Business

Mathematics-Calculation of simple interest and Compound Interest, Calculations of interest on fixed rate and Floating rate,Calculation of EMIs,Calculations of interest on Savings Accounts,Calculations of date of maturity of bills of exchange.

Section C

Insurance – Life Insurance and its principles. Key players in Life InsuranceMeaning and importance of General Insurance , different types of General Insurance,(i) Fire Insurance, (ii) Marine Insurance, (iii) Motor Vehicle Insurance, (iv) Medi-Claim Insurance,(v) Accident Insurance,(vi) Burglary and Theft Insurance,Present Organizational set up of General Insurance companies in India - GIC - its subsidiaries, Private Companies,Principles of General Insurance - Insurable Interest, Indemnity, subrogation, good faith,Regulator of Insurance Sector- IRDA and various provisions and regulations,Fire Insurance- Types of Fire insurance Polices - Their main features and clauses, Meaning & Significance of Average Clause, Procedure for taking Fire Insurance Policies and settlement of claims.

Section D

Kinds of General Insurance(contd.) Marine Insurance, Three types of Marine insurance - Cargo Insurance, Hull Insurance and Freight Insurance, Types of Policies, Clauses of a Marine Insurance Policy, Marine losses, Motor Vehicle Insurance-Types of Polices and Risks Covered therein, Procedure for obtaining motor Insurance Policy, Settlement of claims, Medi-Claim and Accident Insurance-Important conditions of such Polices and Benefits available therein, Procedure for claims, Burglary and Theft Insurance-Need for such Insurance, Information to be furnished and procedure to be follow, Recovering the claims.

TEXTBOOKS

1. G.S. Gill, Practice & Law of banking
2. P.N. Varshney, Banking: Law & practice
3. E. Gordon, K. Talraj, Banking: Theory & Practice
4. Tannan, Banking: Law & practice – in India
5. Maheshwari, Banking: Law & practice –in India
6. G.V. Kayandepatil, B.R. Sangle, G.T. Sangle, N.C. Pawar, Fundamentals of banking.

REFERENCE BOOKS

1. M. N. Mishra, Principles and Practices of Insurance, S. Chand and Co; 2004
2. G. S. Panda, Principles and Practices of Insurance, Kalyani Publications, 2004
3. C. Jeevanandam, Risk Management, Sultan Chand and Sons; 2005
4. C. Arthur and C. William, Risk Management.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MCH393	MANAGEMENT OF BANKING & INSURANCE	CO1	1	2	1	-	-	2	-	1	1	2	1	1	1
		CO2	2	1	2	1	-	2	2	1	1	1	1	1	2
		CO3	1	1	2	1	2	1	-	2	1	-	2	-	1
		CO4	2	1	2	-	2	1	-	2	2	-	-	1	1

Course Title/Code	ECONOMETRICS (MAH317B)	
Course Type	Elective (Departmental)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	To equip the students with the concepts of econometric models	
Course Outcomes (COs)		**Mapping**
CO1	Understand conceptualize econometric model, structure & estimation.	**Skill Development**
CO2	Able to do detection of multicollinearity	**Skill Development**
CO3	Able to apply Aitken estimators	**Skill Development**
CO4	Do tests & find solutions of heteroscedastic disturbances	**Skill Development**
Prerequisites (if any)	STATISTICS – I (105B) & STATISTICS – II (MAH202B)	

Section A

Introduction: Objective behind building econometric models, nature of econometrics, model building, role of econometrics, structural and reduced forms. General linear model (GLM). Estimation under linear restrictions.

Section B

Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity, specification error.

Section C

Generalized least squares estimation, Aitken estimators. Autocorrelation: concept, consequences of autocorrelated disturbances, detection and solution of autocorrelation.

Section D

Heteroscedastic disturbances: Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity. Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity. Autoregressive and Lag models, Dummy variables, Qualitative data.

