Re-Accredited by NAAC with 'A' Grade
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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# -: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન ગણિતશાસ્ત્ર વિષયની અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટના વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ જૂન– ૨૦૨૨–૨૩ થી અમલમાં આવનાર M.Sc. Mathematics Skill Based Elective Course નું Structure તથા નવા અભ્યાસક્રમ બાબતે ચર્ચા કરતા ગણિતશાસ્ત્ર વિષયની અભ્યાસસમિતિની તા.૦૨/૦૮/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલ તા.૦૩/૦૯/૨૦૨૨ ની સભાનાં ઠરાવ ક્રમાંકઃ૦૬ થી સ્વીકારી મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

**ગણિતશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૦૨/૦૮/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ ૨**

:: આથી ઠરાવવામાં આવે છે કે, તારીખ– ૨૧/૧૨/૨૦૨૧ ના રોજ શૈક્ષણિક વર્ષ ૨૦૨૨–૨૦૨૩ થી અમલમાં આવનાર M.Sc. Mathematics Skill Based Elective Courseનું Structure તથા નવા અભ્યાસક્રમ બનાવવા જે પેટાસમિતિની રચના કરવામાં આવી હતી તેને અનુસંધાનમાં તારીખ–૨૯/૦૭/૨૦૨૨ ના રોજ પેટાસમિતિએ તૈયાર કરેલ, શૈક્ષણિક વર્ષ ૨૦૨૨– ૨૦૨૩થી અમલમાં આવનાર M.Sc.Mathematics સેમેસ્ટર–૧ અને ૨ નો Skill Based Elective Course નું Structure તથા નવો Proposed અભ્યાસક્રમ,અભ્યાસક્રમ સમિતિના ચેરમેનશ્રીને સુપ્રત કરવામાં આવ્યો હતો, તેમાં જરૂરી સુધારા–વધારા તેમજ ચર્ચા વિચારણા સાથે તૈયાર કરેલ સંપૂર્ણ આયોજિત અભ્યાસક્રમ,અભ્યાસક્રમ સમિતિના તમામ સભ્યોના સર્વાનુમતે મંજૂર કરી તે અભ્યાસક્રમ જૂન ૨૦૨૨થી અમલમાં મૂકવા તથા મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

**એકેડેમિક કાઉન્સિલની તા.૦૩/૦૯/૨૦૨૨ની ઠરાવ ક્રમાંકઃ ૦૬**

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ જૂન– ૨૦૨૨ થી અમલમાં આવનાર M.Sc. Mathematics Skill Based Elective Courseનું Structure તથા નવા અભ્યાસક્રમ બાબતે ચર્ચા કરતા ગણિતશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૦૨/૦૮/૨૦૨૨ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ )

ક્રમાંક : એસ./ગણિતશાસ્ત્ર/પરિપત્ર/૨૦૨૭૧/૨૦૨૨
તા.૦૬–૦૯–૨૦૨૨

ઈ.ચા. કુલસચિવ

પ્રતિ,

૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન ગણિતશાસ્ત્ર વિષયની અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ. તથા ડિપાર્ટમેન્ટ વડાશ્રી..... આપશ્રીની કોલેજ/ડિપાર્ટમેન્ટના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.

૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.

૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
# SYLLABUS FOR M.Sc. (MATHEMATICS)
# SEMESTER – I
# Effective from June 2022

| M. Sc. Sem – I (Mathematics) | | | | | | |
|---|---|---|---|---|---|---|
| Theory Paper/Practical | Teaching schedule Hrs/week | Exam Schedule | | | Total Marks | Credit |
| | | Duration | Internal Marks | External Marks | | |
| Theory papers: | | | | | | |
| **1: Core Paper-I**<br>PGMTH-101:<br>Advanced Real Analysis | 4 | 3 | 30 | 70 | 100 | 4 |
| **2: Core Paper-II**<br>PGMTH-102:<br>Ordinary Differential Equations | 4 | 3 | 30 | 70 | 100 | 4 |
| **3: Core Paper-III**<br>PGMTH-103:<br>Topology | 4 | 3 | 30 | 70 | 100 | 4 |
| **4: Inter/Multi-Disciplinary Elective Paper**<br>PGMTH-1041:<br>Mathematical Software<br>PGMTH-1042:<br>Linear Programing<br>PGMTH-1043:<br>Integral Transforms-I<br>PGMTH-1044:<br>Advanced Number Theory<br>PGMTH-1045:<br>Special Functions-I | 4 | 3 | 30 | 70 | 100 | 4 |
| **5: Practical based on 101 to 103 and Elective Paper**<br>PGMTH-105: Practical | 12 | 10-15 | 50 | 100 | 150 | 6 |
| **6: Skilled based elective paper / Swayam / other MOOC courses**<br>(Course can be taken from any faculty) | 2 | 0 | 20 | 30 | 50 | 2 |
| | | | | | | |
| | | Total | 190 | 410 | 600 | 24 |

