GC UNIVERSITY, FAISALABAD

Scheme of Studies

BS Honors in Mathematics

8 Semesters / 4 years Degree Program
for the year 2012 and onwards

Department of Mathematics
# Scheme of Studies

## BS Honors in Mathematics

### Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ISL-302</td>
<td>Islamic Studies</td>
<td>2(2-0)</td>
</tr>
<tr>
<td>ENG-321</td>
<td>English-I</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>MTH-301</td>
<td>Calculus-I</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-303</td>
<td>Mathematical Method-I</td>
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<tr>
<td>PHY-325</td>
<td>Physics-I</td>
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### Semester 2

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<tr>
<td>ENG-322</td>
<td>English-II</td>
<td>3(3-0)</td>
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<tr>
<td>STT-322</td>
<td>Statistics-I</td>
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<tr>
<td>MTH-302</td>
<td>Calculus-II</td>
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<td>MTH-304</td>
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### Semester 3

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<td>MTH-401</td>
<td>Vector Calculus</td>
<td>2(2-0)</td>
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<tr>
<td>MTH-403</td>
<td>Mechanics I</td>
<td>4(4-0)</td>
</tr>
<tr>
<td>MTH-405</td>
<td>Mechanics II</td>
<td>4(4-0)</td>
</tr>
<tr>
<td>STT-421</td>
<td>Statistics-II</td>
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<tr>
<td>MTH-402</td>
<td>Metric and Topological Spaces</td>
<td>4(4-0)</td>
</tr>
<tr>
<td>MTH-404</td>
<td>Differential Equations</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-406</td>
<td>Numerical Analysis</td>
<td>2(2-0)</td>
</tr>
<tr>
<td>MTH-408</td>
<td>Operations Research</td>
<td>2(2-0)</td>
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<tr>
<td>CSI-422</td>
<td>C++</td>
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### Semester 5

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<td>MTH-501</td>
<td>Real Analysis I</td>
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<td>MTH-503</td>
<td>Complex Analysis</td>
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<tr>
<td>MTH-505</td>
<td>Vector and Tensor Analysis</td>
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<td>MTH-507</td>
<td>Algebra-I</td>
<td>4(4-0)</td>
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<td>MTH-509</td>
<td>Point Set Topology</td>
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<td>MTH-504</td>
<td>Algebra-II</td>
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<td>MTH-506</td>
<td>Mechanics</td>
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<tr>
<td>MTH-508</td>
<td>Functional Analysis</td>
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<tr>
<td>MTH-510</td>
<td>Differential Geometry</td>
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### Semester 7

**PURE MATHEMATICS**

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<tbody>
<tr>
<td>MTH-601</td>
<td>Advanced Group Theory</td>
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<tr>
<td>MTH-603</td>
<td>Advanced Set Theory</td>
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<tr>
<td>MTH-605</td>
<td>Mathematical Statistics-I</td>
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<tr>
<td>MTH-607</td>
<td>Continuous Groups</td>
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<tr>
<td>MTH-609</td>
<td>Theory of Modules</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-611</td>
<td>Algebraic Topology</td>
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<td>MTH-613</td>
<td>Advanced Topology</td>
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<tr>
<td>MTH-615</td>
<td>Numerical Analysis-I</td>
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<tr>
<td>MTH-617</td>
<td>Linear Algebra</td>
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<tr>
<td>MTH-619</td>
<td>Rings and Fields</td>
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**APPLIED MATHEMATICS**

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<tr>
<td>MTH-621</td>
<td>Fluid Mechanics-I</td>
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<td>MTH-623</td>
<td>Advanced Mathematical Methods</td>
<td>4(4-0)</td>
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<td>MTH-605</td>
<td>Mathematical Statistics-I</td>
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<tr>
<td>MTH-625</td>
<td>Special Theory of Relativity</td>
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<tr>
<td>MTH-627</td>
<td>Operations Research</td>
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<td>MTH-629</td>
<td>Quantum Mechanics</td>
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<td>MTH-631</td>
<td>Soft Ware Engineering</td>
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<td>MTH-615</td>
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**Semester 8**

**PURE MATHEMATICS**

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<td>MTH-602</td>
<td>Measure Theory</td>
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<td>MTH-604</td>
<td>Advanced Functional Analysis</td>
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<td></td>
<td>Optional Paper (2 out of Following)</td>
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<tr>
<td>MTH-606</td>
<td>Rings &amp; Modules</td>
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<tr>
<td>MTH-608</td>
<td>Theory of Numbers</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-610</td>
<td>Mathematical Statistics-II</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-612</td>
<td>Numerical Analysis-II</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-614</td>
<td>Special Functions</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-616</td>
<td>Theory of Optimization</td>
<td>4(4-0)</td>
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<tr>
<td>MTH-628</td>
<td>Project</td>
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**APPLIED MATHEMATICS**

