

**HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION
FOR B. Sc. WITH MATHEMATICS**

Sem	Course Code	Course Type	Title of Paper	Credits (TH+T)*
I	MATH101TH	CORE COURSE	DIFFERENTIAL CALCULUS	5+1=6
I		CORE COURSE	(C2A)	6
I		CORE COURSE	(C3A)	6
I		A.E.C. COURSE	AECC1	4
II	MATH201TH	CORE COURSE	DIFFERENTIAL EQUATIONS	5+1=6
II		CORE COURSE	(C2B)	6
II		CORE COURSE	(C3B)	6
II		A.E.C. COURSE	AECC 2	4
III	MATH301TH	CORE COURSE	REAL ANALYSIS	5+1=6
III		CORE COURSE	(C2C)	6
III		CORE COURSE	(C3C)	6
		SKILL ENHANCEMENT COURSE	SEC 1: CHOOSE ONE OUT OF THE FOLLOWING	4
III	MATH302TH	SEC 1	LOGIC AND SETS	
III	MATH303TH	SEC 1	ANALYTICAL GEOMETRY	
III	MATH304TH	SEC 1	INTEGRAL CALCULUS	
IV	MATH401TH	CORE COURSE	ALGEBRA	5+1=6
IV		CORE COURSE	(C2D)	6
IV		CORE COURSE	(C3D)	6
		SKILL ENHANCEMENT COURSE	SEC 2: CHOOSE ONE OUT OF THE FOLLOWING	4
IV	MATH402TH	SEC 2	VECTOR CALCULUS	
IV	MATH403TH	SEC 2	THEORY OF EQUATIONS	
IV	MATH404TH	SEC 2	NUMBER THEORY	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1A (MATH): CHOOSE ONE CHOOSE ONE OUT OF THE FOLLOWING	5+1=6
V	MATH501TH	DSE 1A	MATRICES	
V	MATH502TH	DSE 1A	MECHANICS	
V	MATH503TH	DSE 1A	LINEAR ALGEBRA	
V		DISCIPLINE SPECIFIC ELECTIVE	DSE2A	6
V		DISCIPLINE SPECIFIC ELECTIVE	DSE3A	6

		SKILL ENHANCEMENT COURSE	SEC 3: CHOOSE ONE OUT OF THE FOLLOWING	4
V	MATH504TH	SEC 3	PROBABILITY AND STATISTICS	
V	MATH505TH	SEC 3	MATHEMATICAL FINANCE	
V	MATH506TH	SEC 3	MATHEMATICAL MODELING	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1B (MATH): CHOOSE ONE OUT OF THE FOLLOWING	5+1=6
VI	MATH601TH	DSE 1B	NUMERICAL METHODS	
VI	MATH602TH	DSE 1B	COMPLEX ANALYSIS	
VI	MATH603TH	DSE 1B	LINEAR PROGRAMMING	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 2B	6
		DISCIPLINE SPECIFIC ELECTIVE	DSE3B	6
		SKILL ENHANCEMENT COURSE	SEC 4: CHOOSE ONE OUT OF THE FOLLOWING	4
VI	MATH604TH	SEC 4	BOOLEAN ALGEBRA	
VI	MATH605TH	SEC 4	TRANSPORTATION AND GAME THEORY	
VI	MATH606TH	SEC 4	GRAPH THEORY	
			TOTAL CREDITS	132

(*) TH: THEORY, T: TUTORIAL

**HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION
FOR B.A. WITH MATHEMATICS**

Sem	Course Code	Course Type	Title of Paper	Credits (TH+T)*
I	MATH101TH	CORE COURSE	DIFFERENTIAL CALCULUS	5+1=6
I		CORE COURSE	(C2A)	6
I		ENGLISH/MIL-1	(C3A)	6
I		A.E.C. COURSE	AECC 1	4
II	MATH201TH	CORE COURSE	DIFFERENTIAL EQUATIONS	5+1=6
II		CORE COURSE	(C2B)	6
II		MIL/ENGLISH-1	(C3B)	6
II		A.E.C. COURSE	AECC 2	4
III	MATH301TH	CORE COURSE	REAL ANALYSIS	5+1=6
III		CORE COURSE	(C2C)	6
III		ENGLISH/MIL-1I	(C3C)	6
		SKILL ENHANCEMENT COURSE	SEC 1: CHOOSE ONE OUT OF THE FOLLOWING	4
III	MATH302TH	SEC 1	LOGIC AND SETS	
III	MATH303TH	SEC 1	ANALYTICAL GEOMETRY	
III	MATH304TH	SEC 1	INTEGRAL CALCULUS	
IV	MATH401TH	CORE COURSE	ALGEBRA	5+1=6
IV		CORE COURSE	(C2D)	6
IV		MIL/ENGLISH-1I	(C3D)	6
		SKILL ENHANCEMENT COURSE	SEC 2: CHOOSE ONE OUT OF THE FOLLOWING	4
IV	MATH402TH	SEC 2	VECTOR CALCULUS	
IV	MATH403TH	SEC 2	THEORY OF EQUATIONS	
IV	MATH404TH	SEC 2	NUMBER THEORY	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1A (MATH): CHOOSE ONE CHOOSE ONE OUT OF THE FOLLOWING	5+1=6
V	MATH501TH	DSE 1A	MATRICES	
V	MATH502TH	DSE 1A	MECHANICS	
V	MATH503TH	DSE 1A	LINEAR ALGEBRA	
V		DISCIPLINE SPECIFIC ELECTIVE	DSE2A	6
V				
		SKILL ENHANCEMENT COURSE	SEC 3: CHOOSE ONE OUT OF THE FOLLOWING	4

V	MATH504TH	SEC 3	PROBABILITY AND STATISTICS	
V	MATH505TH	SEC 3	MATHEMATICAL FINANCE	
V	MATH506TH	SEC 3	MATHEMATICAL MODELING	
		GENERIC ELECTIVE	GE 1: CHOOSE ONE OUT OF THE FOLLOWING	6
V	MATH507TH	GE 1	PORTFOLIO OPTIMIZATION	
V	MATH508TH	GE 1	QUEUEING AND RELIABILITY THEORY	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1B (MATH): CHOOSE ONE OUT OF THE FOLLOWING	5+1=6
VI	MATH601TH	DSE 1B	NUMERICAL METHODS	
VI	MATH602TH	DSE 1B	COMPLEX ANALYSIS	
VI	MATH603TH	DSE 1B	LINEAR PROGRAMMING	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 2B	6
		SKILL ENHANCEMENT COURSE	SEC 4: CHOOSE ONE OUT OF THE FOLLOWING	4
VI	MATH604TH	SEC 4	BOOLEAN ALGEBRA	
VI	MATH605TH	SEC 4	TRANSPORTATION AND GAME THEORY	
VI	MATH606TH	SEC 4	GRAPH THEORY	
		GENERIC ELECTIVE	GE 2: CHOOSE ONE OUT OF THE FOLLOWING	6
VI	MATH607TH	GE 2	DESCRIPTIVE STATISTICS AND PROBABILITY THEORY	
VI	MATH608TH	GE 2	SAMPLE SURVEYS AND DESIGN OF EXPERIMENTS	
			TOTAL CREDITS	132

(*) TH: THEORY, T: TUTORIAL

HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION
FOR B.Sc. (Hons.) MATHEMATICS FOR 1ST
AND IIND (FIRST TWO) SEMESTERS ONLY
W.E.F. SESSION 2016-2017

Sem	Course Code	Course Type	Title of Paper	Credits
I	MATH102TH	CORE COURSE (THEORY)	CALCULUS	4
I	MATH102PR	CORE COURSE (PRACTICAL)	CALCULUS	2
I	MATH103TH	CORE COURSE (THEORY)	ALGEBRA	5+1=6
I		AEC COURSE	AECC1	4
		GENERIC ELECTIVE	GE 1: CHOOSE ONE OUT OF THE FOLLOWING	
I	MATH104TH	(GE) THEORY	OBJECT ORIENTED PROGRAMMING IN C++	4
I	MATH104PR	(GE) PRACTICAL	OBJECT ORIENTED PROGRAMMING IN C++	2
I	MATH105TH (MATH505TH) (*)	(GE) THEORY	MATHEMATICAL FINANCE (*)	5+1=6
II	MATH202TH	CORE COURSE (THEORY)	REAL ANALYSIS	5+1=6
II	MATH203TH	CORE COURSE (THEORY)	DIFFERENTIAL EQUATIONS	4
II	MATH203PR	CORE COURSE (PRACTICAL)	DIFFERENTIAL EQUATIONS	2
II		AEC COURSE	AECC1	4
		GENERIC ELECTIVE	GE 1: CHOOSE ONE OUT OF THE FOLLOWING	
II	MATH204TH	(GE) THEORY	FINITE ELEMENT METHODS	5+1=6
II	MATH205TH	(GE) THEORY	ECONOMETRICS	5+1=6

(*): THESE TWO COURSES (WITH COURSE CODES: MATH105TH & MATH505TH) HAVE SAME SYLLABUS (COURSE CONTENT).