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-101: Advanced Real Analysis**

**L T P**
**4-0-0**

**Unit-I**

Algebra of sets, $\sigma$-Algebra, the extended real numbers, Open and closed set of real numbers, Borel sets, Lebesgue outer measure.

**Unit II**

Measurable sets and Lebesgue measure, Non-measurable set, Measurable function, Littlewoods's three principles (only statements).

**Unit-III:**

Riemann integral, Lebesgue integral of a bounded function over a set of finite measure, Bounded convergence theorem, Integral of a non-negative function.

**Unit-IV:**

Fatou's lemma, Monotone convergence theorem, General Lebesgue integral, Lebesgue convergence theorem, Generalized Lebesgue convergence theorem.

**Reference Books:**


1. H. L. Royden: Real Analysis, Macmillan publication, 1993.
2. G. de Barra: Measure theory and Integration, Wiley Eastern ltd.1981.
3. T. M. Apostol: Mathematical Analysis, Narosa Publishing House, 1985.
4. I. P. Natanson: Theory of Functions of real variable, Fredrick Unger pub. 1961.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**

# PGMTH-102: Ordinary Differential Equations

**L T P**
**4-0-0**

## UNIT-I

Linear Differential Equations of Higher Order: Equations with Variable Coefficients, Wronskian, Variation of Parameters, Some Standard Methods: (i) Method of Undetermined Coefficients (ii) Reduction of the order of equation.

## UNIT-II

Solutions in Power Series: Introduction, Second Order Linear Equations with Ordinary Points, Legendre Equation and Legendre Polynomials, Second Order Equation with Regular Singular Point, Properties of Bessel Functions

## UNIT-III

Systems of Linear Differential Equations: Introduction, Systems of First Order Equations, Existence and Uniqueness Theorem, Fundamental Matrix.

## UNIT-IV

Non homogeneous Linear Systems, Linear Systems with Constant Coefficients, Linear Systems with Periodic Coefficients.

**References:**


1. S. G. Deo, V. Lakshmikantham, V. Raghvendra: Text Book of Ordinary Differential Equations (Second Edition), Tata McGraw Hill Pub. Co. Ltd, New Delhi, 1997.
2. Coddington E. A., Levinson N.: Theory of Ordinary Differential Equations, Mc Graw Hill,1955.
3. Hartmann P.: Ordinary Differential Equations, John Wiley International, 1964.
4. Somasundaram D.: Ordinary Differential Equations, Narosa, 2001.
5. Mandal C. R.: Ordinary Differential Equations, PHI, 2003.
6. Rai B., Freedmanm H. I., Chaudhary D. P.: A Course in Ordinary Differential Equations, Narosa, 2002.
7. King A. C., Otto R., Billingham J.: Differential Equations, Cambridge, 2005.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-103: Topology**

**L T P**
**4-0-0**

**UNIT-I:**

Topological Spaces: Definition and some examples, Metrizable space, Relative Topology, Continuity and Homeomorphism.

Some elementary concepts: Open and Closed sets, Closure of a set, Isolated point, limit point, Derived set.

**UNIT-II:**

Interior of a set, Boundary of a set, Perfect set, Dense and Nowhere dense sets. Open base and Open sub-base, First and second countable spaces, Lindelof's theorem, Separable spaces.

**UNIT-III:**

Compact space, Continuity and compactness, Finite intersection property, Heine-Borel theorem, product topology (definition) and projection mapping (definitions), Tychnoff's theorem (only statement), Locally compact space.

**UNIT-IV:**

Separation Axioms: $T_1$ and $T_2$ Spaces, Regular, completely regular and Normal spaces, Urysohn's lemma, Tietze's extension theorem (Without proof).