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>MTH-618</td>
<td>Fluid Mechanics-II</td>
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<td>MTH-620</td>
<td>Partial Differential Equations</td>
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<td>Optional Paper (2 out of Following)</td>
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<tr>
<td>MTH-622</td>
<td>Theory of Elasticity</td>
<td>4(4-0)</td>
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<td>MTH-624</td>
<td>Electromagnetism</td>
<td>4(4-0)</td>
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<td>MTH-610</td>
<td>Mathematical Statistics-II</td>
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</tr>
<tr>
<td>MTH-614</td>
<td>Special Functions</td>
<td>4(4-0)</td>
</tr>
<tr>
<td>MTH-616</td>
<td>Theory of Optimization</td>
<td>4(4-0)</td>
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<td>MTH-628</td>
<td>Project</td>
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</tr>
<tr>
<td>MTH-626</td>
<td>C ++</td>
<td>4(4-0)</td>
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</table>

The Project of BS (H) Mathematics will be offered as an optional paper to not more than 50% of the class strength and only to those who obtain at least 65% marks on the basis of their performance in V & VI Semesters.
Course Number | Title | Credit Hours | Marks
---|---|---|---
ISL-302 | Islamic Studies | 2(2-0) | 40

Course Number | Title | Credit Hours | Marks
---|---|---|---
ENG-321 | English-I | 3(3-0) | 60

ENGLISH-I

MID EXAM
Sentence, Article, Auxiliary Verbs, Moods of verb, Tenses, Parts of speech, Types of sentences, Sentence Structure (Subject + Predicate), Phrase, Clause, Infinitives, Sequence of Sentences, Transitive and Intransitive verb.

FINAL EXAM
Conditional Sentences, Comprehensive, Précis, Translation (U to E), Tenses, Letters, Application (For Jobs)

RECOMMENDED BOOKS

Course Number | Title | Credit Hours | Marks
---|---|---|---
MTH-301 | Calculus-I | 4(4-0) | 80

CALCULUS-I

RECOMMENDED BOOKS
George B. Thomas, Calculus and Analytic Geometry.
Spiegal M. P; *Advance Calculus New York*. Mc Graw Hill Book Company
Dr. S. M. Yousaf and Muhammad Amin Ch, *Calculus with Analytic Geometry* Ilmi Kitab Khana Urdu Bazar Lahore.
### Scheme of Studies BS Hons in Mathematics

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<tbody>
<tr>
<td>MTH-303</td>
<td>Mathematical Method-I</td>
<td>4(4-0)</td>
<td>80</td>
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</tbody>
</table>

**MATHEMATICAL METHOD-I**


**RECOMMENDED BOOKS**


Aitken A.C *Determinant and Matrices* Edinburgh: Olever and Boyd.

Spiegel M.R; *Advance Calculus* Mc Graw-Hill Book Company New York,


<table>
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<tr>
<th>Course Number</th>
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<th>Credit Hours</th>
<th>Marks</th>
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<tbody>
<tr>
<td>PHY-325</td>
<td>Physics-I</td>
<td>4(3-1)</td>
<td>80</td>
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**PHYSICS-I**

**VECTOR ANALYSIS:** Vector Operations, Gradient of a Scalar field, Divergence of a vector field, Curl of a vector Field, Divergence theorem, Stoke’s theorem.

Suggested Level: Ch # 1 of Mechanics by Tirmizi, 2nd Edition

**SOUND WAVES:** Wave motion and Sound with Beats, Doppler Effect and its application

Suggested Level: Ch # 1 of Wave & Oscillation by Dr. Tahir Hussain T.I New Edition

**FLUID DYNAMICS:** Bernoulli’s Equations, Applications, of Bernoulli’s Equation,

Suggested Level: Ch # 15 of Physics by R.H.K, 4th Edition

**WORK AND ENERGY:** Introduction, Work-Energy Theorem,

Suggested Level: Ch # 11 of Physics by R.H.K, 4th Edition

**ELECTROMAGNETIC SPECTRUM:** Radio waves, Microwaves (terrestrial Microwaves & Satellite Microwave)

Suggested Level: Ch # 41 of Physics by R.H.K, 4th Edition

**LASER:** Principal of Laser, Characteristics and use of laser

Suggested Level: Ch # 52 of Physics by R.H.K, 4th Edition

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GC University, Faisalabad
FIBER OPTICS: Principals and working of fiber optic, Advantages and Disadvantages, Computer Networks and Fiber Optic
Suggested Level: Ch # 42 of Physics by R.H.K, 4th Edition

