Jagannath University
Dhaka, Bangladesh

Department of Mathematics

SYLLABUS FOR M. PHIL./ PH. D. DEGREE

Session: 2019-2020 and onwards

M. PHIL. / PH. D. COURSE IN APPLIED/PURE MATHEMATICS

Published by

Department of Mathematics

Jagannath University
Dhaka, Bangladesh.

COURSES OF STUDIES
Marks & Credits Distribution

Course Code	Course Title	Marks	Credits
MTH-6401	Optimization Techniques	100	4.00
MTH-6402	Fluid Dynamics	100	4.00
MTH-6403	Similarity Analysis	100	4.00
MTH-6404	Special Function and Integral Transform-I	100	4.00
MTH-6405	Special Function and Integral Transform-II	100	4.00
MTH-6406	Perturbation and Approximation Theory	100	4.00
MTH - 6407	Advanced Quantum Mechanics	100	4.00
MTH - 6408	Advanced Matrix Theory	100	4.00
MTH- 6409	Partial Differential Equations	100	4.00
MTH - 6410	Advanced Numerical Methods	100	4.00
MTH-6411	Computational Fluid Dynamics	100	4.00
MTH-6412	Magneto-hydrodynamics	100	4.00
MTH-6413	Numerical Heat Transfer and Fluid Flows	100	4.00
MTH-6414	Dynamical Systems	100	4.00
MTH-6415	Lattice Theory	100	4.00
MTH- 6416	Graph Theory	100	4.00
MTH- 6417	Theory of Rings	100	4.00
MTH- 6418	Control Theory	100	4.00
MTHV-6419	Viva-Voce	50	2.0

Detailed Syllabus

MTH-6401: Optimization Techniques
Credit hour-4.00

1. Introduction to optimization;
2. Advance Linear programming;
3. Network Models; Transportation problem;
4. Nonlinear programming;
5. Multi-Objective Decision Making;
6. Decision Making Under Uncertainty;
7. Introduction to Simulation Modeling;
8. Simulation Models; Inventory Models; Queuing Models;
9. Dynamic programming; Stochastic programming;
10. Game theory.

Reference Books:

1. Practical Management Science, Wayne L Winston, S. Christian Albright & Mark Broadie.
2. An Introduction to Mangement Science, Anderson, Sweeney, Williams.
3. Operations Research, Macmillan publishing company, Hamdy. A. Taha .
4. Operations Research, John Wiley and Sons, A. Rabindran, D. T. Phillips, J. J. Solberg.

MTH-6402: Fluid Dynamics
Credit hour-4.00

1. Derivation and Properties of Navier-Stokes equations;
2. Two Dimensional Boundary layer equations;
3. Displacement, momentum and energy thickness for two dimensional flows; Vonmisses transformation.
4. Derivation of Energe equation and thermal boundary Lager equation,
5. Similarity solutions of boundary layer equations.
6. Unsteady flows;
7. Boundary layer flow over a flat plate, boundary layer flow with pressure gradient; Approximate solutions of boundary layer equations, including Von-Kerman's method;
8. Stability theory; Basic concepts of stability theory; Stability of Quette's flow; Stability of flow between two parallel plates
9. Rayleigh Taylor instability; Kelvin-Helmholtz instability;
10. Turbulence; Reynold's stresses and basic equation for turbulent flows, Prandtl mixing length theory, some simple turbulent flows, homogeneous turbulence, spectral theory of homogeneous turbulence;
11. Non-Newtonian fluid flows; Riener-Rivlin fluids; power law fluids; flows in ells fluids; flow in Binghan plastics, Visco-Elastic flows, general visco elastic fluid flows.

Reference Books:

1. Boundary layer Theory, Schlichting, H.
2. Fundamentals Mechanics of Fluids, I.G. Currie
3. Heat and Mass Transfer, Yunus A. Cengel
4. Viscous fluid flow, F.M. White.
5. Fluid Dynamics, M. D. Raisinghania
6. Foundations of Boundary Layer Theory for Momentum, Heat, and Mass Transfer by Joseph A. Schetz.
7. Mathematical Models in Boundary Models in Boundary Layer Theory (Applied Mathematics) by O.A. Oleinik and V.N. Samokhin.

