DIRECTORATE OF DISTANCE EDUCATION
MAHARSHI DAYANAND UNIVERSITY, ROHTAK

Syllabus
Master of Science (Mathematics)
Two Year Programme
w.e.f. Session 2020-21

Program Specific Outcomes

Students would be able to:

PSO1 Communicate concepts of Mathematics and its applications.

PSO2 Acquire analytical and logical thinking through various mathematical tools and techniques.

PSO3 Investigate real life problems and learn to solve them through formulating mathematical models.

PSO4 Attain in-depth knowledge to pursue higher studies and ability to conduct research. Work as mathematical professional.

PSO5 Achieve targets of successfully clearing various examinations/interviews for placements in teaching, banks, industries and various other organizations/services.

The entire course will be of four semesters.

MASTER OF SCIENCE (MATHEMATICS)
FIRST YEAR
First Semester
Abstract Algebra
Paper code: 20MAT21C1

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:
CO1 Apply group theoretic reasoning to group actions.
CO2 Learn properties and analysis of solvable & nilpotent groups, Noetherian & Artinian modules and rings.
CO3 Apply Sylow's theorems to describe the structure of some finite groups and use the concepts of isomorphism and homomorphism for groups and rings.
CO4 Use various canonical types of groups and rings- cyclic groups and groups of permutations, polynomial rings and modular rings.
CO5 **Analyze and illustrate examples of composition series, normal series, subnormal series.**

Section - I
Conjugates and centralizers in S_n, p-groups, Group actions, Counting orbits.
Sylow subgroups, Sylow theorems, Applications of Sylow theorems, Description of group of order p^2 and pq, Survey of groups upto order 15.

Section - II
Normal and subnormal series, Solvable series, Derived series, Solvable groups, Solvability of S_n-the symmetric group of degree $n \geq 2$, Central series, Nilpotent groups and their properties, Equivalent conditions for a finite group to be nilpotent, Upper and lower central series.
Composition series, Zassenhaus lemma, Jordan-Holder theorem.

Section - III
Modules, Cyclic modules, Simple and semi-simple modules, Schur lemma, Free modules, Torsion modules, Torsion free modules, Torsion part of a module, Modules over principal ideal domain and its applications to finitely generated abelian groups.

Section - IV
Noetherian and Artinian modules, Modules of finite length, Noetherian and Artinian rings, Hilbert basis theorem.
$Hom_R(R,R)$, Opposite rings, Wedderburn – Artin theorem, Maschk theorem, Equivalent statement for left Artinian rings having non-zero nilpotent ideals.
Radicals: Jacobson radical, Radical of an Artinian ring.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol. III-Modules, Narosa Publishing House (Vol. I – 2013, Vol. III –2013).
2. Charles Lanski, Concepts in Abstract Algebra, American Mathematical Society, First Indian Edition, 2010.
3. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
4. D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw Hill, International Edition, 1997.
5. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
6. C. Musili, Introduction to Rings and Modules, Narosa Publication House, 1994.
7. N. Jacobson, Basic Algebra, Vol. I & II, W.H Freeman, 1980 (also published by Hindustan Publishing Company).
8. M. Artin, Algebra, Prentice-Hall of India, 1991.
9. Ian D. Macdonald, The Theory of Groups, Clarendon Press, 1968.

First Semester
Mathematical Analysis
Paper code: 20MAT21C2

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:
CO1 Understand Riemann Stieltjes integral, its properties and rectifiable curves.
CO2 Learn about pointwise and uniform convergence of sequence and series of functions and various tests for uniform convergence.
CO3 Find the stationary points and extreme values of implicit functions.
CO4 Be familiar with the chain rule, partial derivatives and concept of derivation in an open subset of R_n.

Section - I

Riemann-Stieltjes integral, Existence and properties, Integration and differentiation, The fundamental theorem of calculus, Integration of vector-valued functions, Rectifiable curves.

Section - II

Sequence and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weirstrass M test, Abel and Dirichlet tests for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation, Weierstrass approximation theorem.

Section - III

Power series, uniform convergence and uniqueness theorem, Abel theorem, Tauber theorem. Functions of several variables, Linear Transformations, Euclidean space R^n, Derivatives in an open subset of R^n, Chain Rule, Partial derivatives, Continuously Differentiable Mapping, Young and Schwarz theorems.

Section - IV

Taylor theorem, Higher order differentials, Explicit and implicit functions, Implicit function theorem, Inverse function theorem, Change of variables, Extreme values of explicit functions, Stationary values of implicit functions, Lagrange multipliers method, Jacobian and its properties.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1974.
3. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
4. G. De Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co. Pvt. Ltd, 1976.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.
7. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, New Delhi, 2012.

