Himachal Pradesh University

Summer Hill, Shimla-171005

Syllabus and Scheme of Examination

For

B.Sc. (Hons.) with Mathematics

Course

under the

Choice Based Credit System

w.e.f.

Session 2016 -17 onwards

HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION
FOR B.Sc. (Hons.) MATHEMATICS
W.E.F. SESSION 2016-2017

Sem	Course Code	Course Type	Title of Paper	Credits
I	MATH101TH(H)	CORE COURSE (THEORY)	CALCULUS	4
I	MATH101PR(H)	CORE COURSE (PRACTICAL)	CALCULUS	2
I	MATH102TH(H)	CORE COURSE (THEORY)	ALGLEBRA	6
I		AEC COURSE	AECC1	4
		GENERIC ELECTIVE	GE 1: CHOOSE ONE OUT OF THE FOLLOWING	6
I	MATH103TH(H)	(GE) THEORY	OBJECT ORIENTED PROGRAMMING IN C++	
I	MATH103PR(H)	(GE) PRACTICAL	OBJECT ORIENTED PROGRAMMING IN C++	
I	MATH104TH(H) (*)	(GE) THEORY	MATHEMATICAL FINANCE (*)	
II	MATH201TH(H)	CORE COURSE (THEORY)	REAL ANALYSIS	6
II	MATH203TH(H)	CORE COURSE (THEORY)	DIFFERENTIAL EQUATIONS	4
II	MATH203PR(H)	CORE COURSE (PRACTICAL)	DIFFERENTIAL EQUATIONS	2
II		AEC COURSE	AECC1I	4
		GENERIC ELECTIVE	GE 1: CHOOSE ONE OUT OF THE FOLLOWING	6
II	MATH204TH(H)	(GE) THEORY	FINITE ELEMENT METHODS	
II	MATH205TH(H)	(GE) THEORY	ECONOMETRICS	

(H): Hons.

Sem.	Course Code	Course Type	Title of Paper	Credit
III	MATH301TH(H)	CORE COURSE (THEORY)	THEORY OF REAL FUCTIONS	6
III	MATH302TH(H)	CORE COURSE (THEORY)	GROUP THEORY-I	6
III	MATH303TH(H)	CORE COURSE (THEORY)	PDE AND SYSTEMS OF ODE	4
III	MATH304PR(H)	CORE COURSE (PRACTICAL)	PDE AND SYSTEMS OF ODE	2
		SEC COURSE	CHOOSE ONE OUT OF THE FOLLOWING:	4
III	MATH305TH(H)		LOGIC AND SETS	
III	MATH306TH(H)		COMPUTER GRAPHICS	
		GENERIC ELECTIVE	GE3: CHOOSE ONE OUT OF THE FOLLOWING	6
III	MATH307TH(H)	GENERIC ELECTIVE (THEORY)	CRYPTOGRAPHY AND NETWORK SECURITY	
III	MATH308TH(H)	GENERIC ELECTIVE (THEORY)	INFORMATION SECURITY	

Sem.	Course Code	Course Type	Title of Paper	Credit
IV	MATH401TH(H)	CORE COURSE (THEORY)	Numerical Methods	4
IV	MATH401PR(H)	CORE COURSE (PRACTICAL)	Numerical Methods	2
IV	MATH402TH(H)	CORE COURSE (THEORY)	Riemann Integration and series of functions	6
IV	MATH403TH(H)	CORE COURSE (THEORY)	Ring Theory and Linear Algebra I	6
		SEC COURSE	CHOOSE ONE OUT OF THE FOLLOWING:	4
IV	MATH404TH(H)		Graph Theory	
IV	MATH405TH(H)		Operating System : Linux	
		GENERIC ELECTIVE	GE4: CHOOSE ONE OUT OF THE FOLLOWING	6
IV	MATH406TH(H)	GENERIC ELECTIVE (THEORY)	Applications of Algebra	
IV	MATH407TH(H)	GENERIC ELECTIVE (THEORY)	Combinatorial Mathematics	

Sem.	Course Code	Course Type	Title of Paper	Credit
V	MATH501TH(H)	CORE COURSE (THEORY)	Multivariate Calculus	6
V	MATH502TH(H)	CORE COURSE (THEORY)	Group Theory II	6
		DSE COURSE I	CHOOSE ONE OUT OF THE FOLLOWING:	6
V	MATH503TH(H)		Portfolio Optimization	
V	MATH504TH(H)		Number Theory	
V	MATH505TH(H)		Analytic Geometry	
		DSE COURSE II	CHOOSE ONE OUT OF THE FOLLOWING	6
V	MATH506TH(H)		Industrial Mathematics	
V	MATH507TH(H)		Boolean Algebra and Automata Theory	
V	MATH508TH(H)		Probability and Statistics	