TEXTBOOKS

1. D. Gujarati, S. Sangeetha, Basic Econometrics, 4th Edition, McGraw Hill Companies.

2. J. Johnston, Econometric Methods, 2nd Edition, McGraw Hill International.

REFERENCE BOOKS

1. A. Koutsoyiannis, Theory of Econometrics, 2nd Limited, Edition, Palgrave Macmillan Limited Maddala,
2. G.S. K. Lahiri, Introduction to Econometrics, 4th edition, John Wiley & Sons.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH317B	ECONOMETRICS	CO1	2	2	1	3	-	2	-	-	1	-	2	-	1
		CO2	2	2	1	3	-	2	-	-	1	-	2	-	1
		CO3	2	2	1	3	-	2	-	-	1	-	2	-	1
		CO4	2	2	1	3	-	2	-	-	1	-	2	-	1

Course Title/Code	ENTREPRENEURIAL THEORY AND PRACTICES (MCH109)	
Course Type	Elective (Allied)	
L-T-P Structure	3-1-0	
Credits	4	
Course Objective	Recognize the entrepreneurial potential within yourself and in your environment; Appreciate the role of entrepreneurship within society, at the level of the organization, and in your own personal life; Understand the process, nature of entrepreneurship, and ways to manage the process; this course will introduce to the basic knowledge of various aspects of Entrepreneurship.	
Course Outcomes (COs)		**Mapping**
CO1	To acquaint the students with the fundamentals principles of Entrepreneurial theory & practices	**Skill Development**
CO2	To enable the students to prepare, analyze and interpret the start-up economy	**Skill Development**
CO3	To enable the students to take decisions using applicable tools and techniques.	**Skill Development**
CO4	To enable the students to take decisions using innovation & creative invention	**Skill Development**
Prerequisites (if any)	**NA**	

SECTION A

Defining Entrepreneurship; what is an Entrepreneurial Mindset? The Entrepreneurial Process; An Integrative Model of Entrepreneurship. "Who" is the Entrepreneur? Sociological and Psychological Characteristics; The Different Types of Entrepreneurs; Nature versus Nurture, Why Entrepreneurs are not Born

SECTION B

Understanding The Nature of Opportunity & Defining Opportunity; An Opportunity is Different from a Business Concept; Sources and Types of Opportunity; Discovery versus Search; Where are the Emerging Opportunities; Evaluating Opportunity; Factors that Undermine an Opportunity; Windows of Opportunity; Understanding the Market and the Customer Needs. Entrepreneurial Skills such as Communication, Design Thinking, Personal Selling, and Risk and Resilience

SECTION C

Developing a Great Business Concept and Business Model From Product to Business Concept (the Value Proposition), From Business Model to Business Plan; The Nature of Successful Business Concepts; Sources of Concepts; What Makes for a Good Concept; Components of a Complete Business Model; A Look at Successful and Failed Business Models

SECTION D

Expectations about Size, Growth, Returns, and Risk, What About the Investment Model (Income, Growth, or Speculative)?; Ways of Extracting Returns from the Venture; Types of Ventures; What it Takes to Actually Start a Venture; Four Ways to Enter a Market; The Concept of Risk; Types of Risk; Assessing in a New Venture; Risk and Return.

TEXT BOOKS

1. Rajeev Roy , "Entrepreneurship", 2nd ed, Oxford Higher Education, 2011
2. Bruce R. Barringer and R. Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd Edition, Pearson Prentice Hall (2009).
3. Nandini Vaidyanathan. Entrepedia, A Step-by –step Guide to Becoming An Entrepreneur In India, 2nd ed, Publisher: Embassy Books Publishers & Distributors, 2011.

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MCH109	ENTREPRENEURIAL THEORY AND PRACTICES	CO1	1	2	1	-	-	2	-	1	1	2	1	1	1
		CO2	2	1	2	1		2	3	1	3	1	1	1	2
		CO3	1	1	2	1	2	1	-	2	1	-	2	-	1
		CO4	2	1	3	-	2	1	-	2	2	-	-	1	1

Course Title/Code	PROJECT(MAN318B)													
Course Type	Core(Departmental)													
L-T-P Structure	0-0-0-6													
Credits	6													
Course Objective	To equip the students to understand apply the advance knowledge of pure and applied mathematics.													

	Course Outcomes (COs)	Mapping
CO1	Understand and adopt the ethical practice that are to be followed in the research activities as an idividual or in team	**Skill Development**
CO2	Analyze the work done by various researchers relevant to the research topic.	**Skill Development**
CO3	Integrate the relevant theory and practices followed in a logical way and draw appropriate conclusions.	**Skill Development**
CO4	Structure, organize and present the collected information or findings through proper documentation and presentation.	**Skill Development**
Prerequisites (if any)	MINOR PROJECT(MAH308B)	

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAN308	PROJECT (MAN318B)	CO1	-	-	-	-	-	-	-	3	3	-	-	-	3
		CO2	3	2	3	3	2	2	2	-	2	2	3	2	1
		CO3	3	2	3	3	2	2	2	-	2	2	3	2	2
		CO4	3	2	3	3	2	2	2	-	2	2	3	2	1

Course Title/Code	CAREER SKILL-III(CDO305)
Course Type	Audit Course
L-T-P Structure	3-0-0
Credits	0
Course Objective	To equip the students with the concepts of Permutation, combination, probability, verbal and non verbal reasoning .