First Semester
Ordinary Differential Equations
Paper code: 20MAT21C3

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:
CO1 Apply differential equations to variety of problems in diversified fields of life.
CO2 Learn use of differential equations for modeling and solving real life problems.
CO3 Interpret the obtained solutions in terms of the physical quantities involved in the original problem under reference.
CO4 Use various methods of approximation to get qualitative information about the general behaviour of the solutions of various problems

Section - I

Preliminaries, ε-approximate solution, Cauchy-Euler construction of an ε-approximate solution of an initial value problem, Equicontinuous family of functions, Ascoli-Arzela Lemma, Cauchy-Peano existence theorem.
Lipschitz condition, Picards-Lindelof existence and uniqueness theorem for $dy/dt = f(t,y)$, Solution of initial-value problems by Picards method, Dependence of solutions on initial conditions ***(Relevant topics from the books by Coddington & Levinson, and Ross)***.

Section - II

Linear systems, Matrix method for homogeneous first order system of linear differential equations, Fundamental set of solutions, Fundamental matrix of solutions, Wronskian of solutions, Basic theory of the homogeneous linear system, Abel-Liouville formula, Non-homogeneous linear system.
Strum Theory, Self-adjoint equations of the second order, Abel formula, Strum Separation theorem, Strum Fundamental comparison theorem.
(Relevant topics from chapters 7 and 11 of book by Ross)

Section - III

Nonlinear differential systems, Phase plane, Path, Critical points, Autonomous systems, Isolated critical points, Path approaching a critical point, Path entering a critical point, Types of critical points- Center, Saddle points, Spiral points, Node points, Stability of critical points, Asymptotically stable points, Unstable points, Critical points and paths of linear systems. Almost linear systems. **(Relevant topics from chapter 13 of book by Ross)**.

Section - IV

Nonlinear conservative dynamical system, Dependence on a parameter, Liapunov direct method, Limit cycles, Periodic solutions, Bendixson nonexistence criterion, Poincore-Bendixson theorem(statement only), Index of a critical point.
Strum-Liouville problems, Orthogonality of characteristic functions. **(Relevant topics from chapters 12 and 13 of the book by Ross)**.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. E.A. Coddington and N. Levinson, *Theory of ordinary differential equations*, Tata McGraw Hill, 2000.
2. S.L. Ross, *Differential equations*, John Wiley and Sons Inc., New York, 1984.
3. W.E. Boyce and R.C. Diprima, E*lementary differential equations and boundary value problems*, John Wiley and Sons, Inc., New York, 4th edition, 1986.
4. G.F. Simmon, *Differential Equations*, Tata McGraw Hill, New Delhi, 1993.

First Semester
Complex Analysis
Paper code: 20MAT21C4

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:

CO1 **Be familiar with complex numbers and their geometrical interpretations.**
CO2 **Understand the concept of complex numbers as an extension of the real numbers.**
CO3 Represent the sum function of a power series as an analytic function.
CO4 Demonstrate the ideas of complex differentiation and integration for solving related problems and establishing theoretical results.
CO5 Understand concept of residues, evaluate contour integrals and solve polynomial equations.

Section - I
Function of a complex variable, Continuity, Differentiability, Analytic functions and their properties, Cauchy-Riemann equations in cartesian and polar coordinates, Power series, Radius of convergence, Differentiability of sum function of a power series, Branches of many valued functions with special reference to argz, logz and z^a.

Section - II
Path in a region, Contour, Complex integration, Cauchy theorem, Cauchy integral formula, Extension of Cauchy integral formula for multiple connected domain, Poisson integral formula, Higher order derivatives, Complex integral as a function of its upper limit, Morera theorem, Cauchy inequality, Liouville theorem, Taylor theorem.

Section - III
Zeros of an analytic function, Laurent series, Isolated singularities, Cassorati-Weierstrass theorem, Limit point of zeros and poles. Maximum modulus principle, Schwarz lemma, Meromorphic functions, Argument principle, Rouche theorem, Fundamental theorem of algebra, Inverse function theorem.

Section - IV
Calculus of residues, Cauchy residue theorem, Evaluation of integrals of the types $\int_0^{2\pi} f(\cos\theta,\sin\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)dx$, $\int_0^{\infty} f(x)\sin mx\,dx$ and $\int_0^{\infty} f(x)\cos mx\,dx$, Conformal mappings.
Space of analytic functions and their completeness, Hurwitz theorem, Montel theorem, Riemann mapping theorem.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of One Complex Variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 2002.
3. Liang-Shin Hann & Bernand Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.