Sem.	Course Code	Course Type	Title of Paper	Credit
VI	MATH601TH(H)	CORE COURSE (THEORY)	Metric Spaces and Complex Analysis	6
VI	MATH602TH(H)	CORE COURSE (THEORY)	Ring Theory and Linear Algebra II	6
		DSE COURSE I	CHOOSE ONE OUT OF THE FOLLOWING:	6
VI	MATH603TH(H)		Theory of Equations	
VI	MATH604TH(H)		Bio-Mathematics	
VI	MATH605TH(H)		Linear Programming	
		DSE COURSE II	CHOOSE ONE OUT OF THE FOLLOWING	6
VI	MATH606TH(H)		Mathematical Modeling	
VI	MATH606PR(H)		Mathematical Modeling	
VI	MATH607TH(H)		Mechanics	
VI	MATH608TH(H)		Differential Geometry	

TOTAL CREDITS = 148

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

B.Sc. (Hons.) 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 WITHOUT PRACTICALS)

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

(FOR COURSES WITH PRACTICALS)

III.	**Theory**	**marks**
	End-Semester Examination (ESE)	**50 marks**
IV.	**Comprehensive Continuous Assessment (CCA)**	**30 marks**
	a) Assignment/Class Test/Quiz/Seminar/Model	**10 marks**
	c) Mid-Term Examination (One Test)	**15 marks**
	d) Attendance	**05**

V. Practical **20 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

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

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

III. Ability Enhancement Courses

1.**Ability Enhancement Compulsory Courses (AECC)**		
(2 Papers of 4 credit each)	2×4 = 8	2×4= 8
Environmental Science English/MIL Communication		
2. **Skill Enhancement Courses (SEC)**		
(Minimum 2)	2×4 = 8	2×4 = 8
(2 Papers of 4 credit each)		
Total credit	148	148

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

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

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

First S**emester**

Course Code	MATH101TH(H)
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	60 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	30 hours
End Semester Examination	Max Marks: 50 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 50 marks. **Section A** will be **Compulsory** and will contain 8 questions of 12 marks (each of 1.5 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 9.5 marks each.

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

C1.1 Calculus

Unit-I(15 **hrs.**)

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

Unit-II (15 **hrs.**)

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 (15 **hrs.**)

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

Unit-IV (15 **hrs.**)

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

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.

Course Code: MATH101PR(H)

First Semester

Course Code	MATH101PR(H)
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	30 hours
End Semester Examination	Max Marks: 20 Maximum Time: 3 hrs.

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

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 (e.g. 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	MATH102TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C1.2 Algebra

Unit-I (19 **hrs.**)

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

Unit-II (19 **hrs.**)

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

Unit-III (19 **hrs.**)

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

Unit-IV (18 **hrs.**)

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

First Semester

Course Code	MATH103TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

GE 1.1 Object Oriented Programming in C++

Unit-I (19 **hrs.**)

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 (19 **hrs.**)

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 (19 **hrs.**)

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 (18 **hrs.**)

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

First Semester

Course Code	MATH104TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Mathematical Finance
Type of the Course	Generic Elective Course
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

GE1.2Mathematical Finance

Unit-I (19 **hrs.**)

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

Unit-II (19 **hrs.**)

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

Unit-III (19 **hrs.**)

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

Unit-IV (18 **hrs.**)

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

Books Recommended

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

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

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

HIMACHAL PRADESH UNIVERSITY

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

Second Semester

Course Code	MATH201TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C2.1 Real Analysis

Unit-I (19 **hrs.**)

Review of Algebraic and Order Properties of R, δ - 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 (19 **hrs.**)

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

Unit-III (19 **hrs.**)

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

Unit-IV (18 **hrs.**)

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

Books Recommended

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

HIMACHAL PRADESH UNIVERSITY

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

Second Semester

Course Code	MATH202TH(H)
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	60 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	30 hours
End Semester Examination	Max Marks: 50 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

1. **Instructions for paper setter:** The question paper will consist of **two Sections A & B** of 50 marks. **Section A** will be **Compulsory** and will contain 8 questions of 12 marks (each of 1.5 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 9.5 marks each.

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

C2.2 Differential Equations

Unit-I (12 **hrs.**)

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

Unit-II (12 **hrs.**)

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

Unit-III (12 **hrs.**)

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

Unit-IV (12 **hrs.**)

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

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.