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<tr>
<td>PST-322</td>
<td>Pakistan Studies</td>
<td>2(2-0)</td>
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PAKISTAN STUDIES
The main objective of this paper is to familiarize the students with the freedom movement, Pakistan history and the foreign policy of Pakistan. Aligrah movement with special reference to its Educational and Political Activities, Formation of Muslim League and its role in the creation of Pakistan, Khilafat Movement and its impact upon the political culture of the sub-continent, Comparative study of Nehru Report and 14 points of Jinnah, Iqbal’s Allahabad Address, and its Significance, A brief overview of constitutional development in Pakistan, Pakistan Resolution and the creation of Pakistan, Quaid-i-Azam, as a political leader and founder of Pakistan, Pakistan’s geo-strategic position and its importance, Constitutional development in Pakistan: A brief analysis, Pakistan’s political culture and problems of democracy, Human rights in Pakistan, Major determinants of the foreign policy of Pakistan

RECOMMENDED BOOKS
M Ikram Rabbani, Pakistan Studies
M Ikram Rabbani, Current Affairs
Ahmed Saeed, Track to Pakistan
Safdar Mahmood, Political Roots and Development
Waheed-uz-Zaman, Towards Pakistan
Dr. M Imtiaz Shahid, An advance study in Pakistan Affairs.
**STATISTICS**

Meanings of Statistics, Main branches of Statistics (Theoretical and Applied), Meanings of Descriptive and Inferential Statistics, Population and Sample, Types of Variables, Measurement Scales. Sources of statistical data in Pakistan. Description of data by frequency Tables and Graphs. Stem and Leaf display and Box Plots.


**RECOMMENDED BOOKS**


### CALCULUS-II


### RECOMMENDED BOOKS

- George B. Thomas, Calculus And Analytic Geometry

### MATHEMATICAL METHOD-II


### RECOMMENDED BOOKS

- Aitken A.C Determinant and Matrices Edinburgh: Olever and Boyd.
- Spiegal M.R; Advance Calculus Mc Graw-Hill Book Company New York,
VECTORS CALCULUS
RECOMMENDED BOOKS
Dr. S. M. Yousaf Vector Analysis Ilmi Kitab Khana Urdu Bazar Lahore.

MECHANICS-I
BOOKS RECOMMENDED
MECHANICS-II

RECOMMENDED BOOKS
F. Chorlton, A Text Book of Dynamics.

STATISTICS-II
Curve Fitting by Method of Least Squares. Fitting a straight line, fitting of a Second and third degree Parabola, Change of Origin and Unit, Exponential Curves, Criteria for a Suitable Curve, Finding Plausible Values by LS Method.

BOOKS RECOMMENDED

<table>
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<td>PHY-425</td>
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**PHYSICS-II**

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<td>MTH-402</td>
<td>Metric and Topological Spaces</td>
<td>4(4-0)</td>
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**METRIC AND TOPOLOGICAL SPACES**
Distance in $\mathbb{R}^2$ metric, definition of metric and metric space, examples, balls, diameters, open & closed ball, open set & close set. interior points and interior of a set, exterior points and exterior of a set, closure of a subset, limit points, neighborhood points, boundary points, sequences and their convergence complete space,
Basic notions of set theory, set operations, extended set operations and indexed families of sets. relations, equivalence relations, partition, ordering relations, function as relations, topological spaces; subspaces and relative topology, open sets, closed sets, neighborhood, interior, exterior boundary and limit points, base and sub base.

**RECOMMENDED BOOKS**

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<th>Credit Hours</th>
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**DIFFERENTIAL EQUATIONS**


**RECOMMENDED BOOKS**


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<td>MTH-406</td>
<td>Numerical Analysis</td>
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**NUMERICAL ANALYSIS**

Introduction, Computation error analysis, Study of various iterative methods to solve non-linear equations with analysis of error, convergence and stability of bisection, false position, secant, Newton-Raphson and fixed point methods, acceleration of convergence by Aitken method, solution of system of linear equation by LU decomposition method, cases of failure, iterative methods, (Jacobi, Gauss Seidel, SOR, SUR) and their convergence analysis, ill conditioned systems and condition number, interpolation: Review of simple interpolation for equally spaced data, interpolation by Gauss forward/backward methods, Bessel and Stirling method with error analysis, Lagrange Interpolation and Newton divided differences formula with error analysis.

**RECOMMENDED BOOKS**

Alestair Wood Introduction to Numerical Analysis.
M. Iqbal *Numerical Analysis* Nation Book of Foundation  
Ch. Muhammad Saleem *Numerical Analysis*.

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<th>Marks</th>
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<tbody>
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<td>MTH-408</td>
<td>Operations Research</td>
<td>2(2-0)</td>
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**OPERATIONAL RESEARCH**


**RECOMMENDED BOOK**

C. M Harvey, *Operation Research*, North Holland, New Delhi  
Prof. Sr. Saeed Akhtar Bhatti Operations Research: An Introduction  
Krajewsky and Ritzman Operations Management Strategy and Analysis.