Course Outcomes (COs)		Mapping
CO1	Students will be able to apply the short tricks on geometry & calculation problems.	Skill Development
CO2	Students will be able to solve problems on Modern Mathematics & Numbers.	Skill Development
CO3	Students will be able to analysis and solve data related problems.	Skill Development
CO4	Students will be able to use their vocabulary and grammar to solve complex questions	Skill Development
CO5	Students will be able to write formal text with accuracy and ease	Skill Development
CO6	Students will be able to develop speed reading	Skill Development
Prerequisites (if any)	**Career skill-I & II(CDO205, CDO303)**	

Part A – Quantitative Aptitude

Unit 1 : Permutation and Combination

    1.1 Principal of counting and Basic formulas

    1.2 Arrangements, Selection and Selection + Arrangement.

    1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.

Unit 2 : Probability

    2.1 Events and Sample Space, Basic Formulas.

    2.2 Problems on Coins, Cards and Dices.

    2.3 Conditional Probability, Bayes' Theorem and their Applications.

Unit 3: Verbal & Non-Verbal Reasoning

    3.1 Calendar

    3.2 Puzzle Test

    3.3 Non-Verbal Reasoning

Part B - Employability Enhancement

Unit 4: Professional Writing

    4.1. Profiling on Social Sites: LinkedIn, Facebook, Instagram

    4.2. Cover Letter/Emails

    4.3. Resume Writing

Unit 5: Group Discussions
  5.1. Do's and Dont's of a Group Discussion
  5.2. Roles played in a Group Discussion
  5.3. Tips for Cracking a Group Discussion
Unit 6: Managing Interviews
  6.1. Developing the employability mindset
  6.2. Preparing for Self -Introduction
  6.3. Researching the employer
  6.4. Portfolio Management
  6.5. Answering Questions in an Interview
Instructions for paper setting: Fifty MCQ will be set in total. All questions will be compulsory.
Each question will be of 1 mark. There will be no negative marking. Calculator not allowed. Time allotted would be 2 hours.

Assessment Tools:
Sessional tests
Term end examination scores
Class performance & Home assignments
Online assignments & Class attendance

TEXTBOOKS

1. A Modern Approach to Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd
2. Quicker Maths- M. Tyra , BSC publication

REFERENCE BOOKS

1. Quantitative Aptitude- Arun Sharma, Mc Graw Hill Publication.

Weblinks:

- http://www.indiabix.com/aptitude/questions-and-answers/
- http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/
- https://www.sawaal.com/

CO-PO Mapping

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CDO305	CAREER SKILL-III	CO1	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO4	1	-	-	1	-	-	-	-	1	3	-	2	2
		CO5	1	-	-	1	-	1	-	-	1	3	-	2	2
		CO6	1	2	-	1	1	1	1	1	1	3	1	2	2

			B.Sc(H)-Mathematics-MAU01												
			Department of Mathematics												
			Mapping of Cos with POs												
			Semester-I												
Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH107B	ALGEBRA	CO1	3	3	3	3	1	-	2	-	2	-	1	-	-
		CO2	3	3	3	3	2	-	2	-	2	-	-	-	-
		CO3	3	3	3	3	2	-	2	-	2	-	1	-	-
		CO4	3	3	1	3	1	-	2	-	2	-	-	-	-
MAH108B	CALCULUS – I	CO1	3	3	3	3	2	-	2	-	2	-	-	2	-
		CO2	3	3	3	3	2	-	2	-	2	-	2	2	-
		CO3	3	3	3	3	2	-	2	-	2	-	-	2	-
		CO4	3	3	3	3	2	-	2	-	2	-	2	2	-
		CO5	3	3	3	3	1	-	3	-	2	-	2	2	-
CSH105B-(T&P)	PROGRAMMING FOR PROBLEM SOLVING USING C	CO1	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO2	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO3	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO4	3	2	3	3	2	-	2	-	2	2	2	2	-
PHH106B (T & P)	ESSENTIALS OF PHYSICS	CO1	3	2	3	3	2	-	2	-	2	-	1	2	-
		CO2	3	3	2	2	2	-	2	-	2	-	2	2	-
		CO3	3	2	3	3	2	-	3	-	2	-	2	2	-
		CO4	2	3	2	2	2	-	2	-	2	-	2	2	-
		CO5	2	2	2	2	1	-	2	-	2	-	2	2	-
		CO6	3	2	3	3	2	-	2	-	2	-	1	2	-