4. Martha L Abell, James P Braselton, *Differential Equations with MATHEMATICA,* 3rd Ed., Elsevier Academic Press,2004.

Course Code: MATH202PR(H)

Second Semester

Course Code	MATH202PR(H)
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	30 hours
End Semester Examination	Max Marks: 20 Maximum Time: 3 hrs.

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

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 nth roots.

16. Ratio test by plotting the ratio of nth 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.
4. 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	MATH203TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

GE2.1Finite Element Methods

Unit-I (19 **hrs.**)

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 (19 **hrs.**)

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 (19 **hrs.**)

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 (18 **hrs.**)

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

First Semester

Course Code	MATH204TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

GE2.2 Econometrics

Unit-I (19 **hrs.**)

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 (19 **hrs.**)

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 (19 **hrs.**)

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 (18 **hrs.**)

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.

HIMACHAL PRADESH UNIVERSITY

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

Third Semester

Course Code	MATH301TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Theory of Real Functions
Type of the Course	Core Course
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C3.1 Theory of Real Functions

Unit-I (19 hrs)

Limits of functions $(\in -\delta)\, approach)$, sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity.

Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem.

Unit-II (19 hrs.)

Location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem. Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem.

Unit-III (19 hrs.)

Rolle's theorem, Mean value theorem and their applications intermediate value property of derivatives, Daraboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials.

Unit-IV (18 hrs.)

Cauchy's mean value theorem and its applications. Taylor's theorem, Taylor's theorem with Lagrange's form of remainder. Applications of Taylor's theorem to inequalities.

Taylor's theorem with Cauchy's form of remainder applications of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonomtric functions, In (l + x), 1/ax+b and $(1 + X)^n$.

Books Recommended

1. R. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons, 2003.

2. K.A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2004.

3. A. Mattuck, *Introduction to Analysis*, Prentice Hall, 1999.

4. S.R. Ghorpade and B.V. Limaye, *A Course in Calculus and Real Analysis*, Springer, 2006.

HIMACHAL PRADESH UNIVERSITY

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

Third Semester

Course Code	MATH302TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Group Theory I
Type of the Course	Core course
Number of teaching hours required for this course	75 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	15hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C3.2 Group Theory I

Unit-I (19 hrs.)

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Unit-II (19 hrs.)

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets.

Unit-III (19 hrs.)

Lagrange's theorem and consequences including Fermat's Little theorem.Internal and External direct product of a finite number of groups, normal subgroups, factor groups. Cauchy's theorem for finite abelian groups.

Unit-IV (18 hrs.)

Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**

2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.

3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.

4. Joseph J. Rotman, *An Introduction to the Theory of Groups*, 4th Ed., Springer Verlag, 1995.

5. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Limited, India, 1975.

HIMACHAL PRADESH UNIVERSITY

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

Third Semester

Course Code	MATH303TH(H)
Credits= 6	L-4,T-0,P-2
Name of the Course	PDE and Systems of ODE
Type of the Course	Core Course
Number of teaching hours required for this course	60 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	30 hours
End Semester Examination	Max Marks: 50 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 50 marks. **Section A** will be **Compulsory** and will contain 8 questions of 12 marks (each of 1.5 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 9.5 marks each.

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

C3.3 PDE and Systems of ODE

Unit-I (15 hrs.)

Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

Unit-II (15 hrs.)

Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

Unit-III (15 hrs.)

The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end, Equations with non-homogeneous boundary conditions, Non-Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem, Solving the Heat Conduction problem.

Unit-IV (15 hrs.)

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method.

Books Recommended:

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial differential equations for scientists and engineers*, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, *Differential Equations* , 3rd edition, John Wiley and Sons, India, 2004
3. Martha L. Abell, James P. Braselton, *Differential Equations with MATHEMATICA*, *3rd ed., Elsevier academic Press,2004.*

Course Code: MATH304PR(H)

Third Semester

Course Code	MATH304PR(H)
Credits=2	L-0,T-0,P-2
Name of the Course	PDE and Systems of ODE
Type of the Course	Core Course
Number of Practical hours required for this course	30 hrs
End semester examinations	Max Marks: 20 Maximum Time: 3 hrs

Note: Candiate shall have to attempt two practicals out of the given four practicals.

List of Practicals (using any software)

(1) Solution of Cauchy problem for first order PDE.

(2) Finding the characteristics for the first order PDE.

(3) Plot the integral surface of a given first order PDE with initial data.