4. E.T. Copson, An Introduction to the Theory of Functions of a Complex Variable, Oxford University Press, London, 1972.
5. E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
6. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2009.
7. H.S. Kasana, Complex Variable Theory and Applications, PHI Learning Private Ltd, 2011.
8. Dennis G. Zill and Patrik D. Shanahan, A First Course in Complex Analysis with Applications, John Bartlett Publication, 2nd Edition, 2010.

MASTER OF SCIENCE (MATHAMATICS)
First Semester
Mathematical Statistics
Paper code: 20MAT21C5

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:
CO1 Understand the mathematical basis of probability and its applications in various fields of life.
CO2 Use and apply the concepts of probability mass/density functions for the problems involving single/bivariate random variables.
CO3 Have competence in practically applying the discrete and continuous probability distributions along with their properties.
CO4 Decide as to which test of significance is to be applied for any given large sample problem.

Section - I

Probability: Definition and various approaches of probability, Addition theorem, Boole inequality, Conditional probability and multiplication theorem, Independent events, Mutual and pairwise independence of events, Bayes theorem and its applications.

Section - II

Random variable and probability functions: Definition and properties of random variables, Discrete and continuous random variables, Probability mass and density functions, Distribution function. Concepts of bivariate random variable: joint, marginal and conditional distributions.
Mathematical expectation: Definition and its properties. Variance, Covariance, Moment generating function- Definitions and their properties.

Section - III

Discrete distributions: Uniform, Bernoulli, Binomial, Poisson and Geometric distributions with their properties.
Continuous distributions: Uniform, Exponential and Normal distributions with their properties.

Section - IV

Testing of hypothesis: Parameter and statistic, Sampling distribution and standard error of estimate, Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Two types of errors.
Tests of significance: Large sample tests for single mean, Single proportion, Difference between two means and two proportions.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books recommended :

1. V. Hogg and T. Craig, Introduction to Mathematical Statistics , 7^{th} addition, Pearson Education Limited-2014
2. A.M. Mood, F.A. Graybill, and D.C. Boes, Introduction to the Theory of Statistics, Mc Graw Hill Book Company.
3. J.E. Freund, Mathematical Statistics, Prentice Hall of India.
4. M. Speigel, Probability and Statistics, Schaum Outline Series.
5. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.

Second Semester
Theory of Field Extensions
Paper code: 20MAT22C1

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:
CO1 Use diverse properties of field extensions in various areas.
CO2 Establish the connection between the concept of field extensions and Galois theory.
CO3 Describe the concept of automorphism, monomorphism and their linear independence in field theory.
CO4 Compute the Galois group for several classical situations.
CO5 Solve polynomial equations by radicals along with the understanding of ruler and compass constructions.

Section - I

Extension of fields: Elementary properties, Simple Extensions, Algebraic and transcendental Extensions. Factorization of polynomials, Splitting fields, Algebraically closed fields, Separable extensions, Perfect fields.

Section - II

Galios theory: Automorphism of fields, Monomorphisms and their linear independence, Fixed fields, Normal extensions, Normal closure of an extension, The fundamental theorem of Galois theory, Norms and traces.

Section - III

Normal basis, Galios fields, Cyclotomic extensions, Cyclotomic polynomials, Cyclotomic extensions of rational number field, Cyclic extension, Wedderburn theorem.

Section - IV

Ruler and compasses construction, Solutions by radicals, Extension by radicals, Generic polynomial, Algebraically independent sets, Insolvability of the general polynomial of degree $n \geq 5$ by radicals.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended :

1. I.S. Luther and I.B.S.Passi, Algebra, Vol. IV-Field Theory, Narosa Publishing House, 2012.
2. Ian Stewart, Galios Theory, Chapman and Hall/CRC, 2004.
3. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
5. S. Lang, Algebra, 3rd editioin, Addison-Wesley, 1993.
6. Ian T. Adamson, Introduction to Field Theory, Cambridge University Press, 1982.
7. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

Second Semester
Measure and Integration Theory
Paper code: 20MAT22C2

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes

Students would be able to:

CO1 Describe the shortcomings of Riemann integral and benefits of Lebesgue integral.
CO2 Understand the fundamental concept of measure and Lebesgue measure.
CO3 Learn about the differentiation of monotonic function, indefinite integral, use of the fundamental theorem of calculus.

Section - I

Set functions, Intuitive idea of measure, Elementary properties of measure, Measurable sets and their fundamental properties. Lebesgue measure of a set of real numbers, Algebra of measurable sets, Borel set, Equivalent formulation of measurable sets in terms of open, Closed, F_σ and G_δ sets, Non measurable sets.