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH109B	MATHS LAB –I	CO1	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO2	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO3	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO4	1	-	-	3	3	-	-	-	-	2	-	-	-
HLS102	COMMUNICATIVE ENGLISH	CO1	2	3	1	-	-	-	-	1	2	3	-	-	-
		CO2	2	3	1	-	-	-	-	1	2	3	-	-	-
		CO3	2	3	1	-	-	-	-	1	2	3	-	-	-
		CO4	2	3	1	-	-	-	-	1	2	3	-	-	-

Semester-II

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH 115 B	CALCULUS – II	CO1	3	2	3	3	2	-	2	-	2	2	2	1	-
		CO2	3	3	3	3	2	-	2	-	2	2	2	1	-
		CO3	3	3	3	3	2	-	2	-	2	2	2	2	-
		CO4	3	2	3	3	2	-	2	-	2	2	2	2	-
MAH111B	STATISTICS – I	CO1	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO2	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO3	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO4	3	2	3	3	1	-	2	-	2	2	2	-	2
		CO5	-	-	-	-	2	-	2	-	2	2	2	-	2
MAH112B	ORDINARY DIFFERENTIAL EQUATIONS	CO1	3	2	3	3	2	-	2	-	2	2	2	2	-
		CO2	2	1	1	2	2	-	2	-	2	2	2	2	-
		CO3	3	3	2	1	2	-	2	-	2	2	2	2	-
		CO4	3	3	3	1	3	-	2	-	2	3	2	2	-
MAH113B	GEOMETRY OF	CO1	2	1	-	2	-	-	-	-	2	2	-	-	-

Course Code	Course	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
	TWO AND THREE DIMENSIONS	CO2	2	1	-	2	-	-	-	-	2	2	-	-	-
		CO3	2	1	-	2	-	-	-	-	2	2	-	-	-
		CO4	2	1	-	2	-	-	-	-	2	2	-	-	-
MAH114B	MATHS LAB –II	CO1	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO2	1	-	-	3	3	-	-	-	-	2	-	-	-
		CO3	1	-	-	3	3	-	-	-	-	2	-	-	-
CHH 137	Environmental Science	CO1	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO2	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO3	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO4	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO5	-	2	-	-	-	-	-	-	2	2	-	-	-

Semester-III

Course Code	Course	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH204B	REAL ANALYSIS	CO1	3	3	3	3	1	-	2	-	1	1	1	-	-
		CO2	3	3	3	3	1	-	2	-	1	1	1	-	-
		CO3	3	3	3	3	2	-	2	-	2	1	1	-	-
		CO4	3	3	3	3	1	-	2	-	2	1	1	-	-
		CO5	3	3	3	3	2	-	2	-	1	1	-	-	-
MAH205B	STATISTICS – II	CO1	2	2	2	3	2	1	-	2	1	1	1	1	-
		CO2	2	2	2	3	2	1	-	2	1	1	1	1	-
		CO3	2	2	2	3	2	2	-	2	1	1	1	1	-
		CO4	3	2	3	3	3	3	-	3	3	2	2	2	1
MAH206B	GROUP THEORY	CO1	3	2	3	1	1	-	3	-	3	2	2	2	
		CO2	3	2	3	1	1	-	3	-	3	2	2	2	
		CO3	3	2	3	1	1	-	3	-	3	2	2	2	
		CO4	3	2	3	1	1	-	3	-	3	2	2	2	