(4) Solution of the wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) $u(x,0) = \varphi(x)\,, u_t(x,0) = \Psi(x), x \in R, t > 0$

(b) $u(x,o) = \varphi(x)\,, u_t(x,o) = \Psi(x), u(0,t) = 0, x \in (0,\infty), t > 0$

(c) $u(x,o) = \varphi(x)\,, u_t(x,o) = \Psi(x), u_x(0,t) = 0, x \in (0,\infty), t > 0$

(d) $u(x,o) = \varphi(x)\,, u_t(x,o) = \Psi(x), u(0,t) = 0, u(1,t) = 0, 0 < x < l, t > 0$

(5) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated condition

(a) $u(x,0) = \varphi(x),\ u(0,t) = a, u(l,t) = b, 0 < x < l\,, t > 0$

(b) $u(x,0) = \varphi(x),\ x \epsilon R\,, 0 < t < T$

(c) $u(x,0) = \varphi(x), u(0,t) = a, x \in (0,\infty)\,, t \geq 0$

Books Recommended:

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial differential equations for scientists and engineers*, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, *Differential Equations* , 3rd edition, John Wiley and Sons, India, 2004
3. 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

Third Semester

Course Code	*MATH305TH(H)*
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	*60 hrs.*
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	*Max. Marks:30*
Tutorials : Solving Problems and exercises	*NIL*
End Semester Examination	*Max Marks: 70 Maximum Time: 3 hrs.*
Total Lectures to be Delivered (One Hour Each)	*60*

Instructions

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

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

SEC 1.1 Logic and Sets

Unit-I (15 hrs.)

Introduction, propositions, truth table, negation, conjuction and disjunction.

Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit-II (15 hrs.)

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

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets..

Unit-III (15 hrs.)

Finite sets and counting principle. Empty set, properties of empty set. Standard set operations Classes of sets, Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

Unit-IV (15 hrs.).

Relation, Product set, Composition of relations, Types of relations.

Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations n ary relations.

Books Recommended

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

HIMACHAL PRADESH UNIVERSITY

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

Third Semester

Course Code	MATH306TH(H)
Credits= 4	L-4,T-0,P-0
Name of the Course	Computer Graphics
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	60hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials : Solving Problems and exercises	NIL
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

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

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

SEC 1.2 Computer Graphics

Unit-I (15 hrs.)

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques.

Unit-II (15 hrs.)

Interactive input/output devices.

Unit-III (15 hrs.)

Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling anti aliasing.

Unit-IV (15 hrs.).

Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

Books Recommended

1. D. Hearn and M.P. Baker, *Computer Graphics*, 2nd Ed., Prentice-Hall of India, 2004.
2. J.D. Foley, A van Dam, S.K. Feiner and J.F, Hughes, *Computer Graphics: Principals and Practices,* 2nd Ed., Addison-Wesley, MA, 1990.
3. D.F. Rogers and A.J. Admas, Mathematical Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 1990.
4. D.F. Rogers, *Procedural Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 2001.

HIMACHAL PRADESH UNIVERSITY

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

Third Semester

Course Code	MATH307TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Cryptography and Network Security
Type of the Course	Generic Elective Course
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Times: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

GE3.1 Cryptography and Network Security

Unit-I (19 hrs.)

Public Key Cryptography Principles & Applications, Algorithms: RSA, Message Authentication: One way Hash Functions: Message Digest, MD5, SHA1.

Unit-II (19hrs.)

Public Key Infrastructure: Digital Signatures, Digital Certificates, Certificate Authorities.

Unit-III (19 hrs.)

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.

Unit-IV (18 hrs.)

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.

HIMACHAL PRADESH UNIVERSITY

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

Third Semester

Course Code	MATH308TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Information Security
Type of the Course	Generic Elective Course
Number of teaching hours required for this course	75 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	15hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

GE 3.2 Information Security

Unit-I (19 hrs.)

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

Unit-II (19 hrs.)

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

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

Unit-III (19 hrs.)

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

Unit-IV (18 hrs.).

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

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.

HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH401TH(H)
Credits= 6	L-4,T-0,P-2
Name of the Course	Numerical Methods
Type of the Course	Core Course
Number of teaching hours required for this course	60 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	30 hours
End Semester Examination	Max Marks: 50 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 50 marks. **Section A** will be **Compulsory** and will contain 8 questions of 12 marks (each of1.5 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 9.5 marks each.

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

C4.1 Numerical Methods

Unit-I (15 hrs)

Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods.

Unit-II (15 hrs.)