**End-semester Examination (ESE) and Comprehensive Continuance Assessment
(CCA) Scheme of Three years Degree of
B.Sc. Physical Sciences/B.A./B.Sc. with Mathematics**

Scheme for Examination for each course

- ❖ The medium of instructions and Examinations shall be English only.
- ❖ ESE Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by H.P. University, Shimla-5, time to time.
- ❖ Each course of 4/6 credits (theory + Tutorial) will carry 100 marks and will have following components:

(FOR COURSES WITHOUT PRACTICALS)

I.	Theory marks	70
	a) End-Semester Examination (ESE) marks	70
II.	Comprehensive Continuous Assessment (CCA) marks	30
	a) Assignment/Class Test/Quiz/Seminar/Model marks	10
	b) Mid-Term Examination (One Test) marks	15
	c) Attendance marks	05

- ❖ **Minimum Pass Percentage in each component (ESE & CCA shall be 40% separately**
- ❖ **Criterion for Class-room attendance (05 marks)**

75% Attendance is minimum eligibility condition.

- i) Attendance \geq 75% but $<$ 80% 1 mark**
- ii) Attendance \geq 80% but $<$ 85% 2 marks**
- iii) Attendance \geq 85% but $<$ 90% 3 marks**
- iv) Attendance \geq 90% but $<$ 95% 4 marks**
- v) Attendance \geq 95% 5 marks**

NOTE: For correspondence mode (ICDEOL) students enrolled for B.A. with Mathematics Degree/Course, the total marks for each theory paper shall be 100 and there shall be no CCA Component. Further, the tutorial in any course shall be counted in theory credits for correspondence mode students.

**End-semester Examination (ESE) and Comprehensive Continuance Assessment
(CCA) Scheme of Three years Degree of**

B.Sc. (Hons.) with Mathematics/B.Sc./B.A. with Mathematics/B.Sc. Physical Sciences

Scheme for Examination for each course

- ❖ The medium of instructions and Examinations shall be English only.
- ❖ ESE & Practical Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by H.P. University, Shimla-5, time to time.
- ❖ Each course of 4/6 credits (theory + Practicals) will carry 100 marks and will have following components:

(FOR COURSES WITH PRACTICALS)

I.	Theory marks	40
	a) End-Semester Examination (ESE) marks	40
II.	Comprehensive Continuous Assessment (CCA) marks	30
	a) Assignment/Class Test/Quiz/Seminar/Model marks	10
	b) Mid-Term Examination (One Test) marks	15
	c) Attendance marks	05
III.	Practical marks	30

Practical examination will have following components:

- | | |
|--|------------------|
| a) Performing the two practical exercises assigned by the Examiner in terms of requirement of chemicals/Practicals/Theory/reaction (if any) involved, procedure/scheme/Observations/calculations and results. | 7.5 + 7.5 |
| b) Viva-voce examinations | 5 marks |
| c) Practical note book | 5 marks |
| d) Regularity during practical classes | 5 marks |
- ❖ Minimum Pass Percentage in each component (ESE, CCA & Practical) shall be 40%, separately
 - ❖ Criterion for Class-room attendance (05 marks)

75% Attendance is minimum eligibility condition.

- i) Attendance $\geq 75\%$ but $< 80\%$ 1 mark**
- ii) Attendance $\geq 80\%$ but $< 85\%$ 2 marks**
- iii) Attendance $\geq 85\%$ but $< 90\%$ 3 marks**
- iv) Attendance $\geq 90\%$ but $< 95\%$ 4 marks**
- v) Attendance $\geq 95\%$ 5 marks**

Himachal Pradesh University
Summer Hill, Shimla-171005



Syllabus and Scheme of Examination

For

B.Sc. Physical Sciences

(Physics, Chemistry & Mathematics)

&

B.Sc. Physical Sciences

(Physics, Chemistry & Computer Science)

&

B. Sc. with Mathematics

&

B.A. with Mathematics

Courses

under the

Choice Based Credit System

w.e.f.

Session 2016 -17 onwards

Details of Courses under B. Sc. Physical Sciences/B.Sc.with Mathematics/B.A. with Mathematics

Course *Credits

	Theory + Practical	Theory + Tutorials
I. Core Course	$12 \times 4 = 48$	$12 \times 5 = 60$
(12 Papers) 04 Courses from each of the 03 disciplines of choice		
Core Course Practical / Tutorial*	$12 \times 2 = 24$	$12 \times 1 = 12$
(12 Practical/ Tutorials*) 04 Courses from each of the 03 Disciplines of choice		
II. Elective Course	$6 \times 4 = 24$	$6 \times 5 = 30$
(6 Papers) Two papers from each discipline of choice including paper of interdisciplinary nature.		
Elective Course Practical / Tutorials*	$6 \times 2 = 12$	$6 \times 1 = 6$
(6 Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature		
• Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester		
III. Ability Enhancement Courses		
1.Ability Enhancement Compulsory	$2 \times 4 = 8$	$2 \times 4 = 8$
(2 Papers of 4 credits each) Environmental Science English/MIL Communication		

2. Skill Enhancement Course **4×4 = 16**
(Skill Based) (4 Papers of 4 credits each)

4×4 = 16

Total credit = 132

Total credit = 132

***wherever there is practical there will be no tutorials and vice -versa**

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

First Semester

Course Code	MATH101TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Differential Calculus
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 1.1: Differential Calculus

Unit-I (12 hrs.)

Limit and Continuity (epsilon and delta definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Indeterminate forms.

Unit-II (12 hrs.)

Rolle's theorem, Lagrange's & Cauchy Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series. Maclaurin's series of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$,

Unit-III (12 hrs.)

Concavity, Convexity & Points of Inflexion, Curvature, Asymptotes, Singular points, Parametric representation of curves and tracing of curves in parametric form, Polar coordinates and tracing of curves in polar coordinates.

Unit-IV (12 hrs.)

Functions of several variables (upto three variables): Limit and Continuity of these functions Partial differentiation, Euler's theorem on homogeneous functions, Maxima and Minima with Lagrange Multipliers Method, Jacobian.

Books Recommended:

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Second Semester

Course Code	MATH201TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Differential Equations
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 2.1: Differential Equations

Unit-I (12 hrs.)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x , y , p . Methods for solving higher-order differential equations.

Unit-II (12 hrs.)

Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters,

Unit-III (12 hrs.)

The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations(PDE), Linear partial differential equation of first order, Lagrange's method.

Unit-IV(12 hrs.)

Charpit's method for solving PDE, Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH301TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Real Analysis
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 3.1: Real Analysis

Unit-I(12 hrs.)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of \mathbb{R} , Archimedean property of \mathbb{R} , intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Unit-II (12 hrs.)

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Unit-III(12 hrs.)

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Unit-IV (12 hrs.)

Sequences and series of functions, Pointwise and uniform convergence. M_n -test, M-test, Results about uniform convergence, integrability and differentiability of functions (Statements only), Power series and radius of convergence.

Books Recommended

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH401TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Algebra
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 4.1: Algebra

Unit-I (12 hrs.)

Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group $U(n)$ of units under multiplication modulo n . Cyclic groups from number systems, complex roots of unity, the general linear group $GL_n(n, R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group $Sym(n)$,

Unit-II (12 hrs.)

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the

commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element,

Unit-III (12 hrs.)

Normal subgroups: their definition, examples, and characterizations, Quotient groups
Fundamental theorem of Homomorphism. Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, \mathbb{Z}_n the ring of integers modulo n .

Unit-IV (12 hrs.)

Rings of matrices, polynomial rings, Subrings and ideals, Integral domains and fields, examples of fields: \mathbb{Z}_p , \mathbb{Q} , \mathbb{R} , and \mathbb{C} .

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH302TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Logic and Sets
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 1.1: Logic and Sets

Unit-I (12 hrs.)

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit-II (12 hrs.)

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit-III(12 hrs.)

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit-IV (12 hrs.)

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

Book Recommended

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH303TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Analytical Geometry
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 1.2: Analytical Geometry

Unit-I (12 hrs.)

Techniques for sketching parabola, ellipse and hyperbola, Reflection properties of parabola, ellipse and hyperbola

Unit-II (12 hrs.)

Classification of quadratic equations representing lines, parabola, ellipse and hyperbola,

Unit-III (12 hrs.)

Sphere. Plane section of a sphere. Sphere through a given circle. Intersection of two spheres.

Radical plane. Radical line and Radical point in spheres. Co-axial system of spheres.

Unit-IV (12 hrs.)

Cylindrical surfaces, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd., 2002.
3. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.
4. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH304TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Integral Calculus
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 1.3: Integral Calculus

Unit-I (12 hrs.)

Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals.

Unit-II (12 hrs.)