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<tbody>
<tr>
<td>CSI-422</td>
<td>C++</td>
<td>4(4-0)</td>
<td>80</td>
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**C++**

History of Computer Languages, Building Blocks of C++. Control Structures. Functions, Arrays, Pointers, Strings, Object Oriented Concepts e.g. Operator Over landing, Inheritance, Overriding, Polymorphism & Virtual Functions. Introduction to Java.

**RECOMMENDED BOOKS**

Herbet Shildt, Turbo C/C++  
Eric P. Bloom, The Turbo C++  
Robert Lafore, Turbo C  
Deitel & Deitel C++ How to Programme
REAL ANALYSIS-I

BOOKS RECOMMENDED
Kaplan W. Advance Calculus1984 Addison-Wesley publishing Company.

COMPLEX ANALYSIS

BOOKS RECOMMENDED
J. Paliouras, Complex Variables for Scientists and Engineers McMillan
L.V. Ahlfors, Complex Analysis McGraw Hill.
K. Kodaira, Introduction to Complex Analysis, Cambridge.
Scheme of Studies BS Hons in Mathematics

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<th>Credit Hours</th>
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<tbody>
<tr>
<td>MTH-505</td>
<td>Vector &amp; Tensor Analysis</td>
<td>4(4-0)</td>
<td>80</td>
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**VECTOR AND TENSOR**

**VECTOR ANALYSIS**
Curvilinear Coordinates, Scale Factors, Arc length, Area and volume in curvilinear coordinates. Spherical and Cylindrical coordinates, Expansion formulas of Gradient, Divergence and Curl of point in curvilinear coordinate, Relation between orthogonal bases, Curvilinear Coordinates, Spherical and cylindrical coordinates and their applications, Line, Surface and volume integral. Gausses, Green’s and Stokes theorem with their application.

**CARTESIAN TENSORS**

**BOOKS RECOMMENDED**
Dr. Nawzish Ali Shah Vector and Tensor Analysis

<table>
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<td>Algebra-I</td>
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**ALGEBRA –I**

**BOOKS RECOMMENDED**

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<tr>
<td>MTH-509</td>
<td>Point set Topology</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**POINT SET TOPOLOGY**

Set, countable and uncountable sets, partially and totally ordered sets and lattices with examples, axiom of choice. Topological spaces; subspaces and relative topology, open sets, closed sets, neighborhood, interior, exterior and limit points, base and sub base, product spaces, continuous and open mappings, homeomorphism, first and second axioms of countability, separation axioms, $T_0$, $T_1$, $T_{23}$, $T_3$, $T_{3}^{\frac{1}{2}}$, $T_4$, spaces, regular and normal spaces, connectedness various characterizations of connectedness, local connectedness, components, open covers, compact spaces and their characterization, continuity, uniform continuity and their relationship with compactness in metric spaces, limit points sequential compactness. equivalence of different notions of compactness.

**BOOKS RECOMMENDED**


A. Majeed, *Elements of Topology and Functional Analysis*, Ilmi Kitab Khana Lahore

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<tr>
<th>Course Number</th>
<th>Title</th>
<th>Credit Hours</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>MTH-502</td>
<td>Real Analysis - II</td>
<td>4(4-0)</td>
<td>80</td>
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</tbody>
</table>

**REAL ANALYSIS-II**


Book Recommended


Course Number | Title | Credit Hours | Marks
--- | --- | --- | ---
MTH-504 | Algebra-II | 4(4-0) | 80

**ALGEBRA –II**


**BOOKS RECOMMENDED**

S. Lang, *Linear Algebra*, Addison-Wesley.
P.M. Chon, Algebra-I and Algebra-II.

Course Number | Title | Credit Hours | Marks
--- | --- | --- | ---
MTH-506 | Mechanics | 4(4-0) | 80

**MECHANICS**

General Motion of a rigid body, Euler’s Theorem and Chasles Theorem. Euler’s Angles, Moments and Products of Inertia, Inertia Tensor, Euler’s Principal Axes and Principal Moments of Inertia , Kinetic Energy and Angular Momentum of a Rigid Body, Momental Ellipsoid and Equimoment Systems, Euler’s dynamical Equations and their solution in special cases. Heavy asymmetrical Top, Equilibrium of a Rigid Body, General Conditions of Equilibrium, and Deduction of Conditions in Special Cases.

**BOOKS RECOMMENDED**

F. Chorlton, A Text Book of Dynamics.
FUNCTIONAL ANALYSIS


RECOMMENDED BOOKS
A. Majeed, Elements of Topology and Functional Analysis Ilmi Kitab Khana Lahore.