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. Interpolation: Lagrange and Newton's methods

Unit-III (15 hrs.)

Error bounds. Finite difference operators. Gregory forward and backward difference interpolation. Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule,

Unit-IV (15 hrs.)

Composite Trapezoidal rule, Composite Simpson's rule.Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

Books Recommended

1. Brian 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*, 6th Ed., New age International Publisher, India, 2007.

3. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Pearson Education, India, 2

4. Uri M. Ascher and Chen Greif, *A First Course in Numerical Methods*, 7th Ed., PHI Learning Private Limited, 2013.

5. John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI Learning Private Limited, 2012.

Course Code: MATH401PR(H)

Fourth Semester

Course Code	MATH401PR(H)
Credits=2	L-0,T-0,P-2
Name of the Course	Numerical Methods
Type of the Course	Core Course
Number of Practical hours required for this course	30 hrs
End semester examinations	Max Marks: 20 Maximum Time: 3 hrs

Note: Candiate shall have to attempt two practical out of the given four practical.
List of Practicals (using any software)

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Bisection Method.
(v) Newton Raphson Method.
(vi) Secant Method.
(vii) Regulai Falsi Method.
(viii) LU decomposition Method.
(ix) Gauss-Jacobi Method.
(x) SOR Method or Gauss-Siedel Method.
(xi) Lagrange Interpolation or Newton Interpolation.
(xii) Simpson's rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

Books Recommended

6. Brian Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.

7. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Ed., New age International Publisher, India, 2007.

8. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Pearson Education, India, 2

9. Uri M. Ascher and Chen Greif, *A First Course in Numerical Methods*, 7th Ed., PHI Learning Private Limited, 2013.

10. John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI Learning Private Limited, 2012.

HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH402TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Riemann Integration and Series of Functions
Type of the Course	Core Course
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C4.2 Riemann Integration and Series of Functions

Unit-I (19 hrs.)

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.

Unit-II (19 hrs.)

Intermediate Value theorem for Integrals; Fundamental theorems of Calculus. Improper integrals; Convergence of Beta and Gamma functions.

Unit-III (19 hrs.)

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit-IV (18 hrs.)

Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

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Books Recommended

1. K.A. Ross, *Elementary Analysis, The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

2. R.G. Bartle D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.

3. Charles G. Denlinger, *Elements of Real Analysis*, Jones & Bartlett (Student Edition), 2011.

HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH403TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Ring Theory and Linear Algebra I
Type of the Course	Core Course
Number of teaching hours required for this course	75 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 rxercises	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C4.3 Ring Theory and Linear Algebra I

Unit-I (19 hrs.)

Definition and examples of rings, subrings, integral domains and fields. Properties of rings, characteristic of an integral domain ring. Ideals of rings, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit-II (19 hrs.)

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit-III (19 hrs.)

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit-IV (18 hrs.)

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

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. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra,* 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
4. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.
5. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.
6. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.
7. S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India,1999.
8. Kenneth Hoffman, Ray Alden Kunze, *Linear Algebra,* 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
9. D.A.R. Wallace, *Groups, Rings and Fields*, Springer Verlag London Ltd., 1998

HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH404TH(H)
Credits= 4	L-4,T-0,P-0
Name of the Course	Graph Theory
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	60hrs.
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 exercise	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

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

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

SEC 2.1 Graph Theory

Unit-I (15 hrs.)

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-parti graphs.

Unit-II (15 hrs.)

Isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix.

Unit-III (15 hrs.)

Weighted graph, travelling salesman's problem, shortest path.

Unit-IV (15 hrs.)

Dijkstra's algorithm, Floyd-Warshall algorithm.

Books Recommended

1. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.

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

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

HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH405TH(H)
Credits= 4	L-4,T-0,P-0
Name of the Course	Operating System : Linux
Type of the Course	Skill Enhancement Course
Number of teaching hours required for this course	60 hrs.
Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)	Max. Marks:30
Tutorials: Solving problems and exercises	Nil
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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 Operating System: Linux

Unit-I (15 hrs.)

Linux – The Operating System: Linux history, Linux features, Linux distributions, Linux's relationship to Unix, Overview of Linux architecture,

Unit-II (15 hrs.)

Installation, Start up scripts, system processes (an overview), Linux Security, The Ext2 and Ext3 File systems: General Characteristics of, The Ext3 File system, file permissions.

Unit-III (15 hrs.)

User Management: Types of users, the powers of Root, managing users (adding and deleting): using the command line and GUI tools.

Unit-IV (15 hrs.)