Reduction Formulae, $\int \sin^n x \, dx$, $\int \cos^n x \, dx$, $\int e^{ax} x^n \, dx$, $\int x^n (\log x)^m \, dx$, $\int x^n \sin x \, dx$, $\int x^n \cos x \, dx$, $\int \sin^n x \cos^n x \, dx$, $\int_0^{\pi/2} \sin^n x \, dx$, $\int_0^{\pi/2} \cos^n x \, dx$, $\int_0^{\pi/2} \sin^n x \cos^n x \, dx$. Reduction by connecting two integrals (Smaller Index + 1 Method).

Unit-III (12 hrs.)

Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution.

Unit-IV (12 hrs.)

Double and Triple integrals.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH402TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Vector Calculus
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 2.1: Vector Calculus

Unit -I(12 hrs.)

Scalar and vector product of three vectors. Product of four vectors. Reciprocal vectors. Vector differentiation, Scalar valued point functions, vector valued point functions. Derivative along a curve, directional derivatives.

Unit –II(12 hrs.)

Gradient of a scalar point function. Geometrical interpretation of gradient of a scalar point function

($\text{grad}\phi$). Divergence and curl of a vector point function. Character of divergence and curl of a vector point function. Gradient, Divergence and Curl of sums and products and their related vector identities. Laplacian operator.

Unit -III(12 hrs.)

Orthogonal curvilinear coordinates. Conditions for orthogonality. Fundamental triads of mutually orthogonal unit vectors. Gradient, Divergence, Curl and Laplacian operators in terms of orthogonal curvilinear coordinators.

Cylindrical and Spherical coordinates: relation between Cartesian and cylindrical or spherical coordinates.

Unit - IV(12 hrs.)

Vector integration: line integral, surface integral, Volume integral

Theorems of Gauss, Green and Stokes (without proof) and the problems based on these theorems.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.

2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.

3. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH403TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Theory of Equations
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 2.2: Theory of Equations

Unit-I (12 hrs.)

General properties of polynomials, Graphical representation of a polynomials, maximum and

minimum values of a polynomials, General properties of equations,
Unit-II (12 hrs.)

Descarte's rule of signs for positive and negative roots, Relation between the roots and the coefficients of equations.

Unit-III (12 hrs.)

Symmetric functions, Applications symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations.

Unit-IV (12 hrs.)

Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Books Recommended

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH404TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Number Theory
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 2.3: Number Theory

Unit-I (12 hrs.)

Division algorithm, Lame's theorem, linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem, Goldbach conjecture,

Unit-II (12 hrs.)

Binary and decimal representation of integers, linear congruences, complete set of residues.

Unit-III (12 hrs.)

Number theoretic functions, sum and number of divisors, totally multiplicative functions,

Unit-IV (12 hrs.)

Definition and properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function.

Books Recommended:

1. David M. Burton, *Elementary Number Theory* 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple*, CRC Press, Boca Raton, 2000.
3. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH504TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Probability and Statistics
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.1: Probability and Statistics

Unit-I (12 hrs.)

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions,

Unit-II (12 hrs.)

Mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform,

Unit-III (12 hrs.)

Binomial, Poisson, continuous distributions: uniform, normal, exponential.

Unit-IV (12 hrs.)

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

Books Recommended:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application*, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Model*, 9th Ed., Academic Press, Indian Reprint, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH505TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Mathematical Finance
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.2: Mathematical Finance

Unit-I (12 hrs.)

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money.

Unit-II (12 hrs.)

Inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR.

Unit-III (12 hrs.)

Bonds, bond prices and yields. Floating-rate bonds, immunization.
Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation).

Unit-IV (12 hrs.)

Random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).

Books Recommended:

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.
2. John C. Hull, *Options, Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH506TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Mathematical Modeling
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.3: Mathematical Modeling

Unit-I (12 hrs.)

Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion.

Unit-II (12 hrs.)

resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

Unit-III (12 hrs.)

Applications to Traffic Flow. Vibrating string, vibrating membrane,

Unit-IV (12 hrs.)

Conduction of heat in solids, gravitational potential, conservation laws.

Books Recommended:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH604TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Boolean Algebra
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance	Max. Marks:30

(Marks Attendance: 5 marks to be given as per the regulations)	
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC4.1: Boolean Algebra

Unit-I (12 hrs.)

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements,

Unit-II (12 hrs.)

Lattices as ordered sets, complete lattices, lattices as algebraic structures, sub lattices, products and homomorphisms.

Unit-III (12 hrs.)

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials

Unit-IV (12 hrs.)

Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Books Recommended:

1. BA.Davey and H.A.Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Rudolf Lidland and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH605TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Transportation and Game Theory
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 4.2: Transportation and Game Theory

Unit-I (12 hrs.)

Transportation problem and its mathematical formulation. northwest-corner method, least cost method ,

Unit-II (12 hrs.)

Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem,

Unit-III (12 hrs.)

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit-IV (12 hrs.)

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure.

Books Recommended:

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

2. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.

3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH606TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Graph Theory
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC4.3: Graph Theory Unit-I (12 hrs.)

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs.

Unit-II (12 hrs.)

Isomorphism of graphs, paths and circuits, Eulerian circuits.

Unit-III (12 hrs.)

Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem.
Unit-IV (12 hrs.)

Shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Books Recommended:

1. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory* 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.

2. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH501TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Matrices
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1A.1: Matrices

Unit-I (12 hrs.)

Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto three.

Unit-II(12 hrs.)

Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Unit-III(12 hrs.)

Definition of Vector space, \mathbb{R} , \mathbb{R}^2 , \mathbb{R}^3 as vector spaces over \mathbb{R} , Concept of Linear dependence/Independence, Standard basis for \mathbb{R} , \mathbb{R}^2 , \mathbb{R}^3 , Examples of different bases. Subspaces of \mathbb{R}^2 , \mathbb{R}^3 .

Unit-IV (12 hrs.)

Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigenvalues and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Books Recommended

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, *Theory and Problems of Matrix Operations*, Tata McGraw Hill, 1989.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Course Code	MATH502TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Mechanics
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1A.2: Mechanics

Unit-I (12 hrs.)

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body.

Unit-II(12 hrs.)

Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity.

Unit-III(12 hrs.)

Work and potential energy. Velocity and acceleration of a particle along a curve, Radial and transverse components (plane curve), tangential and normal components (space curve).

Unit-IV(12 hrs.)

Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

Books Recommended

1. A.S. Ramsay, *Statics*, CBS Publishers and Distributors (Indian Reprint), 1998.

2. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH503TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Linear Algebra
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1A.3: Linear Algebra

Unit-I (12 hrs.)

Vector spaces, subspaces, algebra of subspaces, quotient spaces.

Unit-II (12 hrs.)

linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit-III (12 hrs.)

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix

representation of a linear transformation, algebra of linear transformations.

Unit-IV (12 hrs.)

Dual Space, Dual Basis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial.

Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.

2. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

3. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.

4. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH601TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Numerical Methods
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1B.1: Numerical Methods

Unit-I (12 hrs.)

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition,

Unit-II (12 hrs.)

Gauss-Jacobi, Gauss-Siedel and SOR iterative methods, Lagrange and Newton interpolation: linear and higher order,.

Unit-III (12 hrs.)

Finite difference operators, Numerical differentiation: Newton's forward difference and backward difference method, Sterling's Central difference method.

Unit-IV (12 hrs.)

Integration: Trapezoidal rule, Simpson's rule, Euler's method.

Recommended Books

1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH602TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Complex Analysis
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1B.2: Complex Analysis

Unit-I (12 hrs.)

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit-II (12 hrs.)

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions.

Unit-III (12 hrs.)

Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit-IV (12 hrs.)

Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples, Laurent series and its examples.

Books Recommended

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009.
2. Joseph Bak and Donald J. Newman, *Complex analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

HIMACHAL PRADESH UNIVERSITY

B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH603TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Linear Programming
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1B.3: Linear Programming

Unit-I (12 hrs.)

Linear Programming Problems, Graphical Approach for Solving some Linear Programs. Convex Sets, Supporting and Separating Hyperplanes.

Unit-II (12 hrs.)

Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format,

Unit-III (12 hrs.)

Introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit-IV (12 hrs.)

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis.

Recommended Books

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.

2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 8th Ed., Tata McGraw Hill, Singapore, 2004.

3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

HIMACHAL PRADESH UNIVERSITY

*B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH507TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Portfolio Optimization
Type of the Course	Generic Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.2: Portfolio Optimization

Unit-I (12 hrs.)

Financial markets. Investment objectives. Measures of return and risk. Types of risks.

Unit-II (12 hrs.)

Portfolio of assets. Expected risk and return of portfolio. Diversification.

Unit-III (12 hrs.)

Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem,

Unit-IV (12 hrs.)

Risk-free assets and one fund theorem, efficient frontier. Portfolio performance evaluation measures.