DIFFERENTIAL GEOMETRY

The moving trihedron, Arc length; The osculating plane, Curvature and torsion of unit speed and non unit speed curves, Serret-Frenet formulae. Helices, Spherical indicatericies, Evolutes & Involutes. Simple surface and coordinate patches. The tangent plane and the normal planes, the first fundamental form and the metric, coordinate transformations. Surface curves: the angle between two curves on a surface; Normal curvature Analysis and geodesic curvature, The second fundamental form, Christoffel symbols. Gauss’s theorem Egregium. Mean and Gaussian curvatures, Principal curvatures, Euler’s theorem, Dupin’s indicatericies. Weingartnen Map. Guass-Codazzi equations.

BOOKS RECOMMENDED
A. Goetz., Introduction to Differential Geometry Addison- Wesley.
ADVANCED GROUP THEORY
Introduction to Sets and Structures. Examples of groups. Finite groups. Subgroups. Permutations and cyclic groups. Isomorphism’s and Homomorphism with separate reference to Abelian groups. Cosets, Normal groups, Factor groups and Simple groups. Series of group .s. The Sylow theorems. Groups actions, Free groups and group presentations, Geometric, Analytic and dynamical applications. A brief introduction to continuous groups and group representations.

RECOMMENDED BOOKS

ADVANCED SET THEORY
Equivalent sets, Countable and uncountable sets, The concept of cardinal number, Addition and multiplication of cardinals, Cartesian products as sets of function, Addition and multiplication of ordinals. Partially ordered sets axiom of choice, statement of lemma.

BOOKS RECOMMENDED
R.G. Bartle, Theory of Integration.
H.L. Royden, *Real Analysis*.

MATHEMATICAL STATISTICS-I

**RECOMMENDED BOOKS**


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<tr>
<th>Course Number</th>
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<th>Credit Hours</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>MTH-607</td>
<td>Continuous Groups</td>
<td>4(4-0)</td>
<td>80</td>
</tr>
</tbody>
</table>

**CONTINUOUS GROUPS**

Continuous Groups; Gl(n,r),Gl(n,c),So(p,q),Sp(2n); generalities on Continuous Groups; Groups of isometrics; Introduction to Lie groups with special emphasis on matrix Lie groups; Relationship of isometrics and Lie group; Theorem of Cartan; Correspondence of continuous groups with Lie algebras; Classification of groups of low dimensions; Homogeneous spaces and orbit types; Curvature of invariant metrics on Lie groups and homogeneous spaces.

**RECOMMENDED BOOKS**


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<th>Course Number</th>
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<tbody>
<tr>
<td>MTH-609</td>
<td>Theory of Modules</td>
<td>4(4-0)</td>
<td>80</td>
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</tbody>
</table>

**THEORY OF MODULES**

Definition and examples, Sub modules, Homeomorphisms and quotient modules. Direct sums of modules. Finitely generated modules, Torsion Modules, Free modules. Basis, Rank and endomorphism of free modules. Matrices over Rings and their connections with the basis of free modules. A Module. A Module as the direct sum of a free and a torsion module. Exact
sequences and elementary notions of homological algebra. Noetherian and modules, Radicals, Semi simple rings and modules.

**BOOKS RECOMMENDED**


Adamson, J. *Rings and Modules*.

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<tr>
<th>Course Number</th>
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<th>Credit Hours</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>MTH-611</td>
<td>Algebraic Topology</td>
<td>4(4-0)</td>
<td>80</td>
</tr>
</tbody>
</table>

**ALGEBRAIC TOPOLOGY**

Path wise connectedness; Notion of homotopy, Homotopy classes. Path homotopy. Path homotopy classes; Fundamental groups, Covering maps. Covering spaces. Lifting properties of covering spaces, Fundamental group of a circle.

**RECOMMENDED BOOKS**

Kosniowski, C.A *A first course in Algebraic Topology* (Cambridge University Press)


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<tbody>
<tr>
<td>MTH-613</td>
<td>Advanced Topology</td>
<td>4(4-00)</td>
<td>80</td>
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</tbody>
</table>

**ADVANCED TOPOLOGY**

Compactness in metric spaces, Limit point, Compactness, Sequential compactness and their various characterizations, Equivalence of different notions of compactness. Connectedness, various characterizations of connectedness, Connectedness and T()spaces, Local connectedness, Path-connectedness, Components. Homotopic maps, Homotopic paths, Loop spaces, Fundamental groups, Covering spaces, the lifting theorem, Fundamental groups of the circle () etc.Chain complex, Notion of homology.