**References:**


1. George F. Simmons: Introduction to Topology and Modern Analysis, McGraw-Hill Book Co., 1963.
2. James R. Munkres: Topology: A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
3. J. Dugundji: Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Pvt. Ltd.).
4. K. D. Joshi: Introduction to General Topology, Wiley Eastern Ltd., 1983.
5. J. Hocking and G. Young: Topology, Addison-Wesley, Reading, 1961.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-1041: Mathematical Software (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

**Introduction:** Introduction to MATLAB, variable and array, subarrays, displaying output data, data files operation on array, hierarchy of operation on array, built in function in MATLAB.

**UNIT-II:**

**Plotting:** Introduction to plotting, graph window, two-dimensional plot, multiple plot, components of graph (legend, title), graphical image, commet, 3D graph, additional plotting features, Subplots, polar plots.

**UNIT-III:**

**Programming:** The if construct, switch construct, The try-catch construct, relational operators, logic operators, logical function, while loop, for loop, the break and continue statements, Nesting loops.

**UNIT-IV:**

**User defined function:** Introduction to MATLAB functions, variable passing in MATLAB (pass by value), preserving data between calls to functions, sub functions, private function, nested function.

**Reference books:**


1. Chapman Stephen: MATLAB programming for engineers, Thompson learning, 2004.
2. Rudra Pratap: getting started with MATLAB, Oxford University Press, 2004.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-1042: Linear Programming (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

**Linear Programming:** General Linear Programming Problem (LPP), Canonical and Standard Form of LPP, Graphical Method, Simplex Method, Fundamental Properties of the Solution, Degeneracy in LPP, Solution of LPP using Simplex Method, Concept of Duality, Fundamental Theorem of Duality, Properties of Duality, Revised Simplex Method.

**UNIT-II:**

**Dynamic Programming:** Introduction, Recursive Equation Approach, Characteristic of Dynamic Programming, Solution of Discrete Dynamic Programming Problem, Solution of LPP by Dynamic Programming.

**UNIT-III:**

**Integer Programming:** Introduction, All and Mixed Integer Programming problems (IPP), Gomory's All-IPP Method, All-IPP Algorithm, The Branch and Bound Techniques.

**UNIT-IV:**

**Post-optimality Analysis:** Sensitivity Analysis, Discrete Change in the Cost-vector, in Requirement-vector and in the Coefficient matrix, Structural Changes in LPP.

**Reference:**


1. Kanti Swarup, P. K. Gupta and Manmohan: Operations Research, Sultan Chand and Sons.
2. S.D. Sharma: Operations Research, Kedar Nath, Ram Nath & Co.
3. S. S. Rao: Optimization Theory and Applications, Wiley Eastern, 1984.
4. J. K. Sharma: Operation Research: Theory and Applications, Macmillan India Ltd., Third Edition, 2007.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-1043: Integral Transforms – I (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

**Laplace Transform:** Introduction and definition of Laplace transform with examples, Existence condition for Laplace transform, Basic properties of Laplace transform, The convolution theorem and properties of convolution.

**UNIT-II:**

**Laplace Transform:** Differentiation and integration of Laplace transform, the inverse Laplace transform and examples, Tauberian theorem, Watson's lemma.

**UNIT-III:**

**Finite Laplace Transform:** Introduction, Definition of finite Laplace transform and examples, Basic operational properties of finite Laplace transform, Applications to Finite Laplace Transform, Tauberian theorems.

**UNIT-IV:**

**Applications of Laplace Transform:** Applications of Laplace transform to ordinary differential equations, Applications of Laplace transform to partial differential equations, Initial and boundary value problems, Solutions to Integral equations.

**References:**


1. Lokenath Debnath: Integral Transform and their applications, CRC Pub., 1995.
2. Ian Sneddon: The use of Integral Transform, TMIH, 1979.
3. B. Davies: Integral Transforms and their applications, Springer - Verlag, 1978.
4. Boss M. L.: Mathematical Methods in Physical Sciences, John Wiley & Sons, 1983.
5. Andrews, L. G. & Shivamoggi B. K.: Integral Transforms for Engineers, PHI, 2003.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-1044: Advanced Number Theory (Elective Paper)**

**L T P**
**4-0-0**

**Unit I:**
**Primitive Roots:** The order of an integer modulo $n$, Primitive roots for primes, Composite numbers having primitive roots.