Books Recommended

1. F.K. Reilly, Keith C. Brown, *Investment Analysis and Portfolio Management*, 10th Ed., South-Western Publishers, 2011.
2. H.M. Markowitz, *Mean-Variance Analysis in Portfolio Choice and Capital Markets*, Blackwell, New York, 1987.
3. D.G. Luenberger, *Investment Science*, 2nd Ed., Oxford University Press, 2013.

HIMACHAL PRADESH UNIVERSITY

*B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH508TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Queuing and Reliability Theory
Type of the Course	Generic Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

GE 1.2: Queuing and Reliability Theory

Unit-I (12 hrs.)

General concepts of queueing system, Measures of performance, Arrival and Service Processes, Single server and multi server models, channels in parallel with limited and unlimited queues- M/M/1/K, M/M/C.

Unit-II (12 hrs.)

Queues with unlimited service. Finite source queues. Application of simple queueing decision model's, Design and control models.

Unit-III (12 hrs.)

Basics of reliability. Classes of life distributions. Series, parallel, configurations. Reliability models,

Unit-IV (12 hrs.)

Reliability, Mean Time before failure and Hazard rate of Exponential and Weibull distributions. Concepts and definitions of preventive maintenance, corrective maintenance and age replacement.

Books Recommended

1. R.B. Cooper, *Introduction to Queueing Theory*, 2nd Ed., North Holland, 1981.
2. D. Gross, C. M. Harris, *Fundamentals of Queueing Theory*, 3rd Ed., John Wiley and Sons Inc. P. Ltd., 2002.
3. U.N. Bhat, *An Introduction to Queueing Theory: Modelling and Analysis in Applications (Statistics for Industry and Technology)*, Birkhauser Boston, 2008.
4. U.N. Prabhu, *Foundations of Queueing Theory*, International Series in Operations Research & Management Science, Kluwer Academic Publishers, 2nd Ed., 2002.
5. John G. Rau, *Optimization and Probability in Systems Engineering*, V.N. Reinhold Co., 1970.
6. Riccardo Manzini, Alberto Regattieri, Hoang Pham, Emilio Ferrai, *Maintenance for Industrial Systems*, Springer-Verlag, London Limited, 2010.
7. P.K. Kapur, R.B. Garg, S. Kumar, *Contributions to Hardware and Software Reliability*, World Scientific, Singapore, 1999.

HIMACHAL PRADESH UNIVERSITY

*B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH607TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Descriptive Statistics and Probability Theory
Type of the Course	Generic Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

GE 2.1: Descriptive Statistics and Probability Theory

Unit-I (12 hrs.)

Concepts of a statistical population and sample from a population, quantitative and qualitative data, nominal, ordinal and time-series data, discrete and continuous data. Presentation of data by tables and by diagrams, frequency distributions for discrete and continuous data, graphical

representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods).

Unit-II (12 hrs.)

Measures of location (or central tendency) and dispersion, moments, measures of skewness and kurtosis, cumulants. Bivariate data: Scatter diagram, principle of least-square and fitting of polynomials and exponential curves.

Unit-III(12 hrs.)

Correlation and regression. Karl Pearson coefficient of correlation, Lines of regression, Spearman's rank correlation coefficient, multiple and partial correlations (for 3 variates only).

Unit-IV(12 hrs.)

Random experiment, sample point and sample space, event, algebra of events, Definition of Probability - classical, relative frequency and axiomatic approaches to probability, merits and demerits of these approaches (only general ideas to be given). Theorem on probability, conditional probability, independent events. Baye's theorem and its applications.

Books Recommended

1. J.E. Freund, *Mathematical Statistics with Applications*, 7th Ed., Pearson Education, 2009.
2. A.M. Goon, M.K. Gupta and B. Dasgupta, *Fundamentals of Statistics*, Vol. I, 8th Ed., World Press, Kolkatta, 2005.
3. S.C. Gupta and V.K. Kapoor, *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons, 2007.
4. R.V. Hogg, A.T. Craig and J.W. Mckean, *Introduction to Mathematical Statistics*, 6th Ed., Pearson Education, 2005.
5. A.M. Mood, F.A. Graybill and D.C. Boes, *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw Hill Publication, 2007.

HIMACHAL PRADESH UNIVERSITY

*B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH608TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Sample Surveys and Design of Experiments
Type of the Course	Generic Elective
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

GE 2.2: Sample Surveys and Design of Experiments

Unit-I (12 hrs.)

Sample Surveys: Concepts of population and sample. Complete enumeration vs. sampling. Need for sampling. Principal and organizational aspects in the conduct of a sample survey. Properties of a good estimator, Sampling and non-sampling errors.

SRSWR & SRSWOR, determination of sample size. Stratified random sampling and different allocations. Systematic sampling, comparison of known sampling strategies

under linear trend. Ratio and Regression estimators and their comparison with SRSWOR estimator.

Unit-II (12 hrs.)

Indian Official Statistics: Present Official Statistical System in India relating to census of population, agriculture, industrial production, and prices; methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics. Also the various agencies responsible for the data collection- C.S.O., N.S.S.O., Office of Registrar General, their historical development, main functions and important publications.

Analysis of variance and covariance: Analysis of variance and covariance (with one concomitant variable) in one-way and two-way classified data with equal number of observations per cell.

Unit-III (12 hrs.)

Design of experiments: Principles of experimentation, uniformity trails, completely randomized, Randomized block and Latin square designs. Missing plot technique, 2^2 and 2^3 Factorial experiments: construction and analysis.

Unit-IV (12 hrs.)

Regression Analysis: Two variable linear model – estimation, testing and problems of predication. Predication of the estimated regression equation, interval estimation, variance estimation.

Books Recommended

1. W.G. Cochran, *Sampling Techniques*, John Wiley and Sons, New York, 1997.
2. A.M. Goon, M.K. Gupta, and B. Dasgupta, *Fundamentals of Statistics* (Vol. II), 8th Ed., World Press, Kolkata, 2005.
3. A.M. Goon, M.K. Gupta and B. Dasgupta, *An Outline of Statistical Theory* (Vol. II), 3rd Ed., World Press, Kolkata, 2005.
4. S.C. Gupta and V.K. Kapoor, *Fundamentals of Applied Statistics*, 4th Ed., Sultan Chand and Sons, 2008.
5. A.M. Kshirsagar, *A Course in Linear Models*, Marcel Dekker, Inc., N.Y., 1983.

6. D.C. Montgomery, *Designs and Analysis of Experiments*, John Wiley and Sons, New York, 2001.
7. D.C. Montgomery, E.A. Peck and G.G. Vinning, *Introduction to Linear Regression Analysis*, 3rd Ed., John Wiley and Sons, 2006.
8. P. Mukhopadhyay, *Theory and Methods of Surveys Sampling*, Prentice Hall of India, 1998.
9. D. Singh and F.S. Chaudhary, *Theory and Analysis of Sample Survey Designs*, New Age International (P) Ltd., 1995.
10. P.V. Sukhatme, B.V. Sukhatme, S. Sukhatme and C. Ashok, *Sampling Theory of Surveys with Applications*, Iowa State University Press, Iowa, USA, 1984.

Proposed Syllabus and Scheme of Examination

for

B.A. with Mathematics

submitted to

*University Grants Commission
New Delhi*

under the

Choice Based Credit System

May 2015

Details of Courses under B.A. with Mathematics

Course ***Credits**

Theory + Practical

Theory + Tutorials

I. Core Course

$12 \times 4 = 48$

$12 \times 5 = 60$

(12 Papers)

Two papers – English

Two papers – MIL

Four papers – Discipline 1

Four papers – Discipline 2

Core Course Practical / Tutorial*

$12 \times 2 = 24$

$12 \times 1 = 12$

(12 Practical/ Tutorials*)

II. Elective Course

$6 \times 4 = 24$

$6 \times 5 = 30$

(6 Papers)

Two papers – Discipline 1 specific

Two papers – Discipline 2 specific

Two papers – Generic Elective (Interdisciplinary)

Two papers from each discipline of choice and two papers of interdisciplinary nature. (GE)

Elective Course Practical / Tutorials* $6 \times 2 = 12$

$6 \times 1 = 6$

(6 Practical / Tutorials*)

Two papers – Discipline 1 specific

Two papers – Discipline 2 specific

Two papers – Generic Elective (Interdisciplinary)

Two Papers from each discipline of choice
including paper of interdisciplinary nature

III. Ability Enhancement Courses

1. **Ability Enhancement Compulsory Courses (AECC)** $2 \times 4 = 8$ $2 \times 4 = 8$
(2 Papers of 4 credits each)
Environmental Science
English /MIL Communication

2. **Skill Enhancement Course (SEC)** $4 \times 4 = 16$ $4 \times 4 = 16$
(4 Papers of 4 credits each)

Total credit = 132

Total credit = 132

***wherever there is practical there will be no tutorials and vice -versa**

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

First Semester

Course Code	MATH101TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Differential Calculus
Type of the Course	Core Course 01
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (12 hours)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 1.1: Differential Calculus

Unit-I (12 hrs.)

Limit and Continuity (epsilon and delta definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Indeterminate forms.

