

**Himachal Pradesh University  
Summer Hill, Shimla-171005**



**Syllabus and Scheme of Examination**

for

**B. Sc. with Mathematics**

&

**B.A. with Mathematics**

&

**B. Sc. Physical Sciences**

**(Physics, Chemistry & Mathematics)**

&

**B.Sc. Physical Sciences**

**(Physics, Mathematics & Computer Science)**

**Courses**

under the

**Choice Based Credit System**

***w.e.f.***

Session 2016 -17 onwards

**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
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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
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III	MATH301TH	CORE COURSE	REAL ANALYSIS	5+1=6
III		CORE COURSE	(C2C)	6
III		CORE COURSE	(C3C)	6
		SKILL ENHANCEMENT COURSE	SEC 1: <i>Choose one out of the following</i>	4
III	MATH302TH	SEC 1	LOGIC AND SETS	
III	MATH303TH	SEC 1	ANALYTICAL GEOMETRY	
III	MATH304TH	SEC 1	INTEGRAL CALCULUS	
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IV	MATH401TH	CORE COURSE	ALGEBRA	5+1=6
IV		CORE COURSE	(C2D)	6
IV		CORE COURSE	(C3D)	6
		SKILL ENHANCEMENT COURSE	SEC 2: <i>Choose one choose one out of the following</i>	4
IV	MATH402TH	SEC 2	VECTOR CALCULUS	
IV	MATH403TH	SEC 2	THEORY OF EQUATIONS	
IV	MATH404TH	SEC 2	NUMBER THEORY	
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		DISCIPLINE SPECIFIC ELECTIVE	DSE 1A (MATH): <i>Choose one choose one out of the following</i>	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: <i>Choose one choose one out of the following</i>	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): <i>Choose one choose one out of the following</i>	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: <i>Choose one choose one out of the following</i>	4
VI	MATH604TH	SEC 4	BOOLEAN ALGEBRA	
VI	MATH605TH	SEC 4	TRANSPORTATION AND GAME THEORY	
VI	MATH606TH	SEC 4	GRAPH THEORY	
			TOTAL CREDITS	132

**HIMACHAL PRADESH UNIVERSITY**  
**Syllabus and Scheme of Examination**  
**for B.A. with Mathematics**

Sem	Course Code	Course Type	Title of Paper	Credits (TH+T)*
<b>I</b>	<b>MATH101TH</b>	<b>CORE COURSE</b>	<b>DIFFERENTIAL CALCULUS</b>	<b>5+1=6</b>
I		CORE COURSE	(C2A)	6
I		ENGLISH/MIL-1	(C3A)	6
I		A.E.C. COURSE	AECC 1	4
<b>II</b>	<b>MATH201TH</b>	<b>CORE COURSE</b>	<b>DIFFERENTIAL EQUATIONS</b>	<b>5+1=6</b>
II		CORE COURSE	(C2B)	6
II		MIL/ENGLISH-1	(C3B)	6
II		A.E.C. COURSE	AECC 2	4
<b>III</b>	<b>MATH301TH</b>	<b>CORE COURSE</b>	<b>REAL ANALYSIS</b>	<b>5+1=6</b>
III		CORE COURSE	(C2C)	6
III		ENGLISH/MIL-1I	(C3C)	6
		SKILL ENHANCEMENT COURSE	SEC 1: Choose one choose one out of the following	4
<b>III</b>	<b>MATH302TH</b>	<b>SEC 1</b>	<b>LOGIC AND SETS</b>	
<b>III</b>	<b>MATH303TH</b>	<b>SEC 1</b>	<b>ANALYTICAL GEOMETRY</b>	
<b>III</b>	<b>MATH304TH</b>	<b>SEC 1</b>	<b>INTEGRAL CALCULUS</b>	
<b>IV</b>	<b>MATH401TH</b>	<b>CORE COURSE</b>	<b>ALGEBRA</b>	<b>5+1=6</b>
IV		CORE COURSE	(C2D)	6
IV		MIL/ENGLISH-1I	(C3D)	6
		SKILL ENHANCEMENT COURSE	SEC 2: Choose one choose one out of the following	4
<b>IV</b>	<b>MATH402TH</b>	<b>SEC 2</b>	<b>VECTOR CALCULUS</b>	
<b>IV</b>	<b>MATH403TH</b>	<b>SEC 2</b>	<b>THEORY OF EQUATIONS</b>	
<b>IV</b>	<b>MATH404TH</b>	<b>SEC 2</b>	<b>NUMBER THEORY</b>	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1A (MATH): Choose one choose one out of the following	5+1=6
<b>V</b>	<b>MATH501TH</b>	<b>DSE 1A</b>	<b>MATRICES</b>	
<b>V</b>	<b>MATH502TH</b>	<b>DSE 1A</b>	<b>MECHANICS</b>	
<b>V</b>	<b>MATH503TH</b>	<b>DSE 1A</b>	<b>LINEAR ALGEBRA</b>	
V		DISCIPLINE SPECIFIC ELECTIVE	DSE2A	6
V		SKILL ENHANCEMENT COURSE	SEC 3: CHOOSE ONE OUT OF THE FOLLOWING	4
<b>V</b>	<b>MATH504TH</b>	<b>SEC 3</b>	<b>PROBABILITY AND STATISTICS</b>	
<b>V</b>	<b>MATH505TH</b>	<b>SEC 3</b>	<b>MATHEMATICAL FINANCE</b>	
<b>V</b>	<b>MATH506TH</b>	<b>SEC 3</b>	<b>MATHEMATICAL</b>	

