Himachal Pradesh University
Summer Hill, Shimla-171005

Syllabus and Scheme of Examination
(for I\textsuperscript{st} & II\textsuperscript{nd} Semesters only)

B.Sc. (Hons.) with Mathematics Course

Under the

Choice Based Credit System

\textit{w.e.f.}

Session 2016 -2017 onwards
**HIMACHAL PRADESH UNIVERSITY**  
Syllabus and Scheme of Examination  
for B.Sc. (Hons.) Mathematics  
for 1st and 2nd (First Two) Semesters Only  
w.e.f. Session 2016-2017

<table>
<thead>
<tr>
<th>Sem.</th>
<th>Course Code</th>
<th>Course Type</th>
<th>Title of Paper</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>MATH102TH</td>
<td>CORE COURSE (THEORY)</td>
<td>CALCULUS</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>MATH102PR</td>
<td>CORE COURSE (PRACTICAL)</td>
<td>CALCULUS</td>
<td>2</td>
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<tr>
<td>I</td>
<td>MATH103TH</td>
<td>CORE COURSE (THEORY)</td>
<td>ALGEBRA</td>
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<tr>
<td>I</td>
<td>AEC COURSE</td>
<td>AEC1</td>
<td>GE 1: CHOOSE ONE OUT OF THE FOLLOWING</td>
<td>5+1=6</td>
</tr>
<tr>
<td>I</td>
<td>MATH104TH</td>
<td>(GE) THEORY</td>
<td>OBJECT ORIENTED PROGRAMMING IN C++</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>MATH105TH</td>
<td>(GE) THEORY</td>
<td>MATHEMATICAL FINANCE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(MATH505TH) (*)</td>
<td></td>
<td>(*</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>MATH202TH</td>
<td>CORE COURSE (THEORY)</td>
<td>REAL ANALYSIS</td>
<td>5+1=6</td>
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<tr>
<td>II</td>
<td>MATH203TH</td>
<td>CORE COURSE (THEORY)</td>
<td>DIFFERENTIAL EQUATIONS</td>
<td>4</td>
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<tr>
<td>II</td>
<td>MATH203PR</td>
<td>CORE COURSE (PRACTICAL)</td>
<td>DIFFERENTIAL EQUATIONS</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>AEC COURSE</td>
<td>AEC1</td>
<td>GE 1: CHOOSE ONE OUT OF THE FOLLOWING</td>
<td>5+1=6</td>
</tr>
<tr>
<td>II</td>
<td>MATH204TH</td>
<td>(GE) THEORY</td>
<td>FINITE ELEMENT METHODS</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>MATH205TH</td>
<td>(GE) THEORY</td>
<td>ECONOMETRICS</td>
<td></td>
</tr>
</tbody>
</table>

(*) These two courses (with course codes: MATH105TH & MATH505TH) have same syllabus (course content).
# Details of courses under B. Sc. (Hons.) Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>*Credits</th>
<th>Theory + Practical</th>
<th>Theory + Tutorial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Core Course</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(14 Papers)</td>
<td></td>
<td>14×4 = 56</td>
<td>14×5 = 70</td>
</tr>
<tr>
<td>Core Course Practical / Tutorial*</td>
<td></td>
<td>14×2 = 28</td>
<td>14×1 = 14</td>
</tr>
<tr>
<td>(14 Papers)</td>
<td></td>
<td></td>
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<tr>
<td><strong>II. Elective Course (8 Papers)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.1. Discipline Specific Elective (4 Papers)</td>
<td></td>
<td>4×4 = 16</td>
<td>4×5 = 20</td>
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<tr>
<td>A.2. Discipline Specific Elective Practical/ Tutorial* (4 Papers)</td>
<td></td>
<td>4×2 = 8</td>
<td>4×1 = 4</td>
</tr>
<tr>
<td>B.1. Generic Elective/ Interdisciplinary (4 Papers)</td>
<td></td>
<td>4×4 = 16</td>
<td>4×5 = 20</td>
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<tr>
<td>B.2. Generic Elective Practical/ Tutorial* (4 Papers)</td>
<td></td>
<td>4×2 = 8</td>
<td>4×1 = 4</td>
</tr>
<tr>
<td><strong>III. Ability Enhancement Courses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Ability Enhancement Compulsory Courses (AECC) (2 Papers of 4 credit each)</td>
<td></td>
<td>2×4 = 8</td>
<td>2×4 = 8</td>
</tr>
<tr>
<td>Environmental Science English/MIL Communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Skill Enhancement Courses (SEC) (Minimum 2) (2 Papers of 4 credit each)</td>
<td></td>
<td>2×4= 8</td>
<td>2×4 = 8</td>
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<tr>
<td></td>
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<tr>
<td><strong>Total credit</strong></td>
<td>148</td>
<td>148</td>
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* wherever there is a practical there will be no tutorial and vice-versa
End-semester Examination (ESE) and Comprehensive Continuance Assessment (CCA)
Scheme of Three years Degree of
B. Sc. (Hons.) with Mathematics
Scheme for Examination for each course