Unit-II (12 hrs.)

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms

of remainder, Taylor's series. Maclaurin's series of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$,

Unit-III (12 hrs.)

Concavity, Convexity & Points of Inflexion, Curvature, Asymptotes, Singular points, Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Unit-IV (12 hrs.)

Functions of several variables (upto three variables), Limit and Continuity of variables Partial differentiation, Euler's theorem on homogeneous functions, Maxima and Minima with Lagrange Multipliers Method, Jacobian.

Books Recommended:

3. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
4. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Second Semester

Course Code	MATH201TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Differential Equations
Type of the Course	Core Course 02
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (12 hours)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

1. Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

2. Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 2.1: Differential Equations

Unit-I (12 hrs.)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x , y , p . Methods for solving higher-order differential equations.

Unit-II (12 hrs.)

Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential

equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters,

Unit-III (12 hrs.)

The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations(PDE), Linear partial differential equation of first order, Lagrange's method.

Unit-IV(12 hrs.)

Charpit's method for solving PDE, Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended

3. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

4. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH301TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Real Analysis
Type of the Course	Core Course 01
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (12 hours)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 1. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 2. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 3.1: Real Analysis

Unit-I(12 hrs.)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of \mathbb{R} , Archimedean property of \mathbb{R} , intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Unit-II (12 hrs.)

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Unit-III(12 hrs.)

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Unit-IV (12 hrs.)

Sequences and series of functions, Pointwise and uniform convergence. M_n -test, M-test, Results about uniform convergence, integrability and differentiability of functions (Statements only), Power series and radius of convergence.

Books Recommended

5. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
6. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
7. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
8. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH401TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Algebra
Type of the Course	Core Course 01
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (12 hours)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 1. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 2. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

Core 4.1: Algebra

Unit-I (12 hrs.)

Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group $U(n)$ of units under multiplication modulo n . Cyclic groups from number systems, complex roots of unity, the general linear group $GL_n(n, R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group $Sym(n)$,

Unit-II (12 hrs.)

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets,

Index of subgroup, Lagrange's theorem, order of an element,
Unit-III (12 hrs.)

Normal subgroups: their definition, examples, and characterizations, Quotient groups
Fundamental theorem of Homomorphism. Definition and examples of rings, examples of
commutative and non-commutative rings: rings from number systems, Z_n the ring of integers
modulo n .

Unit-IV (12 hrs.)

Rings of matrices, polynomial rings, Subrings and ideals, Integral domains and fields,
examples of fields: Z_p , Q , R , and C .

Books Recommended

5. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
6. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
7. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
8. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH302TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Logic and Sets
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered	48 (One Hour Each)

Instructions

- 3. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 4. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 1.1: Logic and Sets

Unit-I (12 hrs.)

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit-II (12 hrs.)

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit-III(12 hrs.)

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit-IV (12 hrs.)

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

Book Recommended

4. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
5. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
6. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH303TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Analytical Geometry
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

1. **Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV.

Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

2. Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 1.2: Analytical Geometry

Unit-I (12 hrs.)

Techniques for sketching parabola, ellipse and hyperbola, Reflection properties of parabola, ellipse and hyperbola

Unit-II (12 hrs.)

. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola,

Unit-III (12 hrs.)

Spheres: Different forms of sphere, Intersection of Sphere with plane, radical planes, orthogonality

Unit-IV (12 hrs.)

Cylindrical surfaces, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Books Recommended

5. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
6. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd., 2002.
7. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.
8. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Third Semester

Course Code	MATH304TH
Credits= 4	L-4,T-0,P-0

Name of the Course	Integral Calculus
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

3. Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

4. Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 1.3: Integral Calculus

Unit-I (12 hrs.)

Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals.

Unit-I (12 hrs.)

Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

Unit-III (12 hrs.)

Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution.

Unit-IV (12 hrs.)

Double and Triple integrals.

Books Recommended

3. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
4. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH402TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Vector Calculus
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

5. **Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
6. **Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the

question paper.

SEC 2.1: Vector Calculus

Unit-I (12 hrs.)

Differentiation and Integration, partial differentiation of a vector function.

Unit-II (12 hrs.)

Derivative of sum, dot product and cross product of two vectors.

Unit-III (12 hrs.)

Gradient, divergence and curl and vector Identities

Unit-IV (12 hrs.)

Statements and applications of Green's theorem, Gauss divergence theorem and Stokes theorem

Books Recommended

4. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
5. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.
6. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

HIMACHAL PRADESH UNIVERSITY

B.S.A. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH403TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Theory of Equations
Type of the Course	Skill Enhancement Course

Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

7. **Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
8. **Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 2.2: Theory of Equations

Unit-I (12 hrs.)

General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials, General properties of equations,

Unit-II (12 hrs.)

Descarte's rule of signs for positive and negative roots, Relation between the roots and the coefficients of equations.

Unit-III (12 hrs.)

Symmetric functions, Applications symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations.

Unit-IV (12 hrs.)

Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Books Recommended

3. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
4. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fourth Semester

Course Code	MATH404TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Number Theory
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

9. **Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
10. **Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 2.3: Number Theory

Unit-I (12 hrs.)

Division algorithm, Lamé's theorem, linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem, Goldbach conjecture,

Unit-II (12 hrs.)

Binary and decimal representation of integers, linear congruences, complete set of residues.

Unit-III (12 hrs.)

Number theoretic functions, sum and number of divisors, totally multiplicative functions,

Unit-IV (12 hrs.)

Definition and properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function.

Books Recommended:

4. David M. Burton, *Elementary Number Theory* 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.

5. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple*, CRC Press, Boca Raton, 2000.

6. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH504TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Probability and Statistics
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

- 11. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 12. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.1: Probability and Statistics

Unit-I (12 hrs.)

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions,

Unit-II (12 hrs.)

Mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform,

Unit-III (12 hrs.)

Binomial, Poisson, continuous distributions: uniform, normal, exponential.

Unit-IV (12 hrs.)

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

Books Recommended:

4. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
5. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application*, 7th Ed., Pearson Education, Asia, 2006.
6. Sheldon Ross, *Introduction to Probability Model*, 9th Ed., Academic Press, Indian Reprint, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH505TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Mathematical Finance
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

- 13. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 14. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.2: Mathematical Finance

Unit-I (12 hrs.)

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money.

Unit-II (12 hrs.)

Inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR.

Unit-III (12 hrs.)

Bonds, bond prices and yields. Floating-rate bonds, immunization.

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation).

Unit-IV (12 hrs.)

Random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).

Books Recommended:

4. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.

5. John C. Hull, *Options, Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.

6. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH506TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Mathematical Modeling
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

- 15. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 16. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.3: Mathematical Modeling

Unit-I (12 hrs.)

Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion.

Unit-II (12 hrs.)

resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

Unit-III (12 hrs.)

Applications to Traffic Flow. Vibrating string, vibrating membrane,

Unit-IV (12 hrs.)

Conduction of heat in solids, gravitational potential, conservation laws.

Books Recommended:

3. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

4. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH604TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Boolean Algebra
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30

Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

- 17. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 18. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC4.1: Boolean Algebra

Unit-I (12 hrs.)

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements,

Unit-II (12 hrs.)

Lattices as ordered sets, complete lattices, lattices as algebraic structures, sub lattices, products and homomorphisms.

Unit-III (12 hrs.)

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials

Unit-IV (12 hrs.)

Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Books Recommended:

3. BA.Davey and H.A.Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
4. Rudolf Lidland and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH605TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Transportation and Game Theory
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

- 19. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 20. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 4.2: Transportation and Game Theory

Unit-I (12 hrs.)

Transportation problem and its mathematical formulation. northwest-corner method, least cost method ,

Unit-II (12 hrs.)

Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem,

Unit-III (12 hrs.)

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit-IV (12 hrs.)

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure.

Books Recommended:

4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.

5. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.

6. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH606TH
Credits= 4	L-4,T-0,P-0
Name of the Course	Graph Theory
Type of the Course	Skill Enhancement Course
Number of hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	0 Credit
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	48

Instructions

- 21. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 22. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC4.3: Graph Theory

Unit-I (12 hrs.)

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs.

Unit-II (12 hrs.)

Isomorphism of graphs, paths and circuits, Eulerian circuits.

Unit-III (12 hrs.)

Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem.

Unit-IV (12 hrs.)

Shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Books Recommended:

3. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory* 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.

4. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH501TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Matrices
Type of the Course	Discipline Specific Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 23. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 24. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1A.1: Matrices

Unit-I (12 hrs.)

Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto three.

Unit-II(12 hrs.)

Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Unit-III(12 hrs.)

Definition of Vector space, \mathbb{R} , \mathbb{R}^2 , \mathbb{R}^3 as vector spaces over \mathbb{R} , Concept of Linear dependence/Independence, Standard basis for \mathbb{R} , \mathbb{R}^2 , \mathbb{R}^3 , Examples of different bases. Subspaces of \mathbb{R}^2 , \mathbb{R}^3 .