MTH-6403: Similarity Analysis
Credit hour-4.00

1. Principle and illustrations of dimensional analysis, systematic calculation of dimensionless products, algebraic theory of dimensional analysis, different procedures, (Rayleigh; Buckingham pie-theorem, stepwise, echelon, proportionalities etc.) for the determination of dimensionless groups and its behaviour for some boundary value problems;
2. Method of Similitude and introduction to fractional analysis of overall equations, a free parameter method for similarity solution applied to two dimensional boundary layer flows, method of separation of variables, similarity requirements for three dimension.
3. Axisymmetric velocity and thermal boundary layer laminar flows (both steady and unsteady),
4. Group theory method, absorption of parameters and natural co-ordinates in similarity variables,
5. Reduction of independent variables, similarity and natural co-ordinates on linearised compressible flow,
6. Supersonic and transonic similarity rules.
7. Karman similarity criteria for turbulent shear layers.

Reference Books:

1. Similarity analyses of boundary value problems in Engineering, G. Hansen.
2. Similarity analysis, Md. Zakerullah.

MTH-6404: Special Function and Integral Transform-I
Credit hour-4.00

1. Gamma and Beta Functions: Properties of gamma function, Continuity and convergence of gamma and beta functions, integral form of $\Gamma(z)$,Asymptotic Representation of Gamma function for Large $|z|$;
2. Elliptic Integral and Elliptic Functions; Reduction of elliptic integrals to standard form, properties of Elliptic function addition formulae, periods of elliptic function.
3. Probability integral and related functions;
4. Application to the theory of heat conduction and to the theory of vibration;
5. Generating function of the Hermite and Laguerre polynomials; recurrence relations, the differential equation and the integral equation satisfied by the polynomials; Integral representations, orthogonality and Laguerre polynomials
6. Hypergoemetric functions, its linear and quadratic transformations; The confluent hypergeometric function, its integral and asymptotic representation; Representation of various functions in terms of Hypergeometric and the confluent Hypergeometric functions;
7. Hermite functions; Matheus functions and the Dirac Delta functions; The minkuiski Temple;
8. Theory of generalized function; Schwartz's theory of distribution.

Reference Books:

1. Special Function, Lebedev.

MTH-6405: Special Function and Integral Transform-II
Credit hour-4.00

1. Green's function and its applications.
2. Fourier integral theorem and Fourier transforms. Multiple fourier transforms. Fourier transforms of radially symmetric functions. The solutions of integral equations of convolution type.
3. Use of Fourier transforms in solving Laplace's equation, diffusion equations and wave equations. The double Laplace transform, the iterated Laplace transform,
4. The Stieltjes transform and the Hankel transform. The perseval relation for Hankel transform and the relation between Fourier and Hankel transforms. Use of Hankel transforms in solving partial differential equations.

Reference Books:

1. Special Function, Lebedev.

MTH-6406: Perturbation and Approximation Theory
Credit hour-4.00

1. The nature of perturbation theory, some regular perturbation problems, the technique of perturbation theory, some singular perturbation in sirofoil theory,
2. Method of matched asymptotic expansion, the method of strained co-ordinates in viscous flow at high Reynolds number, some inviscid single perturbation problems, aspect of perturbation theory.
3. New classes of information by approximation theory,
4. Classification of problems and difficulties in approximation theory,
5. Analysis of the condition for approximation theory.

Reference Books:

1. Perturbation Theory, Nafeh

MTH - 6407: Advanced Quantum Mechanics
Credit hour-4.00

1. Representations of the quantum conditions, development of Schrödinger equation,
2. Approximate Methods for stationary and time dependent of Schrödinger equation.
3. Perturbation theory,
4. The Bohr Approximation. The variation Method, Inelastic collisions, Adiabatic and sudden approximation.
5. Theory of Radiation; Connection between Bosons and Oscillators, Emission and absorption of Bosons, Application to photons,
6. The interaction energy between photon and an atom. Emission, Absorption and scattering of radiation's, assembly of fermions;

7. Relativistic theory of the Electron: Relativistic treatment of a particle, the wave equation for the electron, Invariance under Lorenz's transformation, the motion of a free electron, existence of the spin, the fine structure of the Energy levels of Hydrogen, theory of positrons.
8. Quantum Electrodynamics; The Electromagnetic field in the absence of matter, Relativistic form of the quantum conditions, the Schrödinger dynamic variables, the supplementary conditions, electron and position, difficulties of the theory.