**RECOMMENDED BOOKS**


### Course Number | Title | Credit Hours | Marks |
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<tbody>
<tr>
<td>MTH-615</td>
<td>Numerical Analysis-I</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

#### NUMERICAL ANALYSIS-I
Introduction, Computation error and error analysis, Study of various Iterative methods to solve non-linear equations with analysis of error, Convergence and stability of Bisection, False position, Secant, Newton-Repson and Fixed point methods, Acceleration of convergence by Aitken method, Solution of system of linear equations by LU decomposition method, Cases of failure, Iterative methods, (Jacobi, Gauss Seidel, SOR, SUR) and their convergence analysis, Ill conditioned systems and Condition number, Interpolation: Review of simple interpolation for equally spaced data, Interpolation by Gauss forward/ backward methods, Bessel and Stirling method with error analysis, Lagrange Interpolation and Newton divided differences formula with error analysis, Interpolation by Spline functions (up to Cubic spline), methods of Least squares, Numerical differentiation, Numerical integration for equally spaced data (Newton cotes formula and its special cases e.g. Trapezoidal Rule and Simpson’s rules) and for unequally spaced data (using Lagrange and divided differences formula of interpolation), Gaussian quadrature using a system of orthogonal polynomials (Legendre and Laguerre polynomials).

#### BOOKS RECOMMENDED

### Course Number | Title | Credit Hours | Marks |
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<tbody>
<tr>
<td>MTH-617</td>
<td>Linear Algebra</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

#### LINEAR ALGEBRA

#### BOOKS RECOMMENDED
- S. Lang, Linear Algebra, Addison-Wesley.
- I. N., Herstein, Topics in Algebra, Addison- Wesley.
- P.M. Chon, Algebra-I and Algebra-II.
RINGS AND FIELDS
Definitions and basic concepts, homeomorphisms, homomorphism theorems. Polynomial rings. Unique factorization domain, factorization theory. Euclidean domain, arithmetic in Euclidean domains, Extension fields, Algebraic and transcendental elements, simple extension, Introduction to Galois theory.

RECOMMENDED BOOKS
Adamson, J. *Rings and Modules.*

FLUID MECHANICS -I
Real fluids and ideal fluids, Velocity of a fluid at a point, Streamlines and path lines, Steady ad unsteady flows, Velocity potential, Vorticity vector, Local and particle rates of change, Equation of continuity. Acceleration of a fluid, Conditions at a rigid boundary, General Analysis of fluid motion Euler’s equations of motion, Bernoulli’s equations steady motion under conservative body forces, Some potential theorems, impulsive motion. Sources, Sinks and doublets, Images in rigid infinite plane and solid spheres, Axi-symmetric flows, Stokes’s stream function.
Stream function, Complex potential for two-dimensional, Irrational, Incompressible flow, Complex velocity spotential for uniform stream. Line sources and line sinks, Line doublets image systems, Miline-Thomson circle theorem, Blasius’s Theorem.
BOOKS RECOMMENDED
Brvce R. Munson and Donald F. Young, *Fundamentals of Fluid Mechanics*, Department of Engineering Science and Mechanics, Department of Mechanics Engineering Lowa State university Amos Lowa USA.
<table>
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<tr>
<th>Course Number</th>
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<tbody>
<tr>
<td>MTH-623</td>
<td>Advanced Mathematical Methods</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**Advanced Mathematical Methods**


Power Series, Solutions of Legendre’s Equation, Legendre’s polynomials Generating function; Rodrigue’s formula, Recurrson relations. Orthogonality and normality of Legendre’s Polynomials, Legendre’s Series. Bessel’s equation, Bessel’s Functions, Generating function, Recurring relations, Orthogonality of Bassel’s function, Bessel’s series


**BOOKS RECOMMENDED**

Lal Din Baig Methods of Mathematical Physics 2000.
H.Sagan, Boundary and Eigenvalue problems in Mathematical Physics.
E.L Butkov, *Mathematical Physics*, Addison-Wesley
R.P kanwal, Linear Integral Equations.
My-Tung & Debnath, Partial *Differential Equations*

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<th>Marks</th>
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<tbody>
<tr>
<td>MTH-625</td>
<td>Special Theory of Relativity</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**SPECIAL THEORY OF RELATIVITY**


**BOOKS RECOMMENDED**

J.G. Taylor, *Special Theory of Relativity*
**OPERATIONS RESEARCH**

**LINEAR PROGRAMMING**

**TRANSPORTATION PROBLEMS**

**INTEGER PROGRAMMING**
Definition and formulation- Cutting-Plane Algorithm and Branch-and Bound method, Application. The mixed Algorithm, Zero-one polynomial programming.

**BOOKS RECOMMENDED**
C. M Harvey, *Operation Research*, North Holland, New Delhi
Prof. Sr. Saeed Akhtar Bhatti Operations Research: An Introduction
Krajewsky and Ritzman Operations Management Strategy and Analysis.