Unit-IV (12 hrs.)

Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigenvalues and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Books Recommended

4. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
5. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
6. Richard Bronson, *Theory and Problems of Matrix Operations*, Tata McGraw Hill, 1989.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH502TH
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Credits= 6	L-5,T-1,P-0
Name of the Course	Mechanics
Type of the Course	Discipline Specific Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 25. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 26. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1A.2: Mechanics

Unit-I (12 hrs.)

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body.

Unit-II(12 hrs.)

Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity.

Unit-III(12 hrs.)

Work and potential energy. Velocity and acceleration of a particle along a curve, Radial and transverse components (plane curve), tangential and normal components (space curve).

Unit-IV(12 hrs.)

Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

Books Recommended

3. A.S. Ramsay, *Statics*, CBS Publishers and Distributors (Indian Reprint), 1998.

4. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH503TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Linear Algebra
Type of the Course	Discipline Specific Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 27. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 28. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1A.3: Linear Algebra

Unit-I (12 hrs.)

Vector spaces, subspaces, algebra of subspaces, quotient spaces.

Unit-II (12 hrs.)

linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit-III (12 hrs.)

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.

Unit-IV (12 hrs.)

Dual Space, Dual Basis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial.

Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended

5. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.

6. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

7. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.

8. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH601TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Numerical Methods
Type of the Course	Discipline Specific Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)

Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 29. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 30. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1B.1: Numerical Methods

Unit-I (12 hrs.)

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition,

Unit-II (12 hrs.)

Gauss-Jacobi, Gauss-Siedel and SOR iterative methods, Lagrange and Newton interpolation: linear and higher order,.

Unit-III (12 hrs.)

Finite difference operators, Numerical differentiation: Newton's forward difference and backward difference method, Sterling's Central difference method.

Unit-IV (12 hrs.)

Integration: Trapezoidal rule, Simpson's rule, Euler's method.

Recommended Books

3. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH602TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Complex Analysis
Type of the Course	Discipline Specific Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 31. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 32. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1B.2: Complex Analysis

Unit-I (12 hrs.)

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit-II (12 hrs.)

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions.

Unit-III (12 hrs.)

Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit-IV (12 hrs.)

Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples, Laurent series and its examples.

Books Recommended

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009.
2. Joseph Bak and Donald J. Newman, *Complex analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH603TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Linear Programming
Type of the Course	Discipline Specific Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 33. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 34. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

DSE 1B.3: Linear Programming

Unit-I (12 hrs.)

Linear Programming Problems, Graphical Approach for Solving some Linear Programs. Convex Sets, Supporting and Separating Hyperplanes.

Unit-II (12 hrs.)

Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format,

Unit-III (12 hrs.)

Introduction to artificial variables, two-phase method, Big-M method and their comparison.
Unit-IV (12 hrs.)

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis.

Recommended Books

4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.

5. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 8th Ed., Tata McGraw Hill, Singapore, 2004.

6. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH507TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Portfolio Optimization
Type of the Course	Generic Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 35. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 36. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

SEC 3.2: Portfolio Optimization

Unit-I (12 hrs.)

Financial markets. Investment objectives. Measures of return and risk. Types of risks.

Unit-II (12 hrs.)

Portfolio of assets. Expected risk and return of portfolio. Diversification.

Unit-III (12 hrs.)

Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem,

Unit-IV (12 hrs.)

Risk-free assets and one fund theorem, efficient frontier. Portfolio performance evaluation measures.

Books Recommended

4. F.K. Reilly, Keith C. Brown, *Investment Analysis and Portfolio Management*, 10th Ed., South-Western Publishers, 2011.
5. H.M. Markowitz, *Mean-Variance Analysis in Portfolio Choice and Capital Markets*, Blackwell, New York, 1987.
6. D.G. Luenberger, *Investment Science*, 2nd Ed., Oxford University Press, 2013.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Fifth Semester

Course Code	MATH508TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Queueing and Reliability Theory
Type of the Course	Generic Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 37. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 38. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

GE 1.2: Queueing and Reliability Theory

Unit-I (12 hrs.)

General concepts of queueing system, Measures of performance, Arrival and Service Processes, Single server and multi server models, channels in parallel with limited and unlimited queues- M/M/1/K, M/M/C.

Unit-II (12 hrs.)

Queues with unlimited service. Finite source queues. Application of simple queueing decision model's, Design and control models.

Unit-III (12 hrs.)

Basics of reliability. Classes of life distributions. Series, parallel, configurations. Reliability

models,

Unit-IV (12 hrs.)

Reliability, Mean Time before failure and Hazard rate of Exponential and Weibull distributions. Concepts and definitions of preventive maintenance, corrective maintenance and age replacement.

Books Recommended

8. R.B. Cooper, *Introduction to Queueing Theory*, 2nd Ed., North Holland, 1981.
9. D. Gross, C. M. Harris, *Fundamentals of Queueing Theory*, 3rd Ed., John Wiley and Sons Inc. P. Ltd., 2002.
10. U.N. Bhat, *An Introduction to Queueing Theory: Modelling and Analysis in Applications (Statistics for Industry and Technology)*, Birkhauser Boston, 2008.
11. U.N. Prabhu, *Foundations of Queueing Theory*, International Series in Operations Research & Management Science, Kluwer Academic Publishers, 2nd Ed., 2002.
12. John G. Rau, *Optimization and Probability in Systems Engineering*, V.N. Reinhold Co., 1970.
13. Riccardo Manzini, Alberto Regattieri, Hoang Pham, Emilio Ferrai, *Maintenance for Industrial Systems*, Springer-Verlag, London Limited, 2010.
14. P.K. Kapur, R.B. Garg, S. Kumar, *Contributions to Hardware and Software Reliability*, World Scientific, Singapore, 1999.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH607TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Descriptive Statistics and Probability Theory
Type of the Course	Generic Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 39. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 40. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

GE 2.1: Descriptive Statistics and Probability Theory

Unit-I (12 hrs.)

Concepts of a statistical population and sample from a population, quantitative and qualitative data, nominal, ordinal and time-series data, discrete and continuous data. Presentation of data by tables and by diagrams, frequency distributions for discrete and continuous data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods).

Unit-II (12 hrs.)

Measures of location (or central tendency) and dispersion, moments, measures of skewness and kurtosis, cumulants. Bivariate data: Scatter diagram, principle of least-square and fitting of polynomials and exponential curves.

Unit-III(12 hrs.)

Correlation and regression. Karl Pearson coefficient of correlation, Lines of regression, Spearman's rank correlation coefficient, multiple and partial correlations (for 3 variates only).

Unit-IV(12 hrs.)

Random experiment, sample point and sample space, event, algebra of events, Definition of Probability - classical, relative frequency and axiomatic approaches to probability, merits and demerits of these approaches (only general ideas to be given). Theorem on probability, conditional probability, independent events. Baye's theorem and its applications.

Books Recommended

6. J.E. Freund, *Mathematical Statistics with Applications*, 7th Ed., Pearson Education, 2009.

7. A.M. Goon, M.K. Gupta and B. Dasgupta, *Fundamentals of Statistics*, Vol. I, 8th Ed., World Press, Kolkatta, 2005.

8. S.C. Gupta and V.K. Kapoor, *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons, 2007.

9. R.V. Hogg, A.T. Craig and J.W. Mckean, *Introduction to Mathematical Statistics*, 6th Ed., Pearson Education, 2005.

10. A.M. Mood, F.A. Graybill and D.C. Boes, *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw Hill Publication, 2007.

HIMACHAL PRADESH UNIVERSITY

B.A. with Mathematics Syllabus and Examination Scheme

Sixth Semester

Course Code	MATH608TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Sample Surveys and Design of Experiments
Type of the Course	Generic Elective
Number of hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Tests(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	1 Credit (One Hour Each)
Semester Term End Examination	Max Marks: 70 Maximum Time: 3 hrs.
Lectures to be Delivered (One Hour Each)	60

Instructions

- 41. Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- 42. Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

GE 2.2: Sample Surveys and Design of Experiments

Unit-I (12 hrs.)

Sample Surveys: Concepts of population and sample. Complete enumeration vs. sampling. Need for sampling. Principal and organizational aspects in the conduct of a sample survey. Properties of a good estimator, Sampling and non-sampling errors.

SRSWR & SRSWOR, determination of sample size. Stratified random sampling and different allocations. Systematic sampling, comparison of known sampling strategies under

linear trend. Ratio and Regression estimators and their comparison with SRSWOR estimator.

Unit-II (12 hrs.)

Indian Official Statistics: Present Official Statistical System in India relating to census of population, agriculture, industrial production, and prices; methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics. Also the various agencies responsible for the data collection- C.S.O., N.S.S.O., Office of Registrar General, their historical development, main functions and important publications.

Analysis of variance and covariance: Analysis of variance and covariance (with one concomitant variable) in one-way and two-way classified data with equal number of observations per cell.