			<b>MODELING</b>	
		GENERIC ELECTIVE	GE 1: <i>Choose one choose one out of the following</i>	6
V	MATH507TH	GE 1	<b>PORTFOLIO OPTIMIZATION</b>	
V	MATH508TH	GE 1	<b>QUEUEING AND RELIABILITY THEORY</b>	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1B (MATH): <i>Choose one choose one out of the following</i>	<b>5+1=6</b>
VI	MATH601TH	DSE 1B	<b>NUMERICAL METHODS</b>	
VI	MATH602TH	DSE 1B	<b>COMPLEX ANALYSIS</b>	
VI	MATH603TH	DSE 1B	<b>LINEAR PROGRAMMING</b>	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 2B	6
		SKILL ENHANCEMENT COURSE	SEC 4: <i>Choose one choose one out of the following</i>	4
VI	MATH604TH	SEC 4	<b>BOOLEAN ALGEBRA</b>	
VI	MATH605TH	SEC 4	<b>TRANSPORTATION AND GAME THEORY</b>	
VI	MATH606TH	SEC 4	<b>GRAPH THEORY</b>	
		GENERIC ELECTIVE	GE 2: <i>Choose one choose one out of the following</i>	6
VI	MATH607TH	GE 2	<b>DESCRIPTIVE STATISTICS AND PROBABILITY THEORY</b>	
VI	MATH608TH	GE 2	<b>SAMPLE SURVEYS AND DESIGN OF EXPERIMENTS</b>	
			<b>TOTAL CREDITS</b>	<b>132</b>

(\* ) TH: THEORY, T: TUTORIAL

HIMACHAL PRADESH UNIVERSITY  
Syllabus and Scheme of Examination

**B.Sc. Physical Sciences (Physics, Chemistry & Mathematics) &  
B.Sc. Physical Sciences (Physics, Mathematics & Computer Science)**

Sem	Course Code	Course Type	Title of Paper	Credits (TH+T)*
I	MATH101TH	CORE COURSE	DIFFERENTIAL CALCULUS	5+1=6
I		CORE COURSE	DSC-2A (Physics)	6
I		CORE COURSE	DSC- 3A (Chemistry/Comp. Sc)	6
I		A.E.C. COURSE	AECC1	4
II	MATH201TH	CORE COURSE	DIFFERENTIAL EQUATIONS	5+1=6
II		CORE COURSE	DSC- 2B (Physics)	6
II		CORE COURSE	DSC- 3B (Chemistry/Comp. Sc)	6
II		A.E.C. COURSE	AECC 2	4
III	MATH301TH	CORE COURSE	REAL ANALYSIS	5+1=6
III		CORE COURSE	DSC- 2C (Physics)	6
III		CORE COURSE	DSC- 3C (Chemistry/Comp. Sc)	6
III		SKILL ENHANCEMENT COURSE	SEC 1: <b>One course</b>	4
III			<b>Choose one course out of the list of SEC courses of Physics Discipline</b>	
IV	MATH401TH	CORE COURSE	ALGEBRA	5+1=6
IV		CORE COURSE	DSC- 2D (Physics)	6
IV		CORE COURSE	DSC- 3D (Chemistry/Comp. Sc)	6
		SKILL ENHANCEMENT COURSE	SEC 2: <b>One course</b>	4
IV			<b>Choose one course out of the list of SEC courses of Chemistry/Computer Science Discipline</b>	
		DISCIPLINE SPECIFIC ELECTIVE	DSE-1A (MATH): <i>Choose one choose one out of the following</i>	5+1=6
V	MATH501TH	DSE 1A	MATRICES	
V	MATH502TH	DSE 1A	MECHANICS	
V	MATH503TH	DSE 1A	LINEAR ALGEBRA	
V		DISCIPLINE SPECIFIC ELECTIVE	DSE-2A (Physics)	6
V		DISCIPLINE SPECIFIC ELECTIVE	DSE-3A (Chemistry/Comp. Sc)	6
		SKILL ENHANCEMENT	SEC3: <b>One course</b>	