**Unit II:**
**Indices and Quadratic Congruence:** The theory of indices, Solution of the congruences of the type $ax^n \equiv b\ (mod\ p)$ and $x^n \equiv a\ (mod\ n), \gcd(a,n) = 1$, Quadratic Congruence, Euler's criterion, Quadratic residues.

**Unit III:**
**Quadratic Congruence:** The Legendre symbol and its properties, Gauss' Lemma, Law of quadratic reciprocity, Quadratic residues and primes, Quadratic congruence with compositemoduli.

**Unit IV:**
**Numbers of special forms:** Perfect numbers, Mersenne primes, Amicable numbers, Fermat numbers, Fibonacci numbers.

**References:**

1. David M. Burton: Elementary Number Theory, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 7th edition, 2012.
2. S. G. Talang: Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi.
3. Neville Robbins: Beginning Number Theory, Narosa Pub. House, New Delhi, 2nd edition., 2006.
4. I. Niven, S. Zuckerman, L. Montgomery: An Introduction to the Theory of Numbers, 6th edition, John Wiley and Sons, Inc., New York, 2003.
5. George Andrews: Number Theory, The Hindustan Pub. Corp., New Delhi.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: I**
**w.e.f. July 2022**
**PGMTH-1045: Special Functions-I (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

Definition of an Infinite product, A necessary condition for convergence, The associated series of logarithms, Absolute convergence, Uniform convergence.

**UNIT-II:**

The Euler or Mascheroni constant $\gamma$, The Gama function, A series for $\Gamma(z)$, $\Gamma'(z)$, Evaluation of $\Gamma(1)$ and $\Gamma'(1)$, The Euler product for $\Gamma(z)$, The difference equation $\Gamma(z+1) = z\,\Gamma(z)$, The order symbols o and 0, Evaluation of certain infinite products, Euler integral for $\Gamma(z)$.

**UNIT-III:**

The Beta function, The value of $\Gamma(z)$, $\Gamma(1-z)$, The factorial function, Legendre's duplication formula, Gauss' multiplication theorem, A summation formula due to Euler, The behaviour of $\log \Gamma(z)$, for large z.

**UNIT-IV:**

The function F(a, b; c; z), A simple integral form, F(a, b; c; 1) as a function of the parameters, Evaluation of F(a, b; c; 1), the contiguous function relations, The hypergeometric differential equation, Logarithmic solutions of the hypergeometric equation, F(a, b; c; z) as a function of its parameters, Simple transformations, Relation between functions of z and 1-z, A quadratic transformation, other quadratic transformations, a theorem due to Kummer, Additional properties.

**Reference:**


1. E. D. Rainville, Special Functions, McMillan, New York, 1990.
2. I. N. Sneddon, Special functions of Mathematical Physics and Chemistry, Oliver Boyd.
3. N. N. Lebdev, Special Functions and their applications, Dover Pub. 1972.
4. R. K. Saxena and D. C. Gokhroo, Special Functions, Khanna Pub.

# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.
# SYLLABUS FOR M.Sc. (MATHEMATICS)
# SEMESTER – II
# Effective from June 2022

| M. Sc. Sem – I (Mathematics) | | | | | | |
|---|---|---|---|---|---|---|
| Theory Paper/Practical | Teaching schedule Hrs/week | Exam Schedule | | | Total Marks | Credit |
| | | Duration | Internal Marks | External Marks | | |
| Theory papers: | | | | | | |
| **1: Core Paper-I** PGMTH-201: Advanced Abstract Algebra | 4 | 3 | 30 | 70 | 100 | 4 |
| **2: Core Paper-II** PGMTH-202: Complex Analysis | 4 | 3 | 30 | 70 | 100 | 4 |
| **3: Core Paper-III** PGMTH-203: Partial Differential Equations | 4 | 3 | 30 | 70 | 100 | 4 |
| **4: Inter/Multi-Disciplinary Elective Paper** PGMTH-2041: Mathematical Modelling<br>PGMTH-2042: Operations Research<br>PGMTH-2043: Integral Transforms-II<br>PGMTH-2044: Analytic Number Theory<br>PGMTH-2045: Special Functions-II | 4 | 3 | 30 | 70 | 100 | 4 |
| **5: Practical based on 201 to 203 and Elective Paper** PGMTH-205: Practical | 12 | 10-15 | 50 | 100 | 150 | 6 |
| **6: Skilled based elective paper / Swayam / other MOOC courses** (Course can be taken from any faculty) | 2 | 0 | 20 | 30 | 50 | 2 |
| | | | | | | |
| | | Total | 190 | 410 | 600 | 24 |

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-201: Advanced Abstract Algebra**

**L T P**
**4-0-0**

**Unit-I:**
Conjugate of an element, class equation, Cauchy theorem, Sylow's theorem, Direct Products, Fundamental theorem of Finite Abelian Groups.