Section - II

Measurable functions and their equivalent formulations. Properties of measurable functions. Approximation of a measurable function by a sequence of simple functions, Measurable functions as nearly continuous functions, Egoroff theorem, Lusin theorem, Convergence in measure and F. Riesz theorem. Almost uniform convergence.

Section - III

Shortcomings of Riemann Integral, Lebesgue Integral of a bounded function over a set of finite measure and its properties. Lebesgue integral as a generalization of Riemann integral, Bounded convergence theorem, Lebesgue theorem regarding points of discontinuities of Riemann integrable functions, Integral of non-negative functions, Fatou Lemma, Monotone convergence theorem, General Lebesgue Integral, Lebesgue convergence theorem.

Section - IV

Vitali covering lemma, Differentiation of monotonic functions, Function of bounded variation and its representation as difference of monotonic functions, Differentiation of indefinite integral, Fundamental theorem of calculus, Absolutely continuous functions and their properties.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended :

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
3. P. K. Jain and V. P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986.
4. G.De Barra, Measure Theory and Integration, Wiley Eastern Ltd., 1981.
5. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co. Pvt. Ltd, 1976.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.

Second Semester
Integral Equations and Calculus of Variations
Paper code: 20MAT22C3

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes
Students would be able to:
CO1 Understand the methods to reduce Initial value problems associated with linear differential equations to various integral equations.
CO2 Categorise and solve different integral equations using various techniques.
CO3 Describe importance of Green's function method for solving boundary value problems associated with non-homogeneous ordinary and partial differential equations, especially the Sturm-Liouville boundary value problems.
CO4 Learn methods to solve various mathematical and physical problems using variational techniques.

Section - I

Linear Integral equations, Some basic identities, Initial value problems reduced to Volterra integral equations, Methods of successive substitution and successive approximation to solve Volterra integral equations of second kind, Iterated kernels and Neumann series for Volterra equations. Resolvent kernel as a series. Laplace transform method for a difference kernel. Solution of a Volterra integral equation of the first kind.

Section - II

Boundary value problems reduced to Fredholm integral equations, Methods of successive approximation and successive substitution to solve Fredholm equations of second kind, Iterated kernels and Neumann series for Fredholm equations. Resolvent kernel as a sum of series. Fredholm resolvent kernel as a ratio of two series. Fredholm equations with separable kernels. Approximation of a kernel by a separable kernel, Fredholm Alternative, Non homonogenous Fredholm equations with degenerate kernels.

Section - III

Green function, Use of method of variation of parameters to construct the Green function for a nonhomogeneous linear second order boundary value problem, Basic four properties of the Green function, Alternate procedure for construction of the Green function by using its basic four properties. Reduction of a boundary value problem to a Fredholm integral equation with kernel as Green function, Hilbert-Schmidt theory for symmetric kernels.

Section - IV

Motivating problems of calculus of variations, Shortest distance, Minimum surface of resolution, Brachistochrone problem, Isoperimetric problem, Geodesic. Fundamental lemma of calculus of variations, Euler equation for one dependant function and its generalization to 'n' dependant functions and to higher order derivatives. Conditional extremum under geometric constraints and under integral constraints.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:

1. A.J. Jerri, I*ntroduction to Integral Equations with Applications, A* Wiley-Interscience Publication, 1999.
2. R.P. Kanwal, L*inear Integral Equations,* Theory and Techniques, Academic Press, New York.
3. W.V. Lovitt, L*inear Integral Equations*, McGraw Hill, New York.
4. F.B. Hilderbrand, M*ethods of Applied Mathematics*, Dover Publications.
5. J.M. Gelfand and S.V. Fomin, C*alculus of Variations*, Prentice Hall, New Jersy, 1963.

Second Semester
Partial Differential Equations
Paper code: 20MAT22C4

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes

Students would be able to:

CO1 Establish a fundamental familiarity with partial differential equations and their applications.
CO2 **Distinguish between linear and nonlinear partial differential equations.**
CO3 Solve boundary value problems related to Laplace, heat and wave equations by various methods.
CO4 Use Green's function method to solve partial differential equations.
CO5 Find complete integrals of Non-linear first order partial differential equations.