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

  (FOR COURSES WITHOUT PRACTICALS)

I. Theory 80 marks
   a) End-Semester Examination (ESE) 80 marks

II. Comprehensive Continuous Assessment (CCA) 20 marks
   a) Assignment/Class Test/Quiz/Seminar/Model 05 marks
   b) Mid-Term Examination (One Test) 10 marks
   c) Attendance 05 marks

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

  75% Attendance is minimum eligibility condition.
  
  i) Attendance ≥ 75% but < 80%  1 mark
  ii) Attendance ≥ 80% but < 85%  2 marks
  iii) Attendance ≥ 85% but < 90%  3 marks
  iv) Attendance ≥ 90% but < 95%  4 marks
  v) Attendance ≥ 95%  5 marks

NOTE: For correspondence mode (ICDEOL) students enrolled for B.A. with Mathematics Degree/Course, the total marks for each theory paper shall be 100 and there shall be no CCA Component. Further, the tutorial in any course shall be counted in theory credits for correspondence mode students.
End-sememter Examination (ESE) and Comprehensive Continuance Assessment (CCA)  
Scheme of Three years Degree of 

**B.Sc. (Hons.) with Mathematics**  

**Scheme for Examination for each course**

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

**FOR COURSES WITH PRACTICALS**

<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Theory</td>
<td>50 marks</td>
</tr>
<tr>
<td>a) End-Semester Examination (ESE)</td>
<td>50 marks</td>
</tr>
<tr>
<td>II. Comprehensive Continuous Assessment (CCA)</td>
<td>20 marks</td>
</tr>
<tr>
<td>a) Assignment/Class Test/Quiz/Seminar/Model</td>
<td>05 marks</td>
</tr>
<tr>
<td>b) Mid-Term Examination (One Test)</td>
<td>10 marks</td>
</tr>
<tr>
<td>c) Attendance</td>
<td>05 marks</td>
</tr>
<tr>
<td>III. Practical</td>
<td>30 marks</td>
</tr>
</tbody>
</table>

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/calculation and results. 7.5 + 7.5 marks
- b) Viva-voce examinations 5 marks
- c) Practical note book 5 marks
- d) Regularity during practical classes 5 marks

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

  75% Attendance is minimum eligibility condition.

  i) Attendance ≥75% but < 80%  1 mark  
  ii) Attendance ≥ 80% but < 85%  2 marks  
  iii) Attendance ≥ 85% but < 90%  3 marks  
  iv) Attendance ≥ 90% but < 95%  4 marks  
  v) Attendance ≥ 95%  5 marks
HIMACHAL PRADESH UNIVERSITY  
B.Sc. (Hons.) with Mathematics Syllabus and Examination Scheme

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MATH102TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>6</td>
</tr>
<tr>
<td>Name of the Course</td>
<td>Calculus</td>
</tr>
<tr>
<td>Type of the Course</td>
<td>Core Course</td>
</tr>
<tr>
<td>Number of teaching hours required for this course</td>
<td>48 hrs.</td>
</tr>
</tbody>
</table>

Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations)

Max. Marks:30

Practical

24 hours

End Semester Examination

Max Marks: 50 Maximum Time: 3 hrs.

Total Lectures to be Delivered (One Hour Each) 48

Instructions

Instructions for paper setter: The question paper will consist of two Sections A & B of 50 marks. Section A will be Compulsory and will contain 5 questions of 10 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 10 marks each.

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

C1.1 Calculus

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

Unit-II

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

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

Unit-III

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

Unit-IV

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

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

<table>
<thead>
<tr>
<th>First Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
</tr>
<tr>
<td>Credits</td>
</tr>
<tr>
<td>Name of the Course</td>
</tr>
<tr>
<td>Type of the Course</td>
</tr>
<tr>
<td>Number of Practical hours required for this course</td>
</tr>
<tr>
<td>End Semester Examination</td>
</tr>
</tbody>
</table>

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

List of Practical (using any software)

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

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

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

(iv) Obtaining surface of revolution of curves.

(v) Tracing of conics in cartesian coordinates/ polar coordinates.

(vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.