**QUANTUM MECHANICS**

**RECOMMENDED BOOKS**
Liboff, R.L *Introductory Quantum Mechanics*, Oxford University Press.
<table>
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<th>Marks</th>
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<tr>
<td>MTH-631</td>
<td>Soft Ware Engineering</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**SOFTWARE ENGINEERING**


**RECOMMENDED BOOKS**

Applying UML & Patterns By Grasp
Practitioner’s approach towards Software Engineering by Pressman
Applying UML & Patterns by Craig Larman

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<th>Marks</th>
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<tbody>
<tr>
<td>MTH-606</td>
<td>Rings &amp; Modules</td>
<td>4(4-0)</td>
<td>80</td>
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</tbody>
</table>

**RINGS & MODULES**


**BOOKS RECOMMENDED**


Lal Din Baig Methods of Mathematical Physics 2000.

Adamson, J. *Rings and Modules.*
THEORY OF NUMBERS

Algebraic Numbers and integers, Units and Primes in \( \mathbb{R}(\sqrt{v}) \). Ideals. Arithmetic of Ideals congruences. The norm of a Ideal. Prime Ideals. Units of Algebraic number field.

APPLICATION TO RATIONAL NUMBER THEORY

Equivalence and class number. Cyclotomic field \( K \) Fermat’s equation. Kummer's theorem, the \( q \) equation \( X^2 + 2 = Y^3 \), pure cubic fields. Distribution of Primes and Riemann Zets function, the prime number theorem.

BOOKS RECOMMENDED


Shailesh Shirali, C. S Yogananda, Number theory Universities press.

Steven Miller Ramin Takloo-Bighash, An Introduction to modern Number Theory Publishing Princeton

Neville Robbins, Beginning Number Theory (2nd edition), Jones and Bartlett.

MATHEMATICAL STATISTICS- II

RECOMMENDED BOOKS

<table>
<thead>
<tr>
<th>Course Number</th>
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<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>MTH-612</td>
<td>Numerical Analysis-II</td>
<td>4(4-0)</td>
<td>80</td>
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</tbody>
</table>

NUMERICAL ANALYSIS-II
Methods of least squares, Numerical Integration for equally spaced data, Newton cotes formula and its special cases e.g. Trapezoidal Rule Simson’s Rules, Gaussian quadrature using a system of orthogonal, Polynomials (Legender and Laguere Ploynomials, Numerical Differentiation, Difference Equations, Differential Equations, Euler’s Method, Improved Euler’s Methods. Mid point Formula, Heun’s Method,
BOOKS RECOMMENDED
Johnson L., and Dean, R.; *Numerical Analysis*, Addison Wesley.
Froeberg , C.E. Introduction to Numerical Analysis, Addison Wesley.
Aitkinson , *Elementary Numerical Analysis*.

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<th>Marks</th>
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<tbody>
<tr>
<td>MTH-614</td>
<td>Special Functions</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

SPECIAL FUNCTIONS
Sturm-Liouville theory of DEs, Basic properties of a SL System, Orthogonality, Reality and uniqueness, Sturm’s comparison theorem, completeness of Eigenfunctions Via Rayleigh quotient, Bessel functions, Legendre Polynomial and their Generating functions and properties, Hermite equation and functions and their properties, Laguerre Equation and functions and their properties, chibeicif function, Hypergeomtric Differential Equations and Functions, Gamma and Beta Functions
RECOMMENDED BOOKS
B. G. Korenev, Bessel Functions and their Applications
R. E. Attar, Special Functions and Orthogonal Polynomials
G. N. Watson, A Treatise on the Theory of Bessel Functions

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<tbody>
<tr>
<td>MTH-616</td>
<td>Theory of Optimization</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

THEORY OF OPTIMIZATION

OPTIMIZATION BY EQUALITY CONSTRAINTS

RECOMMENDED BOOKS

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<th>Course Number</th>
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<th>Credit Hours</th>
<th>Marks</th>
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<tbody>
<tr>
<td>MTH-619-P</td>
<td>Project</td>
<td>4(4-0)</td>
<td>80</td>
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The Project of BS (H) Mathematics will be offered as an optional paper to not more than 50 % of the class strength and only to those who obtain at least 65 % marks on the basis of their performance in V & VI Semesters.
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<th>Marks</th>
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<tbody>
<tr>
<td>MTH-618</td>
<td>Fluid Mechanics -II</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**FLUID MECHANICS -II**


Constitutive equations; Navier- Stoke’s equations; Exact solution of Navier- Stoke’s equations; Steady unidirectional flow; Poiseuille flow; Couette flow; Unsteady unidirectional flow, Sudden motion of a plane boundary in a fluid at rest; Flow due to an oscillatory boundary; Equations of motion relative to a rotating system; Ekman flow; Dynamical similarity of turbulent motion.