Resource Management in Linux: file and directory management, system calls for files Process Management, Signals, IPC: Pipes, FIFOs, System V IPC, Message Queues, system calls for processes, Memory Management, library and system calls for memory.

Books Recommended

1. Arnold Robbins, *Linux Programming by Examples The Fundamentals*, 2nd Ed., Pearson Education, 2008.

2. Cox K, *Red Hat Linux Administrator's Guide*, PHI, 2009.

3. R. Stevens, *UNIX Network Programming*, 3rd Ed., PHI, 2008.

4. Sumitabha Das, *Unix Concepts and Applications*, 4th Ed., TMH, 2009.

5. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, *Linux in a Nutshell*, 6th Ed., O'Reilly Media, 2009.

6. Neil Matthew, Richard Stones, Alan Cox, *Beginning Linux Programming*, 3rd Ed., 2004.

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HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH406TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Application of Algebra
Type of the Course	Generic Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

GE4.1 Applications of Algebra

Unit-I (19 hrs.)

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.

Unit-II (19 hrs.)

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.

Unit-III (19 hrs.)

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.

Unit-IV (18 hrs.)

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

HIMACHAL PRADESH UNIVERSITY

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

Fourth Semester

Course Code	MATH407TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Combinatorial Mathematics
Type of the Course	Generic Elective
Number of teaching hours required for this course	75hrs.
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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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 4.2 Combinatorial Mathematics

Unit-I (19 hrs.)

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

Unit-II (19 hrs.)

Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions.

Unit-III (19 hrs.)

Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions. Integer partitions, Systems of distinct representatives.

Unit-IV (18 hrs.)

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.

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH501TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Multivariate Calculus
Type of the Course	Core Course
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

C5.1 Multivariate Calculus

Unit-I (19 hrs)

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

Unit-II (19hrs.)

Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl. Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates,

Unit-III (19 hrs.)

Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work.

Unit-IV (18 hrs.)

Fundamental theorem for line integrals, conservative vector fields, independence of path.Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

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) Pvt. Ltd. (Pearson Education), Delhi, 2007.

3. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus*, Springer (SIE), Indian reprint, 2005.

4. James Stewart, *Multivariable Calculus, Concepts and Contexts*, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH502TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Group Theory II
Type of the Course	Core course
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

C5.2 Group Theory II

Unit-I (19 hrs.)

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

Unit-II (19 hrs.)

Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

Unit-III (19 hrs.)

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.

Unit-IV (18 hrs.)

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in S_n, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra,* 4th Ed., Narosa Publishing House, 1999.
4. David S. Dummit and Richard M. Foote, *Abstract Algebra*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
5. J.R. Durbin, *Modern Algebra*, John Wiley & Sons, New York Inc., 2000.
6. D. A. R. Wallace, *Groups, Rings and Fields*, Springer Verlag London Ltd., 1998.

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH503TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Portfolio Optimization
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

DSE1.1 Portfolio Optimization

Unit-I (19 hrs.)

Financial markets. Investment objectives. Measures of return and risk. Types of risks. Risk free assets. Mutual funds. Portfolio of assets. Expected risk and return of portfolio. Diversification.

Unit-II (19 hrs.)

Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem, risk-free assets and one fund theorem, efficient frontier.

Unit-III (19 hrs.)

Portfolios with short sales. Capital market theory. Capital assets pricing model- the capital market line, beta of an asset, beta of a portfolio, security market line.

Unit-IV (18 hrs.)

Index tracking optimization models. Portfolio performance evaluation measures.

Books Recommended:

1. F. K. Reilly, Keith C. Brown, *Investment Analysis and Portfolio Management*, 10th Ed., South-Western Publishers, 2011.
2. H.M. Markowitz, *Mean-Variance Analysis in Portfolio Choice and Capital Markets*, Blackwell, New York, 1987.
3. M.J. Best, *Portfolio Optimization*, Chapman and Hall, CRC Press, 2010.
4. D.G. Luenberger, *Investment Science*, 2nd Ed., Oxford University Press, 2013.

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH504TH
Credits= 6	L-5,T-1,P-0
Name of the Course	Number Theory
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

DSE1.2 Number Theory

Unit-I (19 hrs.)

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

Unit-II (19 hrs.)

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function.

Unit-III (19 hrs.)

Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function. Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties.

Unit-IV (18 hrs.)

Quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

Books Recommended:

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

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

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH505TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Analytic Geometry
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

DSE1.3 Analytical Geometry

Unit-I (19 hrs.)