(vii) Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended


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

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MATH103TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>6</td>
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<tr>
<td>L-5, T-1, P-0</td>
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</tr>
<tr>
<td>Name of the Course</td>
<td>Algebra</td>
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<td>Type of the Course</td>
<td>Core Course</td>
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<tr>
<td>Number of teaching hours required for this course</td>
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</tr>
<tr>
<td>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)</td>
<td>Max. Marks: 30</td>
</tr>
<tr>
<td>Tutorials: Solving Problems and exercises</td>
<td>12 hours</td>
</tr>
<tr>
<td>End Semester Examination</td>
<td>Max Marks: 80 Maximum Time: 3 hrs.</td>
</tr>
<tr>
<td>Total Lectures to be Delivered (One Hour Each)</td>
<td>60</td>
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</table>

Instructions

Instructions for paper setter: The question paper will consist of two Sections A & B of 80 marks. Section A will be Compulsory and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 16 marks each.

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

C1.2 Algebra

Polar representation of complex numbers, n-th roots of unity, De Moivre’s theorem for rational indices and its applications. Equivalence relations, Functions, Composition of functions, Invertible functions, Unit-II

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

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

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

Second Semester

<table>
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<tr>
<th>Course Code</th>
<th>MATH202TH</th>
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<tbody>
<tr>
<td>Credits</td>
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<tr>
<td>Name of the Course</td>
<td>Real Analysis</td>
</tr>
<tr>
<td>Type of the Course</td>
<td>Core Course</td>
</tr>
<tr>
<td>Number of teaching hours required for this course</td>
<td>48 hrs.</td>
</tr>
<tr>
<td>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)</td>
<td>Max. Marks:30</td>
</tr>
<tr>
<td>Tutorials: Solving Problems and exercises</td>
<td>12 hours</td>
</tr>
<tr>
<td>End Semester Examination</td>
<td>Max Marks: 80 Maximum Time: 3 hrs.</td>
</tr>
<tr>
<td>Total Lectures to be Delivered (One Hour Each)</td>
<td>60</td>
</tr>
</tbody>
</table>

**Instructions**

**Instructions for paper setter:** The question paper will consist of two Sections A & B of 80 marks. **Section A** will be **Compulsory** and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. **Section B** of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 16 marks each.

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

**C2.1 Real Analysis**

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

Unit-II

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

Unit-III


Unit-IV

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

**Books Recommended**

### C2.2 Differential Equations

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

**Unit-II**

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

**Unit-III**

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

**Unit-IV**

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

**Books Recommended:** For List, see the syllabus of Course MATH203PR.
### Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MATH203PR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>L-0,T-0,P-2</td>
</tr>
<tr>
<td>Name of the Course</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>Type of the Course</td>
<td>Core Course</td>
</tr>
<tr>
<td>Number of Practical hours required for this course</td>
<td>24 hours</td>
</tr>
<tr>
<td>End Semester Examination</td>
<td>Max Marks: 30 Maximum Time: 3 hrs.</td>
</tr>
</tbody>
</table>

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

**List of Practicals (using any software)**

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
10. Battle model (basic battle model, jungle warfare, long range weapons).
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy’s root test by plotting n\(^{th}\) roots.
16. Ratio test by plotting the ratio of n\(^{th}\) and (n+1)\(^{th}\) term.

**Books Recommended**

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

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MATH104TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits=</td>
<td>L-5,T-1,P-0</td>
</tr>
<tr>
<td>Name of the Course</td>
<td>Object Oriented Programming in C++</td>
</tr>
<tr>
<td>Type of the Course</td>
<td>Generic Elective Course</td>
</tr>
</tbody>
</table>

Number of teaching hours required for this course 48 hrs.

Continuous Comprehensive Assessment: Based on Minor Test(1), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations) Max. Marks:30

Tutorials : Solving Problems and exercises 12 hours

End Semester Examination Max Marks: 80 Maximum Time: 3 hrs.

Total Lectures to be Delivered (One Hour Each) 60

Instructions

Instructions for paper setter: The question paper will consist of two Sections A & B of 80 marks. Section A will be Compulsory and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 16 marks each.

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

GE 1.1 Object Oriented Programming in C++


Unit-II

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

Unit-III

Abstract data types, Class Component, Object & Class, Constructors Default and Copy Constructor, Assignment operator deep and shallow coping, Access modifiers – private, public and protected. Implementing Class Functions within Class declaration or outside the Class declaration. instantiation of objects, Scope resolution operator, Working with Friend Functions, Using Static Class members. Understanding Compile Time Polymorphism function overloading

Unit-IV

Rules of Operator Overloading (Unary and Binary) as member function/friend function, Implementation of operator overloading of Arithmetic Operators, Overloading Output/Input, Prefix/ Postfix Increment and decrement Operators, Overloading comparison operators, Assignment, subscript and function call Operator , concepts of namespaces.