Unit-III (12 hrs.)

Design of experiments: Principles of experimentation, uniformity trials, completely randomized, Randomized block and Latin square designs. Missing plot technique, 2^2 and 2^3 Factorial experiments: construction and analysis.

Unit-IV (12 hrs.)

Regression Analysis: Two variable linear model – estimation, testing and problems of predication. Predication of the estimated regression equation, interval estimation, variance estimation.

Books Recommended

1. W.G. Cochran, *Sampling Techniques*, John Wiley and Sons, New York, 1997.
2. A.M. Goon, M.K. Gupta, and B. Dasgupta, *Fundamentals of Statistics* (Vol. II), 8th Ed., World Press, Kolkata, 2005.
3. A.M. Goon, M.K. Gupta and B. Dasgupta, *An Outline of Statistical Theory* (Vol. II), 3rd Ed., World Press, Kolkata, 2005.
4. S.C. Gupta and V.K. Kapoor, *Fundamentals of Applied Statistics*, 4th Ed., Sultan Chand and Sons, 2008.
5. A.M. Kshirsagar, *A Course in Linear Models*, Marcel Dekker, Inc., N.Y., 1983.

6. D.C. Montgomery, *Designs and Analysis of Experiments*, John Wiley and Sons, New York, 2001.
7. D.C. Montgomery, E.A. Peak and G.G. Vinning, *Introduction to Linear Regression Analysis*, 3rd Ed., John Wiley and Sons, 2006.
8. P. Mukhopadhyay, *Theory and Methods of Surveys Sampling*, Prentice Hall of India, 1998.
9. D. Singh and F.S. Chaudhary, *Theory and Analysis of Sample Survey Designs*, New Age International (P) Ltd., 1995.
10. P.V. Sukhatme, B.V. Sukhatme, S. Sukhatme and C. Ashok, *Sampling Theory of Surveys with Applications*, Iowa State University Press, Iowa, USA, 1984.

Himachal Pradesh University
Summer Hill, Shimla-171005



Syllabus and Scheme of Examination

(For Ist & IInd Semesters only)

B.Sc. (Hons.) with Mathematics

Courses

under the

Choice Based Credit System

w.e.f.

Session 2016 -17 onwards

Details of courses under B.Sc. (Hons.) Mathematics

Course	*Credits	Theory + Practical	Theory + Tutorial
I. Core Course			
(14 Papers)		$14 \times 4 = 56$	$14 \times 5 = 70$
Core Course Practical / Tutorial*		$14 \times 2 = 28$	$14 \times 1 = 14$
(14 Papers)			
II. Elective Course (8 Papers)			
A.1. Discipline Specific Elective		$4 \times 4 = 16$	$4 \times 5 = 20$
(4 Papers)			
A.2. Discipline Specific Elective			
Practical/ Tutorial*		$4 \times 2 = 8$	$4 \times 1 = 4$
(4 Papers)			
B.1. Generic Elective/			
Interdisciplinary		$4 \times 4 = 16$	$4 \times 5 = 20$
(4 Papers)			
B.2. Generic Elective			
Practical/ Tutorial*		$4 \times 2 = 8$	$4 \times 1 = 4$
(4 Papers)			

- Optional Dissertation or project work in place of one Discipline Specific Elective Paper (6 credits) in 6th Semester

III. Ability Enhancement Courses

1. Ability Enhancement Compulsory Courses (AECC)

(2 Papers of 2 credit each)

2×2 = 4

2×2 = 4

Environmental Science English/MIL Communication

2. Skill Enhancement Courses (SEC)

(Minimum 2)

2×2 = 4

2×2 = 4

(2 Papers of 2 credit each)

Total credit

140

140

Institute should evolve a system/ policy about ECA/ General Interest/ Hobby/ Sports/ NCC/ NSS/ related courses on its own.

*** wherever there is a practical there will be no tutorial and vice-versa**

HIMACHAL PRADESH UNIVERSITY

B.Sc. (Hons.) with Mathematics Syllabus and Examination Scheme

First Semester

Course Code	MATH102TH
Credits= 6	L-4,T-0,P-2
Name of the Course	Calculus
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Practical	24 hours
End Semester Examination	Max Marks: 40 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 40 marks. **Section A** will be **Compulsory** and will contain 8 questions of 8 marks (each of 1 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 8 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

C1.1 Calculus

Unit-I(12 hrs.)

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

Unit-II (12 hrs.)

Reduction Formulae, $\int \sin^n x \, dx$, $\int \cos^n x \, dx$, $\int e^{ax} x^n \, dx$, $\int x^n (\log x)^m \, dx$, $\int x^n \sin x \, dx$, $\int x^n \cos x \, dx$, $\int \sin^n x \cos x \, dx$, $\int_0^{\pi/2} \sin^n x \, dx$, $\int_0^{\pi/2} \cos^n x \, dx$, $\int_0^{\pi/2} \sin^n x \cos x \, dx$. Reduction by connecting two integrals (Smaller Index + 1 Method).

volumes by slicing, disks and washers methods, volumes by cylindrical shells,
Unit-III (12 hrs.)

parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.

Unit-IV (12 hrs.)

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

Course Code: MATH102PR

First Semester

Course Code	MATH102PR
Credits= 2	L-0,T-0,P-2
Name of the Course	Calculus
Type of the Course	Core Course
Number of Practical hours required for this course	24 hours
End Semester Examination	Max Marks: 30 Maximum Time: 3 hrs.

NOTE: Candidate shall have to attempt two practical out of the given four practical.

List of Practical (using any software)

(i) Plotting of graphs of function e^{ax+b} , $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|ax+b|$ and to illustrate the effect of a and b on the graph.

(ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(iii) Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).

- (iv) Obtaining surface of revolution of curves.
- (v) Tracing of conics in cartesian coordinates/ polar coordinates.
- (vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
- (vii) Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
3. H. Anton, I. Bivens and S. Davis, *Calculus*, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
4. R. Courant and F. John, *Introduction to Calculus and Analysis* (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

HIMACHAL PRADESH UNIVERSITY

B.Sc. (Hons.) with Mathematics Syllabus and Examination Scheme

First Semester

Course Code	MATH103TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Algebra
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 40 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

C1.2 Algebra

Unit-I (12 hrs.)

Polar representation of complex numbers, n^{th} roots of unity, De Moivre's theorem for rational indices and its applications. Equivalence relations, Functions, Composition of functions, Invertible functions,

Unit-II (12 hrs.)

One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of

Arithmetic.

Unit-III (12 hrs.)

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax=b$, solution sets of linear systems, applications of linear systems, linear independence.

Unit-IV (12 hrs.)

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of \mathbb{R}^n , dimension of subspaces of \mathbb{R}^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended

1. Titu Andreescu and Dorin Andrica, *Complex Numbers from A to Z*, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

HIMACHAL PRADESH UNIVERSITY

B.Sc. (Hons.) with Mathematics Syllabus and Examination Scheme

Second Semester

Course Code	MATH202TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Real Analysis
Type of the Course	Core Course
Number of teaching hours required for this course	48 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 40 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.

Instructions for Candidates: Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

C2.1 Real Analysis

Unit-I (12 hrs.)

Review of Algebraic and Order Properties of R , ϵ -neighborhood of a point in R , Idea of countable sets, uncountable sets and uncountability of R . Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, the Completeness Property of R ,

Unit-II (12 hrs.)

The Archimedean Property, Density of Rational (and Irrational) numbers in R , Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Unit-III (12 hrs.)

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences.

Cauchy sequence, Cauchy's Convergence Criterion.

Unit-IV (12 hrs.)

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's n^{th} root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Books Recommended

1. R.G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, *An Introduction to Analysis*, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, *Elementary Real Analysis*, Prentice Hall, 2001.
4. S.K. Berberian, *A First Course in Real Analysis*, Springer Verlag, New York, 1994.

HIMACHAL PRADESH UNIVERSITY

B.Sc. (Hons.) with Mathematics Syllabus and Examination Scheme

Second Semester

Course Code	MATH203TH
Credits= 6	L-4,T-0,P-2
Name of the Course	Differential Equations
Type of the Course	Core Course
Number of teaching hours required for this course	48 hours
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Practical	24 hours
End Semester Examination	Max Marks: 40 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	48

Instructions

- Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 40 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.5 marks each.
- Instructions for Candidates:** Candidates are required to attempt five questions in all. Section A is Compulsory and from Section B they are required to attempt one question from each of the Units I, II, III and IV of the question paper.

C2.2 Differential Equations

Unit-I (12 hrs.)

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Unit-II (12 hrs.)

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

Unit-III (12 hrs.)

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

Unit-IV (12 hrs.)

Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

First Semester

Course Code	MATH102PR
Credits= 2	L-0,T-0,P-2
Name of the Course	Calculus
Type of the Course	Core Course
Number of Practical hours required for this course	24 hours
End Semester Examination	Max Marks: 30 Maximum Time: 3 hrs.