Section – I
Method of separation of variables to solve Boundary Value Problems (B.V.P.) associated with one dimensional heat equation. Steady state temperature in a rectangular plate, Circular disc, Semi-infinite plate. The heat equation in semi-infinite and infinite regions. Solution of three dimensional Laplace equations, Heat Equations, Wave Equations in cartesian, cylindrical and spherical coordinates. Method of separation of variables to solve B.V.P. associated with motion of a vibrating string. Solution of wave equation for semi-infinite and infinite strings. (Relevant topics from the book by O'Neil)

Section -II
Partial differential equations: Examples of PDE classification. Transport equation – Initial value problem. Non-homogeneous equations.
Laplaceequation – Fundamental solution, Mean value formula, Properties of harmonic functions, Greenfunction.

Section - III
Heat Equation – Fundamental solution, Mean value formula, Properties of solutions, Energy methods.
Wave Equation – Solution by spherical means, Non-homogeneous equations, Energy methods.

Section -IV
Non-linear first order PDE – Complete integrals, Envelopes, Characteristics, Hamilton Jacobi equations (Calculus of variations, Hamilton ODE, Legendre transform, Hopf-Lax formula, Weak solutions, Uniqueness).

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books Recommended:
I.N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, New York.
Peter V. O'Neil, Advanced Engineering Mathematics, ITP.
L.C. Evans, Partial Differential Equations: Second Edition (Graduate Studies in Mathematics) 2nd Edition, American Mathematical Society, 2010.
H.F. Weinberger, A First Course in Partial Differential Equations, John Wiley & Sons, 1965.
M.D. Raisinghania, Advanced Differential equations, S. Chand & Co.

Second Semester
Operations Research Techniques
Paper code: 20MAT22C5

M. Marks = 100
Term End Examination = 80
Assignment = 20
Time = 3 hrs

Course Outcomes

Students would be able to:

CO1 Identify and develop operations research model describing a real life problem.
CO2 Understand the mathematical tools that are needed to solve various optimization problems.
CO3 Solve various linear programming, transportation, assignment, queuing, inventory and game problems related to real life.

Section - I

Operations Research: Origin, Definition and scope.

Linear Programming: Formulation and solution of linear programming problems by graphical and simplex methods, Big - M and two-phase methods, Degeneracy, Duality in linear programming.

Section - II

Transportation Problems: Basic feasible solutions, Optimum solution by stepping stone and modified distribution methods, Unbalanced and degenerate problems, Transhipment problem. Assignment problems: Hungarian method, Unbalanced problem, Case of maximization, Travelling salesman and crew assignment problems.

Section - III

Concepts of stochastic processes, Poisson process, Birth-death process, Queuing models: Basic components of a queuing system, Steady-state solution of Markovian queuing models with single and multiple servers (M/M/1. M/M/C, M/M/1/k, M/MC/k)

Section - IV

Inventory control models: Economic order quantity(EOQ) model with uniform demand, EOQ when shortages are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

Game Theory : Two person zero sum game, Game with saddle points, The rule of dominance; Algebric, Graphical and linear programming methods for solving mixed strategy games.

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus.

Books recommended :

1. H.A. Taha, Operation Research-An introducton, Printice Hall of India.
2. P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.
3. S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications.
4. J.K. Sharma, Mathematical Model in Operation Research, Tata McGraw Hill.

Second Semester
(Foundation Elective Paper)
MORAL EDUCATION
Paper Code:20GENF1

Total Marks: 50
External Marks: 40
Internal Marks: 10
Time: 02 Hours

Instructions

There will be a total of five questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. The students will be required to attempt one question from each unit. The students will attempt three questions in all.

UNIT I

Guiding principles for life

Ethics

a. Guidelines set by society
b. Changes according time and place

Morals

c. Guidelines given by the conscience
d. Always constant

Ethics in the workplace

a. Respect for each other
b. Obedience to the organization
c. Dignity of labour
d. Excellence in action

UNIT II

Concept of Trusteeship

a. Everything belongs to society
b. Man is only a caretaker
c. Our responsibility to ensure welfare of all

Importance of service

a. Responsibility of an individual
b. Man is only a caretaker
c Our responsibility to ensure welfare of all

Second Semester
MEDIA AND SOCIETY
Paper Code 20JRM01

Time Allowed 3 hrs

Max. Marks 100
Theory Marks 80
Assignment 20

UNIT I

1. Media Definition
2. Relationship of Media in Society
3. Impact of Media on society – recent trends
4. Media and Social Development

UNIT II

1. Media Literacy
2. Impact of Media on children and youth
3. Media and gender issues
4. Media and Rural Society

UNIT III

1. Media and Violence
2. Media and Rising Crime
3. Media and Democracy
4. Media and development of Scientific temperament
5. Media and environmental issues

UNIT IV

1. Media Accountability.
2. Media and Economic development
3. Media and Nation Building
4. Popular culture and media