Techniques for sketching parabola, ellipse and hyperbola.

Unit-II (19 hrs.)

Reflection properties of parabola, ellipse and hyperbola.

Unit-III (19 hrs.)

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

Unit-IV (18 hrs.)

Spheres, 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

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HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH506TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Industrial Mathematics
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

DSE2.1 Industrial Mathematics

Unit-I (19 hrs.)

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

Unit-II (19 hrs.)

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

Unit-III (19 hrs.)

X-ray: Introduction, X-ray behavior and Beers Law (The fundament question of image construction) Lines in the place. Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms). Back Projection: Definition, properties and examples.

Unit-IV (18 hrs.)

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

Books Recommended

1. Timothy G. Feeman, *The Mathematics of Medical Imaging, A Beginners Guide*, Springer Under graduate Text in Mathematics and Technology, Springer, 2010.

2. C.W. Groetsch, *Inverse Problems*, Activities for Undergraduates, The Mathematical Association of America, 1999.

3. Andreas Kirsch, *An Introduction to the Mathematical Theory of Inverse Problems*, 2nd Ed., Springer, 2011.

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH507TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Boolean Algebra and Automata Theory
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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 2.2 Boolean Algebra and Automata Theory

Unit-I (19hrs.)

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

Unit-II (19 hrs.)

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits. Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Unit-III (19 hrs.)

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Unit-IV (18 hrs.)

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.
Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems About CFGs.

Books Recommended

1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.

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

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

4. J. E. Hopcroft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 2nd Ed., Addison-Wesley, 2001.

5. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, *Elements of the Theory of Computation*, 2nd Ed., Prentice-Hall, NJ, 1997.

6. J.A. Anderson, *Automata Theory with Modern Applications*, Cambridge University Press, 2006.

HIMACHAL PRADESH UNIVERSITY

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

Fifth Semester

Course Code	MATH508TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Probability and Statistics
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

DSE2.3 Probability and Statistics

Unit-I (19 hrs.)

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function.

Unit-II (19 hrs.)

Discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential. Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions.

Unit-III (19 hrs.)

Expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Unit-IV (18 hrs.)

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

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 Applications*, 7th Ed., Pearson Education, Asia, 2006.

3. Sheldon Ross, *Introduction to Probability Models*, 9th Ed., Academic Press, Indian Reprint, 2007.

4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw- Hill, Reprint 2007

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH601TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Metric Spaces and Complex Analysis
Type of the Course	Core Course
Number of teaching hours required for this course	75hrs.
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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C6.1 Metric Spaces and Complex Analysis

Unit-I (19 hrs)

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor's theorem. Subspaces, dense sets, separable spaces. Continuous mappings, Uniform continuity. sequential criterion and other characterizations of continuity.

Unit-II (19 hrs.)

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-III (19 hrs.)

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula.

Unit-IV (18 hrs.)

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

Books Recommended

1. Satish Shirali and Harikishan L. Vasudeva, *Metric Spaces*, Springer Verlag, London, 2006.

2. S. Kumaresan, *Topology of Metric Spaces*, 2nd Ed., Narosa Publishing House, 2011.

3. G.F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw-Hill, 2004.

4. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw – Hill International Edition, 2009.

5. Joseph Bak and Donald J. Newman, *Complex Analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH602TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Ring Theory and Linear Algebra II
Type of the Course	Core course
Number of teaching hours required for this course	75hrs.
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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

C6.2 Ring Theory and Linear Algebra II

Unit-I (19 hrs.)

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests.

Unit-II (19 hrs.)

Eisenstein criterion, unique factorization in Z[x]**.** Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Unit-III (19 hrs.)

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Unit-IV (18 hrs.)

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, 1999.
4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra,* 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
5. S. Lang, *Introduction to Linear Algebra,* 2nd Ed., Springer, 2005.
6. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.
7. S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India, 1999.
8. Kenneth Hoffman, Ray Alden Kunze, *Linear Algebra*, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
9. S.H. Friedberg, A.L. Insel and L.E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., 2004.

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH603TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Theory of Equations
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

DSE3.1 Theory of Equations

Unit-I (19 hrs.)

General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Unit-II (19 hrs.)

Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Unit-III (19 hrs.)

Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

Unit-IV (18 hrs.)

Separation of the roots of equations, Strums theorem, Applications of Strum's theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

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.

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HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH604TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Bio-Mathematics
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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.

DSE3.2 Bio-Mathematics

Unit-I (19 hrs.)

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations.

Unit-II (19 hrs.)

Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria.

Unit-III (19 hrs.)

Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population.

Unit-IV (18 hrs.)

Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

Books Recommended

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.

2. J. D. Murray, *Mathematical Biology*, Springer, 1993.

3. Y.C. Fung, *Biomechanics*, Springer-Verlag, 1990.

4. F. Brauer, P.V.D. Driessche and J. Wu, *Mathematical Epidemiology*, Springer, 2008.

5. M. Kot, *Elements of Mathematical Ecology*, Cambridge University Press, 2001.

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH605TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

DSE3.3 Linear Programming

Unit-I (19 hrs.)

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit-II (19 hrs.)

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

Unit-III (19 hrs.)

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit-IV (18 hrs.)

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

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.

4. G. Hadley, *Linear Programming,* Narosa Publishing House, New Delhi, 2002.

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH606TH(H)
Credits= 6	L-4,T-0,P-2
Name of the Course	Mathematical Modeling
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	60 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	30 hours
End Semester Examination	Max Marks: 50 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	60

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 12 marks (each of1.5 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 9.5 marks each.

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

DSE4.1 Mathematical Modeling

Unit-I (15 hrs.)

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation,

Unit-II (15 hrs.)

Laplace transform and inverse transform, application to initial value problem up to second order.

Unit-III (15 hrs.)

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence.

Unit-IV (15 hrs.)

Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis.

Books Recommended

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.

2. Frank R. Giordano, Maurice D. Weir and William P. Fox, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.

Course Code: MATH606PR(H)

Sixth Semester

Course Code	MATH606PR(H)
Credits=2	L-0,T-0,P-2
Name of the Course	Mathematical Modeling
Type of the Course	Core Course
Number of Practical hours required for this course	30 hrs
End semester examinations	Max Marks: 20 Maximum Time: 3 hrs

Note: Candiate shall have to attempt two practicals out of the given four practicals.

List of Practicals (using any software)

(i) Plotting of Legendre polynomial for n = 1 to 5 in the interval [0,1]. Verifying graphically that all the roots of Pn (x) lie in the interval [0,1].
(ii) Automatic computation of coefficients in the series solution near ordinary points.
(iii) Plotting of the Bessel's function of first kind of order 0 to 3.
(iv) Automating the Frobenius Series Method.
(v) Random number generation and then use it for one of the following (a) Simulate area under a curve (b) Simulate volume under a surface.
(vi) Programming of either one of the queuing model (a) Single server queue (e.g. Harbor system) (b) Multiple server queue (e.g. Rush hour).
(vii) Programming of the Simplex method for 2/3 variables

Books Recommended

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.
2. Frank R. Giordano, Maurice D. Weir and William P. Fox, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH607TH(H)
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	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

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

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

DSE4.2 Mechanics

Unit-I (19 hrs.)

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Unit-II (19 hrs.)

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers.

Unit-III (19 hrs.)

Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass.

Unit-IV (18 hrs.)

Moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Books Recommended

1. I.H. Shames and G. Krishna Mohan Rao, *Engineering Mechanics: Statics and Dynamics,* (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
2. R.C. Hibbeler and Ashok Gupta, *Engineering Mechanics: Statics and Dynamics*, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

HIMACHAL PRADESH UNIVERSITY

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

Sixth Semester

Course Code	MATH608TH(H)
Credits= 6	L-5,T-1,P-0
Name of the Course	Differential Geometry
Type of the Course	Discipline Specific Elective
Number of teaching hours required for this course	75 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	15 hours
End Semester Examination	Max Marks: 70 Maximum Time: 3 hrs.
Total Lectures to be Delivered (One Hour Each)	75

Instructions

Instructions for paper setter: The question paper will consist of **two Sections A & B** of 70 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 13.50 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 4.3 Differential Geometry

Unit-I (19 hrs.)

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Unit-II (19 hrs.)

Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Unit-III (19 hrs.)

Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces. Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

Unit-IV (18 hrs.)

Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

Books Recommended:

1. T.J. Willmore, *An Introduction to Differential Geometry*, Dover Publications, 2012.

2. B. O'Neill, *Elementary Differential Geometry*, 2nd Ed., Academic Press, 2006.

3. C.E. Weatherburn, *Differential Geometry of Three Dimensions*, Cambridge University Press 2003.

4. D.J. Struik, *Lectures on Classical Differential Geometry*, Dover Publications, 1988.

5. S. Lang, *Fundamentals of Differential Geometry*, Springer, 1999.

6. B. Spain, *Tensor Calculus: A Concise Course*, Dover Publications, 2003.