Code	Course	CO													
		CO5	3	2	3	1	1	-	3	-	3	2	2	2	
MAH207B	PARTIAL DIFFERENTIAL EQUATIONS	CO1	3	2	3	3	2	-	2	-	3	2	3	3	2
		CO2	3	2	3	3	2	-	2	-	3	2	3	3	2
		CO3	3	2	3	3	2	-	2	-	3	2	3	3	2
		CO4	3	2	3	3	2	-	2	-	3	2	3	3	
MAH208B	MATHS LAB III	CO1	-		-	-	-		-	-	2	-	-	-	-
		CO2	-	3	-	-	-	2	-	-	-	-	-	-	-
		CO3	-	3	-	-	-	2	-	-	-	-	-	-	-
		CO4	-	3	-	-	-	2	-	-	-	-	-	-	-
		CO5	-	3	-	-	-	2	-	-	-	-	-	-	-
EDS288	APPLIED PHILOSOPHY	CO1	-	-	1	1	-	-	-	3	2	2	-	-	-
		CO2	-	-	-	1	-	-	-	3	2	2	-	-	-
		CO3	-	-	-	1	-	-	-	3	1	1	-	-	-
		CO4	-	-	-	1	-	-	-	3	2	2	-	-	-
		CO5	-	-	1	1	-	-	-	2	2	3	-	-	-
EDS289	APPLIED PSYCHOLOGY	CO1	-	3	-	-	-	-	-	2	2	3	-	-	3
		CO2	-	3	-	-	-	-	1	2	1	3	-	-	3
		CO3	-	3	-	-	-	-	-	3		3	-	-	2
		CO4	-	3	-	-	-	-	-	2	1	2	-	-	3
		CO5	-	3	-	-	-	-	-	2	1	2	-	-	3
EDS290	APPLIED SOCIOLOGY	CO1	-	2	-	-	-	-	-	-	-	-	-	-	-
		CO2	-	3	-	-	-	2	-	-	1	-	-	-	-
		CO3	-	-	-	-	-	-	-	3	1		-	-	-
		CO4	-	-	-	-	-	2	-	-	-	2	-	-	2
MCS231	BASICS OF ECONOMICS	CO1	-	-	1	1	-	-	-	1	1	1	1	1	1
		CO2	-	-	1	2	-	-	-	1	2	1	2	-	1
		CO3	-	-	1	2	-	-	-	1	1	1	1	-	1
		CO4	-	-	1	2	-	-	-	1	2	1	2	-	1
MCS232	INTRODUCTION TO	CO1	-	-	1	1	-	-	-	1	1	1	1	1	1

Code	Course	CO													
	FINANCE	CO2	-	-	1	2	-	-	-	1	2	1	2	-	1
		CO3	-	-	1	2	-	-	-	1	1	1	1	-	1
		CO4	-	-	1	2	-	-	-	1	2	1	2	-	1
CDO203	QUANTITATIVE APTITUDE - I	CO1	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO2	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO3	1	2	3	-	-	-	-	-	-	-	-	-	3
MAN209B	MINI PROJECT –I	CO1	-	-	-	-	3	-	-	-	-	-	-	-	-
		CO2	2	-	2	2	3	-	--	-	2	-	2	2	-
		CO3	-	-	-	-	2	3	-	-	-	-	-	-	-
		CO4	2	-	2	2	3	-	-	-	-	-	2	2	-
		CO5	-	-	-	-	-	-	-	3	-	2	-	-	-
		CO6	-	3	-	-	-	-	-	-	2	2	2	2	-
FLS103	FRENCH-I	CO1	-	3	-	-	-	-	1	3	2	1	-	-	
		CO2	1	3	1	-	1	-	1	-	1	-	-	1	
		CO3	2	3	2	-	2	-	3	-	1	-	-	1	-
		CO4	2	3	-	-	1	-	2	-	-	-	-	1	
		CO5	1	1	-	-	2	-	1	2	2	-	-	-	
FLS101	SPANISH-I GERMAN-I	CO1	-	3	-	-	-	-	1	3	2	1	-	-	-
		CO2	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO3	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO4	1	1	-	-	2	-	1	2	2	-	-	-	-
FLS102	GERMAN-I	CO1	-	3	-	-	-	-	1	3	2	1	-	-	-
		CO2	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO3	1	3	1	-	1	-	1	-	1	-	-	1	-
		CO4	1	1	-	-	2	-	1	2	2	-	-	-	-

