Annexure-II

Himachal Pradesh University
Summer Hill, Shimla-171005

Syllabus and Scheme of Examination
(for Ist & IInd Semesters only)

B.Sc. (Hons.) with Mathematics Course

Under the

Choice Based Credit System

w.e.f.

Session 2016 -2017 onwards

HIMACHAL PRADESH UNIVERSITY

Syllabus and Scheme of Examination

for B.Sc. (Hons.) Mathematics

for Ist 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)**	**ALGLEBRA**	**5+1=6**
I		AEC COURSE	AECC1	4
		GENERIC ELECTIVE	GE 1: CHOOSE ONE OUT OF THE FOLLOWING	**5+1=6**
I	**MATH104TH**	**(GE) THEORY**	**OBJECT ORIENTED PROGRAMMING IN C++**	
I	**MATH105TH (MATH505TH) (*)**	**(GE) THEORY**	**MATHEMATICAL FINANCE (*)**	
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**	**5+1=6**
II	**MATH204TH**	**(GE) THEORY**	**FINITE ELEMENT METHODS**	
II	**MATH205TH**	**(GE) THEORY**	**ECONOMETRICS**	

(*): These two courses (with course codes: MATH105TH & MATH505TH) have same syllabus (course content).

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

Course	***Credits**	
	Theory + Practical	Theory + Tutorial
I. Core Course (14 Papers)	14×4 = 56	14×5 = 70
Core Course Practical / Tutorial* (14 Papers)	14×2 = 28	14×1 = 14
II. Elective Course (8 Papers)		
A.1. Discipline Specific Elective **(4 Papers)**	4×4 = 16	4×5 = 20
A.2. Discipline Specific Elective Practical/ Tutorial* **(4 Papers)**	4×2 = 8	4×1 = 4
B.1. Generic Elective/ Interdisciplinary **(4 Papers)**	4×4 = 16	4×5 = 20
B.2. Generic Elective Practical/ Tutorial* **(4 Papers)**	4×2 = 8	4×1 = 4
III. Ability Enhancement Courses		
1.**Ability Enhancement Compulsory Courses (AECC) (2 Papers of 4 credit each)** Environmental Science English/MIL Communication	2×4 = 8	2×4 = 8
2. **Skill Enhancement Courses (SEC) (Minimum 2) (2 Papers of 4 credit each)**	2×4= 8	2×4 = 8
Total credit	148	148

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

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

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

- **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 ≥ 75% but < 80%**	**1 mark**
ii)	**Attendance ≥ 80% but < 85%**	**2 marks**
iii)	**Attendance ≥ 85% but < 90%**	**3 marks**
iv)	**Attendance ≥ 90% but < 95%**	**4 marks**
v)	**Attendance ≥ 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

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**	**50 marks**
	a) End-Semester Examination (ESE)	**50 marks**
II.	**Comprehensive Continuous Assessment (CCA)**	**20 marks**
	a) Assignment/Class Test/Quiz/Seminar/Model	**05 marks**
	b) Mid-Term Examination (One Test)	**10 marks**
	c) Attendance	**05 marks**
III.	**Practical**	**30 marks**

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 marks**
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 ≥75% but < 80%**	**1 mark**
ii)	**Attendance ≥ 80% but < 85%**	**2 marks**
iii)	**Attendance ≥ 85% but < 90%**	**3 marks**
iv)	**Attendance ≥ 90% but < 95%**	**4 marks**
v)	**Attendance ≥ 95%**	**5 marks**

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: 50 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 50 marks. **Section A** will be **Compulsory** and will contain 5 questions of 10 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 10 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

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

Reduction Formulae, $\int Sin^n x\,dx$, $\int Cos^n x\,dx$, $\int e^{ax}\,x^n dx$, $\int x^n (logx)^m dx$, $\int x^n Sinx dx$, $\int x^n cosx dx$, $\int Sin^n x\,Cox^n x dx$, , $\int_0^{\pi/2} Sin^n x\text{dx}$, $\int_0^{\pi/2} Cos^n x\text{dx}$, $\int_0^{\pi/2} Sin^n x Cox^n x\text{dx}$. Reduction by connecting two integrals (Smaller Index + 1 Method).

volumes by slicing, disks and washers methods, volumes by cylindrical shells,

Unit-III

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

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.

Books Recommended: For List, see the syllabus of Course MATH102PR.

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: 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.

C1.2 Algebra

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

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

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

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of 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: 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.

C2.1 Real Analysis

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

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

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

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: 50 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 50 marks. **Section A** will be **Compulsory** and will contain 5 questions of 10 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 10 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

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

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

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

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.

Books Recommended: For List, see the syllabus of Course MATH203PR.

Second Semester

Course Code	MATH203PR
Credits= 2	L-0,T-0,P-2
Name of the Course	Differential Equations
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 $(n+1)^{th}$ 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

HIMACHAL PRADESH UNIVERSITY

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

First Semester

Course Code	MATH104TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Object Oriented Programming in C++
Type of the Course	Generic Elective 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: 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 1.1 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.

Unit-II

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

Unit-III

Abstract data types, Class Component, Object & Class, Constructors Default and Copy Constructor, Assignment operator deep and shallow coping, Access modifiers – private, publicand 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

Unit-IV

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, M*astering 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. Parasons, *Object Oriented Programming with C++*, BPB Publication.
5. Bjarne Stroustrup , *The C++ Programming Language*, 3rd Ed., Addison Welsley.

HIMACHAL PRADESH UNIVERSITY

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

First Semester

Course Code	MATH105TH/ MATH505TH
Credits= 4	L-5,T-1,P-0
Name of the Course	Mathematical Finance
Type of the Course	Generic Elective 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	12 hours
Semester Term End Examination	Max Marks: 80 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 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: Mathematical Finance

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

First Semester

Course Code	MATH204TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Finite Element Methods
Type of the Course	Generic Elective 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: 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.

GE2.2 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.

Unit-II

Applications to solving simple problems of ordinary differential equations, Linear, quadratic and higher order elements in one dimensional and assembly, solution of assembled system.

Unit-III

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

Unit-IV

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.

HIMACHAL PRADESH UNIVERSITY

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

Second Semester

Course Code	MATH205TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Econometrics
Type of the Course	Generic Elective 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: 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.

GE2.2 Econometrics

Unit-I

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.

Unit-II

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.

Unit-III

Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - R2 and adjusted R2 ; partial regression coefficients; testing hypotheses – individual and joint; functional forms of regression models; qualitative (dummy) independent variables.

Unit-IV

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 over flow; system threats- intruders; communication threats- tapping and piracy.

Cryptography: Substitution, transposition ciphers, symmetric-key algorithms-Data EncryptionStandard, 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 cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.

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

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 apositive 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.