		COURSE		4
V			Choose one course out of the following list of SEC courses of Mathematics Discipline	
	MATH302TH		LOGIC AND SETS	
	MATH303TH		ANALYTICAL GEOMETRY	
	MATH304TH		INTEGRAL CALCULUS	
	MATH402TH		VECTOR CALCULUS	
	MATH403TH		THEORY OF EQUATIONS	
	MATH404TH		NUMBER THEORY	
	MATH504TH		PROBABILITY AND STATISTICS	
	MATH505TH		MATHEMATICAL FINANCE	
	MATH506TH		MATHEMATICAL MODELING	
	MATH604TH		BOOLEAN ALGEBRA	
	MATH605TH		TRANSPORTATION AND GAME THEORY	
	MATH606TH		GRAPH THEORY	
		DISCIPLINE SPECIFIC ELECTIVE	DSE 1B (MATH): <i>Choose one choose one out of the following</i>	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 (Physics)	6
		DISCIPLINE SPECIFIC ELECTIVE	DSE3B (Chemistry/Comp. Sc)	6
		SKILL ENHANCEMENT COURSE	SEC 4: <i>Choose one choose one out of the following</i>	4
VI			SEC 4: <b>One course</b>	
VI			Choose one course out of the lists of SEC courses of Physics/Chemistry(or Comp. Sc ) / Mathematics Disciplines, but not chosen earlier in SEC 1, SEC 2 and SEC 3	
			TOTAL CREDITS	132

(\* ) TH: THEORY, T: TUTORIAL

**NOTE:** Students have to select at least one Skill Enhancement Course (out of SEC 1, SEC II & SEC III and SEC IV) from each core discipline (Physics, Chemistry/Computer Science, Mathematics) for B.Sc. Physical Sciences.

## Details of Courses under B. Sc. with Mathematics

Course	*Credits	
	Theory + Practical	Theory + Tutorials
<b>I. Core Course</b> (12 Papers) 04 Courses from each of the 03 disciplines of choice	$12 \times 4 = 48$	$12 \times 5 = 60$
<b>Core Course Practical / Tutorial*</b> (12 Practical/ Tutorials*) 04 Courses from each of the 03 Disciplines of choice	$12 \times 2 = 24$	$12 \times 1 = 12$
<b>II. Elective Course</b> (6 Papers) Two papers from each discipline of choice including paper of interdisciplinary nature.	$6 \times 4 = 24$	$6 \times 5 = 30$
<b>Elective Course Practical / Tutorials*</b> (6 Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature	$6 \times 2 = 12$	$6 \times 1 = 6$
<b>• Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester</b>		
<b>III. Ability Enhancement Courses</b>		
1. <b>Ability Enhancement Compulsory</b> (2 Papers of 4 credits each) <b>Environmental Science</b> <b>English/MIL Communication</b>	$2 \times 4 = 8$	$2 \times 4 = 8$
2. <b>Skill Enhancement Course</b> (Skill Based) (4 Papers of 4 credits each)	$4 \times 4 = 16$	$4 \times 4 = 16$
<b>Total credit = 132</b>	<b>Total credit = 132</b>	

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

## Details of Courses under B.A. with Mathematics

Course	*Credits	
	Theory + Practical	Theory + Tutorials
<b>I. Core Course</b> (12 Papers) Two papers – English Two papers – MIL Four papers – Discipline 1 Four papers – Discipline 2	$12 \times 4 = 48$	$12 \times 5 = 60$
<b>Core Course Practical / Tutorial*</b> (12 Practical/ Tutorials*)	$12 \times 2 = 24$	$12 \times 1 = 12$
<b>II. Elective Course</b> (6 Papers) Two papers – Discipline 1 specific Two papers – Discipline 2 specific Two papers – Generic Elective (Interdisciplinary)	$6 \times 4 = 24$	$6 \times 5 = 30$
Two papers from each discipline of choice and two papers of interdisciplinary nature. (GE)		
<b>Elective Course Practical / Tutorials*</b> (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	$6 \times 2 = 12$	$6 \times 1 = 6$
<b>III. Ability Enhancement Courses</b>		
1. Ability Enhancement Compulsory Courses (AECC) (2 Papers of 4 credits each) <b>Environmental Science</b> <b>English /MIL Communication</b>	$2 \times 4 = 8$	$2 \times 4 = 8$
2. Skill Enhancement Course (SEC) (4 Papers of 4 credits each)	$4 \times 4 = 16$	$4 \times 4 = 16$
<b>Total credit = 132</b>	<b>Total credit = 132</b>	