Semester-IV

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PO13
MAH210B	ADVANCED ANALYSIS	CO1	3	3	3	3	-	1	2	-	2	-	-	-	-
		CO2	3	3	3	3	-	1	2	-	2	-	-	-	-
		CO3	3	3	3	3	-	-	2	-	2	-	-	-	-
		CO4	3	3	3	3	-	-	2	-	2	-	-	-	-
MAH211B	Advanced Algebra	CO1	3	2	3	-	2	-	2	-	2	-	-	-	-
		CO2	3	2	3	-	2	-	2	-	2	-	-	-	-
		CO3	3	2	3	-	2	-	2	-	2	-	-	-	-
		CO4	3	2	3	-	2	-	2	-	2	-	-	-	-
MAH212B	MECHANICS-I	CO1	3	2	3	3	-	-	2	2	2	2	2	1	2
		CO2	3	3	3	2	-	-	2	2	1	1	2	2	1
		CO3	3	2	2	2	-	-	2	1	1	2	1	2	2
		CO4	2	3	1	2	-	-	1	2	1	2	2	1	1
MAH213B	INTEGRAL TRANSFORMS & APPLICATION	CO1	3	3	2	3	1	1	2	-	2	1	1	-	-
		CO2	3	3	2	2	1	2	2	-	2	1	1	-	-
		CO3	3	2	2	3	1	1	2	-	2	1	1	-	-
		CO4	3	1	2	3	1	1	2	-	2	1	1	-	-
MAH214B	SET THEORY AND NUMBER THEORY	CO1	3	3	2	3	2	1	2	-	2	1	2	-	-
		CO2	3	3	3	3	2	2	2	-	2	1	2	-	-
		CO3	3	2	3	2	1	1	2	-	2	1	1	-	-
		CO4	3	2	3	2	1	-	2	-	2	1	1	-	-
CSH210 B- T & P	DATA STRUCTURES	CO1	3	3	2	2	1	2	1	1	1	1	1	1	2
		CO2	3	3	2	2	1	2	1	1	1	1	1	1	1
		CO3	3	3	2	2	1	2	1	1	1	1	1	1	1
		CO4	3	3	2	2	1	2	1	1	1	1	1	1	-
MAH215B	ACTUARIAL	CO1	1	2	3	2	3	2	2	1	1	2	2	1	1

Code	Course	CO													
	STATISTICS	CO2	1	2	3	2	3	2	2	1	1	2	2	1	1
		CO3	2	2	3	2	3	2	2	1	1	2	2	1	1
		CO4	2	2	3	2	3	2	2	1	1	2	2	1	1
MAH216B	SURVEY SAMPLING AND INDIAN OFFICIAL STATISTICS	CO1	3	1	2	-	3	-	1	-	3	3	3	2	3
		CO2	3	1	2	-	3	-	1	-	3	3	3	2	3
		CO3	3	1	2	-	3	-	1	-	3	3	3	2	3
		CO4	3	1	2	-	3	-	1	-	3	3	3	2	3
CHS234	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT	CO1	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO2	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO3	-	2	-	-	-	-	-	-	2	2	-	-	-
		CO4	-	2	-	-	-	-	-	-	2	2	-	-	-
ECS306B	E-Waste: Environmental Problems and Management	CO1	1	1	3	-	-	-	-	2	2	3	2	1	1
		CO2	1	1	3	-	-	-	-	2	2	3	2	1	1
		CO3	1	1	3	-	-	-	-	2	2	3	2	1	1
		CO4	1	1	3	-	-	-	-	2	2	3	2	1	1
CDO204	QUANTITATIVE APTITUDE-II	CO1	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO2	1	2	3	-	-	-	-	-	-	-	-	-	3
		CO3	1	2	3	-	-	-	-	-	-	-	-	-	3

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
LWS 323	CYBER CRIMES & LAWS	CO1	2	1	-	-	-	-	2	-	-	1	-	3	-
		CO2	3	2	-	-	-	-	-	-	2	-	-	1	1
		CO3	3	1	2	-	-	-	-	1	-	-	-	2	1
		CO4	3	1	-	-	-	-	-	-	-	-	-	3	1
MAN218B	MINI PROJECT –II	CO1	2	-	2	-	3	-	-	1	2	2	2	2	-
		CO2	2	-	2	-	3	2	2	-	2	-	-	-	-
		CO3	-	2	-	-	3	2	2	-	2	2	2	2	-
		CO4	-	2	-	-	3	-	-	-	2	2	2	2	-
CDO205	CAREER SKILLS –I	CO1	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO4	1	-	-	1	-	-	-	-	1	3	-	2	2