**BOOKS RECOMMENDED**


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<tbody>
<tr>
<td>MTH-620</td>
<td>Partial Differential Equations</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**PARTIAL DIFFERENTIAL EQUATIONS**


**RECOMMENDED BOOKS**

H. Sagan, Boundary and Eigenvalue Problems in Mathematical Physics.
My-Tung & Debnath, Partial Differential Equations.


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<tbody>
<tr>
<td>MTH-622</td>
<td>Theory of Elasticity</td>
<td>4(4-0)</td>
<td>80</td>
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</table>

**THEORY OF ELASTICITY**

Cartesian tensors, Analysis of stress and strain, Generalized Hooke’s law; crystalline structure, Point groups of crystals, Reduction in the number of elastic moduli due to crystal symmetry; Equations of equilibrium; Boundary conditions, compatibility equations; Plane stress and plane strain problems; Two dimensional problems in rectangular and polar coordinates; torsion of rods and beams.

**RECOMMENDED BOOKS**


ELECTROMAGNETISM

Electrostatics and the solution of electrostatics problems in vacuum and in media, Electrostatic energy, Electro currents, The magnetic field of steady currents. Magnetic properties of matter. Magnetic energy, Electromagnetic Introduction, Maxwell’s equations, Boundary Value Potential Problems in two dimensions, Electromagnetic Waves, Radiation, Motion of electric charges.

RECOMMENDED BOOKS


MATHEMATICAL STATISTICS- II


RECOMMENDED BOOKS

 Publish by Pearson education Singapore (Pvt) Ltd

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<tbody>
<tr>
<td>MTH-616</td>
<td>Numerical Analysis-II</td>
<td>4(4-0)</td>
<td>80</td>
</tr>
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</table>

**NUMERICAL ANALYSIS-II**

Methods of least squares, Numerical Integration for equally spaced data, Newton cotes formula and its special cases e.g. Trapezoidal Rule Simson’s Rules, Gaussian quadrature using a system of orthogonal, polynomials (Legender and Laguere Ploynomials, Numerical Differentiation, Difference Equations, Differential Equations, Euler’s Method, Improved Euler’s Methods. Mid point Formula, Heun’s Method,

**BOOKS RECOMMENDED**

Johnson L., and Dean, R.; *Numerical Analysis*, Addison Wesley.
Aitkinson , Elementary Numerical Analysis.

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<tr>
<td>MTH-617</td>
<td>Special Functions</td>
<td>4(4-0)</td>
<td>80</td>
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**SPECIAL FUNCTIONS**

Sturm-Liouville theory of DEs, Basic properties of a SL System, Orthogonality, Reality and uniqueness, Sturm’s comparison theorem, completeness of Eigenfunctions Via Rayleigh quotient, Bessel functions, Legendre Polynomial and their Generating functions and properties, Hermite equation and functions and their properties, Laguerre Equation and functions and their properties, chibeicif function, Hypergeomtric Differential Equations and Functions, Gamma and Beta Functions

**RECOMMENDED BOOKS**

B. G. Korenev, Bessel Functions and their Applications
R. E. Attar, Special Functions and Orthogonal Polynomials
G. N. Watson, A Treatise on the Theory of Bessel Functions
OPTIMIZATION THEORY


OPTIMIZATION BY EQUALITY CONSTRAINTS


RECOMMENDED BOOKS


The Project of BS (H) Mathematics will be offered as an optional paper to not more than 50% of the class strength and only to those who obtain at least 65% marks on the basis of their performance in V & VI Semesters.
PROGRAMMING LANGUAGE C++.
Introduction I:- History of C++, writing C++ Program, structure, preprocessor, Header file, Main function, Increment operators++, data types, Declaration of the variable, Initialization of the variable, Arithmetic operators, arithmetic Expression, order of precedence of operation.
Introduction 2:- Basis input / output, cout<< object, the escape sequence, the end line, setw manipulator, Assignment operator, the cin>> operator. Compound assignment, increment and decrement operator, the comment statement, the conditional statement, loops statement, arrays, structures, functions part I and part II, pointers, inheritance, and polymorphism part I and II, Files graphics, bit wise operators.
RECOMMENDED BOOKS

ADVANCED FUNCTIONAL ANALYSIS
Hahn-Banach theorem, adjoint operator, uniform boundedness theorem, strong and weak convergence, convergence of sequences of operators and functionals, open mapping theorem, closed graph theorem, Banach fixed point theorem and its applications, spectral theory in finite dimensional normed spaces, spectral properties of bounded linear operators, compact linear operators and their properties, spectral properties of compact linear operators on normed spaces.
RECOMMENDED BOOKS

The End