**Unit II:**
Polynomial rings, Primitive polynomials, Guass's lemma, the Eisenstein criterion, polynomial rings over commutative rings, unique factorization domain.

**Unit-III:**
Extension fields, Finite extension field, Algebraic extension, Algebraic number, Roots of polynomials.

**Unit-IV:**
Splitting fields, Uniqueness of Splitting fields, More about roots, Simple extension, Elements of Galois theory: Group of automorphisms of a field and their fixed fields, Normal extension, Galois group and its examples.

**Reference Books:**

1. I. N. Herstein: Topics in Algebra 4thEd., John Wiley Sons.
2. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul: Basic Abstract Algebra, 2nd edition, Cambridge University Press.
3. Artin M.: Algebra, Prentice Hall, Englewood, Cliffs NJ.
4. J. A. Gallian: Contemporary Abstract Algebra, Narosa Publishing House.

**DEPARTMENT OF MATHEMATICS**
**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-202: Complex Analysis**

**L T P**
**4-0-0**

**UNIT-I:**
Analytic Functions: Functions of a Complex variables, Limits, Continuity, Differentiability, Cauchy-Riemann Equations, Analytic functions, Harmonic functions, Elementary Functions: Exponential function, Trigonometric functions, Hyperbolic functions.

**UNIT-II:**
Complex Integration: Contour Integral, Primitives, Cauchy-Goursat Theorem, Extension of Cauchy-Goursat Theorem, Cauchy Integral formula, Consequences of Cauchy Integral formula, Concept of Maximum Moduli of functions.

**UNIT-III:**
Series Expansions: Power Series, Uniform convergence of power series, Taylor series, Zeros of Analytic functions, Laurent Series.

**UNIT-IV:**
Singularities and Residues: Classification of Singularities, Residues, Poles and Zeros, Behavior of functions and infinity, Meromorphic functions, Open mapping theorem.

**References:**

1. H. S. Kasana: Complex Variables – Theory and Applications, 2nd edition (2005), PHI Learning Private Limited, Delhi.
2. J. N. Sharma: Functions of a Complex Variable, Krishna Prakashan, 2000.
3. S. Ponnuswamy: Foundation of Complex Analysis, Narosa Publishing House, 1997.
4. S. Lang: Complex Analysis, Addition Wesley, 1997.
5. H. A. Priestly: Introduction to Complex Analysis, Clarendon Press, 1990.
6. J. B. Conway: Functions of one Complex Variable, Springer-Verlag, 1980.

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**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-203: Partial Differential Equations**

**L T P**
**4-0-0**

**UNIT-I:**

**Ordinary Differential Equations in More than Two Variables:** Surfaces and Curves in Three Dimensions, Simultaneous Differential Equations of the First Order and the First Degree in Three Variables, Methods of Solutions of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Orthogonal Trajectories of a System of Curves on a Surface, Pfaffian Differential Forms and Equations, Solution of Pfaffian Differential Equations in Three Variables.

**UNIT-II:**

**Partial Differential Equations of the First Order:** Partial Differential Equations, Origins of First-Order Partial Differential Equations, Linear Equations of the First Order, Integral Surfaces Passing through a Given Curve, Surfaces Orthogonal to a Given System of Surfaces.

**UNIT-III:**

Nonlinear Partial Differential Equations of the First Order, Compatible Systems of First-order Equations, Charpit's Method, Special Types of First order Equations, Solutions Satisfying Given Conditions, Jacobi's Method.

**UNIT-IV:**

**Partial Differential Equations of the Second Order:** Linear Partial Differential Equations with Constant Coefficients, Equations with Variable Coefficients, Separation of Variables, Nonlinear Equations of the Second Order.

**References:**


1. Sneddon I. N.: Elements of Partial Differential Equations, McGraw Hill, International Editions, 1957.
2. Zafar Hasan: Differential Equations and their applications, Second Edition, PHI, 2009.
3. Iyengar S. N.: Differential Equations, Anmol Publications, 2000.
4. Sharma, Gupta: Differential Equations, Krishna Prakashan Media, 1997- 98.