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

## Details of Courses under B. Sc. Physical Sciences (Physict, Chemistry/Computer Science, Mathematics)

Course	Theory + Practical	Theory + Tutorials
<b>I. Core Course</b> (12 Papers) 04 Courses from each of the 03 disciplines of choice (Physics, Chemistry/Computer Science, Mathematics)	$12 \times 4 = 48$	$12 \times 5 = 60$
<b>Core Course Practical / Tutorial*</b> (12 Practical/ Tutorials*) 04 Courses from each of the 03 Disciplines of choice	$12 \times 2 = 24$	$12 \times 1 = 12$
<b>II. Discipline Specific Elective Elective Course</b> (6 Papers) Two papers from each discipline of choice including paper of interdisciplinary nature.	$6 \times 4 = 24$	$6 \times 5 = 30$
<b>Elective Course Practical / Tutorials*</b> (6 Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature	$6 \times 2 = 12$	$6 \times 1 = 6$
<b>III. Ability Enhancement Courses</b>		
<b>1. Ability Enhancement Compulsory</b> (2 Papers of 4 credits each) <b>Environmental Science</b> <b>English/MIL Communication</b>	$2 \times 4 = 8$	$2 \times 4 = 8$
<b>2. Skill Enhancement Course(Skill Based)</b> (4 Papers of 4 credits each, selecting at least one from each discipline)	$4 \times 4 = 16$	$4 \times 4 = 16$
<b>Total credit = 132</b>	<b>Total credit = 132</b>	<b>Total credit = 132</b>

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

**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)**

<b>I.</b>	<b>Theory</b>	<b>80 marks</b>
	a) End-Semester Examination (ESE)	<b>80 marks</b>
<b>II.</b>	<b>Comprehensive Continuous Assessment (CCA)</b>	<b>20 marks</b>
	a) Assignment/Class Test/Quiz/Seminar/Model	<b>05 marks</b>
	b) Mid-Term Examination (One Test)	<b>10 marks</b>
	c) Attendance	<b>05 marks</b>

- ❖ 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.**

**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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

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

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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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

**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*, 4<sup>th</sup> 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:20
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

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:20
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

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.

**HIMACHAL PRADESH UNIVERSITY**  
**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:20
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

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

Unit-IV

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.

## 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:20
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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:20
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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:20
Tutorials : Solving Problems and exercises	Nil
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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:20
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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:20
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

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:20
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

Applications to Traffic Flow. Vibrating string, vibrating membrane,

Unit-IV

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 (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:20
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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:20
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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.

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**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:20
Tutorials : Solving Problems and exercises	Nil
Semester Term End Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

Isomorphism of graphs, paths and circuits, Eulerian circuits.

Unit-III

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

Unit-IV

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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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.

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

#### Fifth Semester

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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

#### Unit-II

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

#### Unit-III

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

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.

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**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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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*, 4<sup>th</sup> 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.

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**Sixth 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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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.

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**Sixth 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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

Unit-III

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

Unit-IV

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**

**Sixth 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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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.

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**\*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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

Unit-II

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

Unit-III

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

Unit-IV

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*, 10<sup>th</sup> 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*, 2<sup>nd</sup> Ed., Oxford University Press, 2013.

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**\*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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

Unit-III

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

Unit-IV

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*, 2<sup>nd</sup> Ed., North Holland, 1981.
2. D. Gross, C. M. Harris, *Fundamentals of Queueing Theory*, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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.

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**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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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.

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**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:20
Tutorials : Solving Problems and exercises	12 hours
End Semester Examination	Max Marks: 80 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 80 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 16 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

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

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

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

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), 8<sup>th</sup> Ed., World Press, Kolkata, 2005.
3. A.M. Goon, M.K. Gupta and B. Dasgupta, *An Outline of Statistical Theory* (Vol. II), 3<sup>rd</sup> Ed., World Press, Kolkata, 2005.
4. S.C. Gupta and V.K. Kapoor, *Fundamentals of Applied Statistics*, 4<sup>th</sup> 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*, 3<sup>rd</sup> 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.