Semester-V

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH301B	NUMERICAL ANALYSIS	CO1	3	1	3	2	3	-	2	-	3	2	3	3	2
		CO2	3	1	3	2	3	-	2	-	3	2	3	3	2
		CO3	3	1	3	2	3	-	2	-	3	2	3	3	2
		CO4	3	1	3	2	3	-	2	-	3	2	3	3	2
MAH302B	LINEAR ALGEBRA	CO1	3	3	3	3	2	1	2	-	2	1	2	-	-
		CO2	3	3	3	3	2	2	2	-	2	1	2	-	-
		CO3	3	2	3	2	1	1	2	-	2	1	1	-	-
		CO4	3	1	3	1	1	-	2	-	2	1	1	-	-
MAH303B	METRIC SPACES	CO1	3	2	3	2	3	-	2	-	2	1	1	-	-
		CO2	3	2	3	2	3	-	2	-	2	1	1	-	-
		CO3	3	2	3	2	3	-	2	-	2	1	1	-	-
		CO4	3	2	3	2	3	-	2	-	2	1	1	-	-
MAH304B	INFORMATION	CO1	3	3	3	3	-	-	1	-	1	1	1	1	-

Code	Course	CO													
	THEORY AND CODING	CO2	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO3	3	3	3	3	-	-	2	-	1	1	1	1	-
		CO4	3	3	3	3	-	-	2	-	2	1	1	2	-
		CO5	3	3	3	3	-	-	2	-	2	1	1	2	-
CSH321B-T&P	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	CO1	2	1	2	1	-	-	-	-	1	-	1	1	-
		CO2	3	1	3	2	3	-	-	-	2	1	3	2	-
		CO3	2	2	3	3	3	-	-	-	3	2	3	2	-
		CO4	3	2	3	2	2	-	-	-	2	1	3	2	-
		CO5	1	1	2	-	-	1	-	1	1	-	2	1	-
MAH305B	MATHEMATICS OF FINANCE	CO1	3	3	3	3	2	-	2	-	2	1	-	-	1
		CO2	-	3	3	3	2	-	2	-	2	2	2	-	1
		CO3	3	3	3	3	2	-	2	-	2	2	2	-	1
		CO4	3	3	3	3	2	-	2	-	2	2	2	-	1
MAH306B	STATISTICAL INFERENCES	CO1	1	2	3	3	3	2	1	1	1	2	2	2	2
		CO2	1	2	3	3	3	2	1	1	1	2	2	2	2
		CO3	1	2	3	3	3	2	1	1	1	2	2	2	2
		CO4	1	2	3	3	3	2	1	1	1	2	2	2	2
MAH307B	MATHS LAB IV	CO1	1	-	-	2	-	3	-	-	3	-	-	-	-
		CO2	1	-	-	2	-	3	-	-	3	-	-	-	-
		CO3	1	-	-	2	-	3	-	-	3	-	-	-	-
		CO4	1	-	-	-	-	3	-	-	3	-	-	-	-
		CO5	-	-	-	-	-	3	-	-	3	-	-	-	-
MAN308B	MINOR PROJECT	CO1	3	2	3	3	2	2	1		3	2	2	2	-
		CO2	-	-	-	-	-	3	-	-	-	-	-	-	-
		CO3	3	2	3	3	2	2	1	-	3	2	2	2	-
		CO4	-	-	-	-	-	-	-	-	-	3	-	-	-
CDO303	CAREER SKILL-II	CO1	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	1

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
		CO4	1	-	-	1	-	-	-	-	1	3	-	2	2
		CO5	1	-	-	1	-	1	-	-	1	3	-	2	2
		CO6	1	2	-	1	1	1	1	1	1	3	1	2	2
Semester-VI															