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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-2041: Mathematical Modelling (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

**Introduction to Mathematical modeling:** Needs and Techniques of mathematical modeling: Idea of mathematical modeling, need for mathematical modeling, Advantages and Disadvantages of Model, steps in mathematical modeling, Characteristics of mathematical modeling, Interpretation.

**UNIT-II:**

**Model of Linear Algebra:** Modeling Explorations, Input-Output Economies, Traffic Networks, Balancing Chemical Equations.

**UNIT-III:**

**First Order Models:** Models for Birth, Death, and Immigration, Difference Equations and Differential Equations, Stability and Equilibria, Euler's Method: Numerical Solutions for Differential Equations, Classifying Difference and Differential Equations, Modeling Explorations with Difference and Differential Equations.

**UNIT-IV:**

**Second Order Models:** Modeling Oscillations, Homogeneous Linear $2^{nd}$ Order Differential Equations, Forced Oscillations, Energy in Mass Spring Systems, Modelling Explorations with $2^{nd}$ Order Differential Equations.

**Reference Books:**


1. J. N. Kapur: Mathematical Modelling, Wiley eastern Ltd., 1994.
2. M. M. Gibbons: A concrete approach to Mathematical Modeling, John Wiley and sons, 1995.
3. H. Neunzert and A. H. Siddiqui: Topics in Industrial Mathematics, Kluwer Academic Publishers, London, 2000
4. P. E. Wellstead : Introduction to Physical System Modeling, Academic Press,1979.
5. Richard Haberman: Mathematical Models, Practice- Hall Inc., NJ, 1979.

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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**
**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-2042: Operations Research (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

**Inventory Control:** Introduction to Various Types of Inventory Problems, Method with known Demand Function, Economic Order Quantity (EOQ), Deterministic Inventory Problems when Shortages are Allowed Deterministic Inventory Problems when Shortages are Not Allowed, EOQ Problems with Price Breaks.

**UNIT-II:**

**PERT – CPM:** Introduction to Network with Basic Components, Rules of Network Construction, Time Calculation in Network, CPM - PERT, PERT Calculations, Advantages of PERT-CPM, Project Cost, Time Cost, Optimization Algorithm, Resource Allocation and Scheduling.

**UNIT-III:**

**Simulation:** Introduction, Why Simulation, Methodology of Simulation, Generation of Random Numbers.

**UNIT-IV:**

**Theory of Games:** Revision: Two-person zero-sum game, Pure strategies, Mixed Strategies, The rules of dominance, Solution methods for Games without Saddle point: Algebraic method, Arithmetic method, Matrix method, Linear Programming method.

**Reference:**


1. Operations research: Kanti Swarup, P. K. Gupta and Nan Mohan. S. Chand & Sons, New Delhi, 7th edition, 1994.
2. Operation Research: Theory and Applications: J. K. Sharma, Macmillan India Ltd., 3rd edition, 2007.
3. Operations Research: S. D. Sharma. Kedarnath Ramnath Pub.1998. Merrut.
4. Optimization Methods in Operation Research and System Analysis: K. V. Mittal and C. Mohan, New Age International Publishers, 3rd edition, 1996.

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**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-2043: Integral Transforms – II (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

**Hankel Transform:** Introduction, Hankel transform and Examples, Operational properties of the Hankel transform.

**UNIT-II:**

**Finite Hankel Transform:** Introduction, Definition of the finite Hankel transform and examples, Finite Hankel transform of some elementary functions, Basic operational properties of the finite Hankel transform.

**UNIT-III:**

**Applications of Hankel transform:** Applications of Hankel transform to partial differential equations. Applications of finite Hankel transform.

**UNIT-IV:**

**Hilbert and Stieltjes Transforms:** Introduction and definition of Hilbert transform and examples, Basic properties of Hilbert transform, Definition of Stieltjes transform and examples, Basic properties of Stieltjes transform, Inverse theorem for Stieltjes transform, Applications of Stieltjes transform, The generalized Stieltjes transform, Basic properties of the generalized Stieltjes transform.