NOTE: Candidate shall have to attempt two practical out of the given four practical

List of Practicals (using any software)

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).

5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
9. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
10. Battle model (basic battle model, jungle warfare, long range weapons).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy's root test by plotting n^{th} roots.
16. Ratio test by plotting the ratio of n^{th} and $(n+1)^{\text{th}}$ term.

Books Recommended

1. Belinda Barnes and Glenn R. Fulford, *Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab*, 2nd Ed., Taylor and Francis group, London and New York, 2009.
 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*, 3rd Ed., John Wiley and Sons, India, 2004.
- Martha L Abell, James P Braselton, *Differential Equations with MATHEMATICA*, 3rd Ed., Elsevier Academic Press, 2004

GE 1.1 Object Oriented Programming in C++

OOP Paradigm: Comparison of Programming paradigms, Characteristics of Object-Oriented Programming Languages, Object-based programming languages C++: Brief History of C++, Structure of a C++ program, Difference between C and C++ - cin, cout, new, delete operators, ANSI/ISO Standard C++, Comments, Working with Variables and const Qualifiers. Enumeration, Arrays and Pointer.

Implementing oops concepts in C++ Objects, Classes, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Passing, Default Parameter Value, Using Reference variables with Functions.

Abstract data types, Class Component, Object & Class, Constructors Default and Copy Constructor, Assignment operator deep and shallow coping, Access modifiers – private, public and protected. Implementing Class Functions within Class declaration or outside the Class declaration. instantiation of objects, Scope resolution operator, Working with Friend Functions, Using Static Class members. Understanding Compile Time Polymorphism function overloading Rules of Operator Overloading (Unary and Binary) as member function/friend function, Implementation of operator overloading of Arithmetic Operators, Overloading Output/Input, Prefix/ Postfix Increment and decrement Operators, Overloading comparison operators, Assignment, subscript and function call Operator , concepts of namespaces.

Practical to be performed in lab.

Books Recommended

1. A. R. Venugopal, Rajkumar, and T. Ravishanker, *Mastering C++*, TMH, 1997.
2. S. B. Lippman and J. Lajoie, *C++ Primer*, 3rd Ed., Addison Wesley, 2000.
3. Bruce Eckel, *Thinking in C++*, 2nd Ed., President, Mindview Inc., Prentice Hall.
4. D. Parsons, *Object Oriented Programming with C++*, BPB Publication.
5. Bjarne Stroustrup , *The C++ Programming Language*, 3rd Ed., Addison Welsley.

GE1.2 Finite Element Methods

Introduction to finite element methods, comparison with finite difference methods, Methods of weighted residuals, collocations, least squares and Galerkin's method. Variational formulation of boundary value problems equivalence of Galerkin and Ritz methods.

Applications to solving simple problems of ordinary differential equations.

Linear, quadratic and higher order elements in one dimensional and assembly, solution of assembled system.

Simplex elements in two and three dimensions, quadratic triangular elements, rectangular elements, serendipity elements and isoperimetric elements and their assembly, discretization with curved boundaries

Interpolation functions, numerical integration, and modeling considerations.

Solution of two dimensional partial differential equations under different Geometric conditions.

Books Recommended

1. J.N. Reddy, *Introduction to the Finite Element Methods*, Tata McGraw-Hill, 2003.
2. K.J. Bathe, *Finite Element Procedures*, Prentice-Hall, 2001.
3. R.D. Cook, D.S. Malkus and M.E. Plesha, *Concepts and Applications of Finite Element Analysis*, John Wiley and Sons, 2002.
4. Thomas J.R. Hughes, *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis*, Dover Publication, 2000.
5. George R. Buchanan, *Finite Element Analysis*, McGraw Hill, 1994.

GE2.1 Mathematical Finance

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, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, puttable 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), 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.

Books Recommended

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.
2. John C. Hull, *Options, Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.

GE2.2 Econometrics

Statistical Concepts Normal distribution; chi-square, t and F-distributions; estimation of parameters; properties of estimators; testing of hypotheses: defining statistical hypotheses; distributions of test statistics; testing hypotheses related to population parameters; Type I and Type II errors; power of a test; tests for comparing parameters from two samples.

Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem; forecasting.

Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - R^2 and adjusted R^2 ; partial regression coefficients; testing hypotheses – individual and joint; functional forms of regression models; qualitative (dummy) independent variables.

Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation.

Specification Analysis Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

Books Recommended

1. Jay L. Devore, *Probability and Statistics for Engineers*, Cengage Learning, 2010.
2. John E. Freund, *Mathematical Statistics*, Prentice Hall, 1992.
3. Richard J. Larsen and Morris L. Marx, *An Introduction to Mathematical Statistics and its Applications*, Prentice Hall, 2011.
4. D. N. Gujarati and D.C. Porter, *Essentials of Econometrics*, McGraw Hill, 4th Ed., International Edition, 2009.
5. Christopher Dougherty, *Introduction to Econometrics*, Oxford University Press, 3rd Ed., Indian edition, 2007.

GE3.1 Cryptography and Network Security

Public Key Cryptography Principles & Applications, Algorithms: RSA, Message Authentication: One way Hash Functions: Message Digest, MD5, SHA1. Public Key Infrastructure: Digital Signatures, Digital Certificates, Certificate Authorities.

Network Attacks: Buffer Overflow, IP Spoofing, TCP Session Hijacking, Sequence Guessing, Network Scanning: ICMP, TCP sweeps, Basic Port Scans; Denial of Service Attacks: SYN Flood, Teardrop attacks, land, Smurf Attacks. IP security Architecture: Overview, Authentication header, Encapsulating Security Pay Load, combining Security Associations, Key Management. Virtual Private Network Technology: Tunneling using IPSEC.

Requirements, Secure Socket Layer, and Secure Electronic Transactions, Network Management Security: Overview of SNMP Architecture- SNMPV1, SNMPV3. Firewall Characteristics & Design Principles, Types of Firewalls: Packet Filtering Router, Application Level Gateway or Proxy, Content Filters, Bastion Host.

Books Recommended

1. W. Stallings, *Networks Security Essentials: Application & Standards*, Pearson Education, 2000.

2. TCP/IP Protocol Suite , Behrouz A. Forouzan, *Data Communication and Networking*, Tata McGraw Hill.

3. W. Stallings, *Cryptography and Network Security, Principles and Practice*, Pearson Education, 2000.

GE 3.2 Information Security

Overview of Security: Protection versus security; aspects of security—data integrity, data availability, privacy; security problems, user authentication, Orange Book.

Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer overflow; system threats- intruders; communication threats- tapping and piracy.

Cryptography: Substitution, transposition ciphers, symmetric-key algorithms-Data Encryption Standard, advanced encryption standards, public key encryption - RSA; Diffie-Hellman key exchange, ECC cryptography, Message Authentication- MAC, hash functions.

Digital signatures: Symmetric key signatures, public key signatures, message digests, public key infrastructures.

Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended

1. W. Stallings, *Cryptography and Network Security Principles and Practices*, 4th Ed., Prentice-Hall of India, 2006.
2. C. Pfleeger and S.L. Pfleeger, *Security in Computing*, 3rd Ed., Prentice-Hall of India, 2007.
3. D. Gollmann, *Computer Security*, John Wiley and Sons, NY, 2002.
4. J. Piwprzyk, T. Hardjono and J. Seberry, *Fundamentals of Computer Security*, Springer-Verlag Berlin, 2003.
5. J.M. Kizza, *Computer Network Security*, Springer, 2007.
6. M. Merkow and J. Breithaupt, *Information Security: Principles and Practices*, Pearson Education, 2006.

GE4.1 Applications of Algebra

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.

Coding Theory: introduction to error correcting codes, linear codes, 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.

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.

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 $m \times n$ 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.

Books Recommended

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

GE4.2 Combinatorial Mathematics

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers

Principle of Inclusion and Exclusion, Derangements, Inversion formulae

Generating functions: Algebra of formal power series, Generating function models,

Calculating generating functions, Exponential generating functions.

Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.

Integer partitions, Systems of distinct representatives.

Polya theory of counting: Necklace problem and Burnside's lemma, Cyclic index of a permutation group, Polya's theorems and their immediate applications.

Latin squares, Hadamard matrices, Combinatorial designs: t designs, BIBDs, Symmetric designs.

Books Recommended

1. J.H. van Lint and R.M. Wilson, *A Course in Combinatorics*, 2nd Ed., Cambridge University Press, 2001.
2. V. Krishnamurthy, *Combinatorics, Theory and Application*, Affiliated East-West Press 1985.
3. P.J. Cameron, *Combinatorics, Topics, Techniques, Algorithms*, Cambridge University Press, 1995.
4. M. Jr. Hall, *Combinatorial Theory*, 2nd Ed., John Wiley & Sons, 1986.
5. S.S. Sane, *Combinatorial Techniques*, Hindustan Book Agency, 2013.
6. R.A. Brualdi, *Introductory Combinatorics*, 5th Ed., Pearson Education Inc., 2009.