**Practical to be performed in Lab.

Books Recommended
HIMACHAL PRADESH UNIVERSITY
B.A./B.Sc. with Mathematics Syllabus and Examination Scheme

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MATH105TH/ MATH505TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>4</td>
</tr>
<tr>
<td>L-T-P</td>
<td>5-1-0</td>
</tr>
<tr>
<td>Name of the Course</td>
<td>Mathematical Finance</td>
</tr>
<tr>
<td>Type of the Course</td>
<td>Generic Elective Course</td>
</tr>
</tbody>
</table>

| Number of hours required for this course | 48 hrs. |
| Continuous Comprehensive Assessment: Based on Minor Test(2), Class tests, Assignments, Quiz, Seminar and Attendance (Marks Attendance: 5 marks to be given as per the regulations) | Max. Marks:30 |
| Tutorials : Solving Problems and exercises | 12 hours |
| Semester Term End Examination | Max Marks: 80 Maximum Time: 3 hrs. |
| Lectures to be Delivered (One Hour Each) | 60 |

Instructions

Instructions for paper setter: The question paper will consist of two Sections A & B of 80 marks. Section A will be Compulsory and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 16 marks each.

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

SEC 1.2: Mathematical Finance

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

Unit-II

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

Unit-III

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

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

Unit-IV

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

Books Recommended:


<table>
<thead>
<tr>
<th>First Semester</th>
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<tbody>
<tr>
<td><strong>Course Code</strong></td>
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<tr>
<td><strong>Credits= 6</strong></td>
</tr>
<tr>
<td><strong>Name of the Course</strong></td>
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<tr>
<td><strong>Type of the Course</strong></td>
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<tr>
<td><strong>Number of teaching hours required for this course</strong></td>
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<tr>
<td><strong>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)</strong></td>
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<tr>
<td><strong>Tutorials : Solving Problems and exercises</strong></td>
</tr>
<tr>
<td><strong>End Semester Examination</strong></td>
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<tr>
<td><strong>Total Lectures to be Delivered (One Hour Each)</strong></td>
</tr>
</tbody>
</table>

**Instructions**

**Instructions for paper setter:** The question paper will consist of two Sections A & B of 80 marks. Section A will be Compulsory and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 16 marks each.

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

**GE2.2 Finite Element Methods**

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

**Unit-II**

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

**Unit-III**

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

**Unit-IV**

Interpolation functions, numerical integration, and modeling considerations, Solution of two dimensional partial differential equations under different Geometric conditions.

**Books Recommended**

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

Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MATH205TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>L-T-P</td>
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<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Name of the Course</td>
<td>Econometrics</td>
</tr>
<tr>
<td>Type of the Course</td>
<td>Generic Elective Course</td>
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<tr>
<td>Number of teaching hours required for this course</td>
<td>48 hrs.</td>
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<tr>
<td>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)</td>
<td>Max. Marks: 30</td>
</tr>
<tr>
<td>Tutorials: Solving Problems and exercises</td>
<td>12 hours</td>
</tr>
<tr>
<td>End Semester Examination</td>
<td>Max Marks: 80 Maximum Time: 3 hrs.</td>
</tr>
<tr>
<td>Total Lectures to be Delivered (One Hour Each)</td>
<td>60</td>
</tr>
</tbody>
</table>

Instructions

Instructions for paper setter: The question paper will consist of two Sections A & B of 80 marks. Section A will be Compulsory and will contain 8 questions of 16 marks (each of 2 marks) of short answer type having two questions from each Unit of the syllabus. Section B of the question paper shall have four Units I, II, III, and IV. Two questions will be set from each unit of the syllabus and the candidates are required to attempt one question from each of these units. Each question in Units I, II, III and IV shall be of 16 marks each.

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

GE2.2 Econometrics

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation, Specification Analysis Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

Books Recommended
GE3.1 Cryptography and Network Security


Books Recommended


GE 3.2 Information Security

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

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

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

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

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

Books Recommended

GE4.1 Applications of Algebra

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

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

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


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


GE4.2 Combinatorial Mathematics

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers
Principle of Inclusion and Exclusion, Derangements, Inversion formulae
Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions.
Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.
Integer partitions, Systems of distinct representatives.
Polya theory of counting: Necklace problem and Burnside’s lemma, Cyclic index of a permutation group, Polya’s theorems and their immediate applications.
Latin squares, Hadamard matrices, Combinatorial designs: t designs, BIBDs, Symmetric designs.

Books Recommended