**References:**


1. Lokenath Debnath: Integral Transforms and their applications, CRC Pub., 1995.
2. Ian Sneddon: The use of Integral Transforms. TMIH, 1979.
3. B. Davies: Integral Transforms and their applications, Springer - Verlag, 1978.
4. Boss M. L.: Mathematical Methods in Physical Sciences, John Wiley & Sons, 1983.
5. Andrews, L. G. & Shivamoggi B. K.: Integral Transforms for Engineers, PHI, 2003.

# DEPARTMENT OF MATHEMATICS
# VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
## Syllabus to be offered at M. Sc. (Mathematics) Semester: II
## w.e.f. July 2022
## PGMTH-2044: Analytic Number Theory (Elective Paper)

**L T P**
**4-0-0**

**Unit I:**

**Arithmetical functions and Dirichlet multiplication:** Basic introduction of the Möbius function $\mu(n)$ and the Euler totient function $\phi(n)$, relation connecting $\mu$ and $\phi$, the Dirichlet product of two arithmetical functions (a.f.) and group structure w.r.t. this product, the Mangöldt function $\Lambda(n)$, Multiplicative a.f., the inverse of a completely multiplicative a.f.

**Unit II:**

**Dirichlet multiplication and averages of Arithmetical functions:** Liouville's function $\lambda(n)$, the divisor functions $d(n)$and $\sigma_\alpha(n)$, the generalized convolutions, the big oh notation, Euler's summation formula, some elementary asymptotic formulas, the average order of divisor functions $d(n)$and $\sigma_\alpha(n)$, the average order of functions $\phi(n), \mu(n), \Lambda(n)$.

**Unit III:**

**Averages of Arithmetical Functions and Chebyshev's functions:** Distribution of lattice points visible from the origin, the partial sums of a Dirichlet product, applications to $\mu(n)$ and $\Lambda(n)$, Chebyshev's functions $\psi(x)$and $\vartheta(x)$, relation between $\psi(x), \pi(x)$and $\vartheta(x)$, Abel's identity.

**Unit IV:**

**Elementary theorems on the distribution of prime numbers:** Equivalent forms of prime number theorem, lower and upper bounds for $\pi(n)$ and $p_n$, Shapiro's Tauberian theorem and its applications, an asymptotic formula for the partial sums $\sum_{p \le x}\left(\frac{1}{p}\right)$, the partial sums of function $\mu(n)$.

**References:**


1. Tom M. Apostol: Introduction to Analytic Number Theory, Narosa Pub. House, New Delhi, 1998.
2. Mc Carthy P. J.: Introduction to Arithmetical function, Springer-Verlag, New York, 1986.
3. K. Chandrashekharan: Introduction to Analytic Number Theory, Springer-Verlag, New York, 1968.
4. Hua L. K.: Introduction to Number Theory, Springer-Verlag, New York, 1982.

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**Syllabus to be offered at M. Sc. (Mathematics) Semester: II**
**w.e.f. July 2022**
**PGMTH-2045: Special Functions-II (Elective Paper)**

**L T P**
**4-0-0**

**UNIT-I:**

Orthogonal polynomials, Simple set of polynomials, Orthogonality, an equivalent condition for Orthogonality, zeros of orthogonal polynomials, Expansion of polynomials, The threeterm recurrence relations, The Christoffel-Darboux formula, Normalization; Bessel's inequality.

**UNIT-II:**

Legendre polynomials, A generating function, differential recurrence relations, The pure recurrencerelations, Legendre's differential equation, The Rodrigues formula, Bateman's generating function, Additional generating functions.

**UNIT-III:**

Hypergeometric forms of Pn(X), Brafman's generating functions, Special properties of Pn(X), More generating functions, Laplace'sfirst integral form, Some bounds on Pn(X), Orthogonality, An expansion theorem, Expansion of $X^n$, Expansion of analytic functions.

**UNIT-IV:**

Hermite polynomials: Definition of Hn(x), Recurrence relations, The Rodrigues formula, Other generating functions, Integrals, The Hermite polynomial as a ${}_2F_0$, Orthogonality, Expansion of polynomials, More generating functions.

**Reference:**


1. E. D. Rainville, Special Functions, McMillan, New York, 1990.
2. I. N. Sneddon, Special functions of Mathematical Physics and Chemistry, Oliver Boyd.
3. N. N. Lebdev, Special Functions and their applications, Dover Pub. 1972.
4. R. K. Saxena and D. C. Gokhroo, Special Functions, Khanna Pub.