Course Code	Course Name	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
MAH309B	LINEAR PROGRAMMING & GAME THEORY	CO1	3	1	2	3	2	-	-	-	-	2	2	1	1
		CO2	3	1	2	3	2	-	1	1	1	2	2	1	1
		CO3	3	1	2	3	2	-	1	1	1	2	2	1	1
		CO4	3	1	2	3	2	-	1	1	1	2	2	1	1
MAH310B	MECHANICS-II	CO1	3	2	3	3	-	-	2	2	2	2	2	1	2
		CO2	3	3	3	2	-	-	2	2	1	1	2	2	1
		CO3	3	2	2	2	-	-	2	1	1	2	1	2	2
		CO4	3	2	2	2	-	-	2	1	1	2	1	2	2
MAH311B	DISCRETE MATHEMATICS	CO1	3	3	3	3	-	-	2	-	2	-	-	-	-
		CO2	3	3	3	3	-	-	2	-	2	-	-	-	-
		CO3	3	3	3	3	1	-	2	-	2	-	1	-	-
		CO4	3	3	3	3	2	-	2	-	2	-	1	-	-
		CO5	-	-	-	-	-	3	1	-	2	-	2	3	-
MAH312B	MATHEMATICAL MODELING-	CO1	3	3	-	3	2	1	-	-	-	2	3	1	-
		CO2	3	3	2	3	2	1	-	-	-	2	3	1	-
		CO3	3	3	2	3	2	1	-	-	-	2	3	1	-
		CO4	3	3	2	3	2	1	-	-	-	2	3	1	-
MAH313B	APPLICATIONS OF ALGEBRA	CO1	3	3	3	-	1	-	2	-	2	-	2	-	-
		CO2	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO3	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO4	3	3	3	2	1	-	2	-	2	-	2	-	-
		CO5	3	3	3	2	1	-	2	-	2	-	2	-	-

Code	Course	CO													
		CO6	3	3	3	2	1	-	2	-	2	-	2	-	-
MAH314B	INDUSTRIAL MATHEMATICS	CO1	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO2	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO3	3	3	3	3	2	-	2	-	2	2	3	1	2
MAH315B	BIO-MATHS	CO1	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO2	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO3	3	3	3	3	2	-	2	-	2	2	3	1	2
		CO4	3	3	3	3	2	-	2	-	2	2	3	1	-
MAH316B	CRYPTOGRAPHY	CO1	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO2	3	3	3	3	-	-	1	-	1	1	1	1	-
		CO3	3	3	3	3	-	-	2	-	1	1	1	1	-
		CO4	3	3	3	3	-	-	2	-	2	1	2	2	-
CSH322B-T & P	FUNDAMENTALS OF MACHINE LEARNING	CO1	3	1	3	2	2	3	2	-	1	-	1	1	1
		CO2	3	1	3	2	2	3	2	-	1	-	1	1	1
		CO3	3	2	3	2	3	3	2	3	1	1	1	2	1
		CO4	3	2	3	2	3	3	2	3	1	1	1	2	1
MCH393	MANAGEMENT OF BANKING & INSURANCE	CO1	1	2	1	-	-	2	-	1	1	2	1	1	1
		CO2	2	1	2	1	-	2	2	1	1	1	1	1	2
		CO3	1	1	2	1	2	1	-	2	1	-	2	-	1
		CO4	2	1	2	-	2	1	-	2	2	-	-	1	1
MAH317B	ECONOMETRICS	CO1	2	2	1	3	-	2	-	-	1	-	2	-	1
		CO2	2	2	1	3	-	2	-	-	1	-	2	-	1
		CO3	2	2	1	3	-	2	-	-	1	-	2	-	1
		CO4	2	2	1	3	-	2	-	-	1	-	2	-	1
MCH109	ENTREPRENEURIAL THEORY AND PRACTICES	CO1	1	2	1	-	-	2	-	1	1	2	1	1	1
		CO2	2	1	2	1		2	3	1	3	1	1	1	2
		CO3	1	1	2	1	2	1	-	2	1	-	2	-	1

Code	Course	CO													
		CO4	2	1	3	-	2	1	-	2	2	-	-	1	1
MAN318B	PROJECT	CO1	-	-	-	-	-	-	-	3	3	-	-	-	3
		CO2	3	2	3	3	2	2	2	-	2	2	3	2	1
		CO3	3	2	3	3	2	2	2	-	2	2	3	2	2
		CO4	3	2	3	3	2	2	2	-	2	2	3	2	1
CDO305	CAREER SKILL-III	CO5	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO2	1	-	-	2	-	-	-	-	-	-	-	-	1
		CO3	1	-	-	-	-	1	-	-	-	-	-	1	1
		CO4	1	-	-	1	-	-	-	-	1	3	-	2	2
		CO5	1	-	-	1	-	1	-	-	1	3	-	2	2
		CO6	1	2	-	1	1	1	1	1	1	3	1	2	2