Reference Books:

1. B. H. Brarsdes & C. I . Joachain, Introduction to Quantum Mechanics.
2. Leonard I. Schiff, Quantum Mechanics.
3. David J. Griffiths, Introduction to Quantum Mechanics.
4. Gupta, Kumar, Sharma, Quantum Mechanics.

MTH - 6408: Advanced Matrix Theory
Credit hour-4.00

1. Matrix Operations: Direct sum of matrices, Kronecker product, Jordan product, Lie product, Khatri-Rao product, Vec operation and their properties.
2. Canonical Forms and Matrix Factorization: Jordan canonical form, Smith's canonical form, Full rank factorization, Shur's Triangularization, LU factorization, QR Factorization, Spectral decomposition. Norms and Measures of Matrices.
3. Matrix calculus: Matrix sequence, series and their convergence. Computation of matrix function by different methods; limit, continuity, differentiation of matrices. Solving ODE using matrix.
4. Generalized inverse of matrices: Classification and properties.
5. Different methods of computing generalized inverse of matrices: using property, Decell's method, Fedeev-Leverrier's method, Penrose method, Graybill-Meyer-Painter method, Drazin pseudoinverse, Moore-Penrose-Cline inverse, Urquhart computation of various inverses from (1) inverse.

Reference Books:

1. Hazra, A. K., Matrix : Algebra, Calculus and Generalized Inverse,
2. Ben-Israel, A. and Grevilla, T. N. E, Generalized Inverses: Theory and Applications.

MTH- 6409: Partial Differential Equations
Credit hour-4.00

1. Classification of PDE (parabolic, elliptic, hyperbolic), Existence, uniqueness and represention of solutions for the PDE (wave equation & heat equation).
2. Cauchy, Dirichlet and Neumann boundary-value problems for the Laplace and Poisson equation.
3. Potential theory in two and higher dimensional domains, initial and boundary value problems of heat equation and wave equation,
4. Maximum principle of parabolic equations;
5. Sturm-Liouville systems,
6. Boundary and eigenvalue problems, method of eigenfunction expansions.

Reference Books:

1. Tur Myirt U with Lokenath Debnath. Elsevier science Publication Co. Inc. Partial Differential Equations for Scientists and Engineers.
2. Prashad, P. and Ravindran, R. Partial Differential Equations,
3. Pinsky, M. A., Partial Differential Equations and Boundary Value Problems with Applications.

MTH - 6410: Advanced Numerical Methods
Credit hour-4.00

1. Richardson extrapolation of differentiation,
2. Romberg integration, Predictor-corrector methods,
3. Runge-Kutta Methods, Multistep methods (Adam Bashforth-Moulton method, Adams method for initial value problem, Milne-Simpson method);
4. Stability, time stability, stiffness. Hybrid (Gragg and Stetter, Butcher, Nordsieck) and extrapolation (Bulirsch and Stoer) methods for two point boundary value problem,
5. Linear shooting, shooting for nonlinear problems,
6. Finite difference methods for linear and nonlinear problems.
7. Systems of ODE, stiffness, A-stability, Gear's method.
8. Finite difference methods for Elliptic, Parabolic & Hyperbolic PDEs.

9. Pade′ Approximants. Algebraic and Differential Approximants. Approximate Solution of Linear Differential Equations. Approximate Solution of Nonlinear Differential Equations.
10. Asymptotic Expansion of Integrals. Perturbation Series. Summation of Series.
11. WKB Theory. Multiple Scale Analysis.
12. Keller Box methods. MAPLE and MATLAB.

Reference Books:

1. Balagurusamy, E., Numerical Methods
2. Smith, Numerical Solution of Partial Differential Equations.

MTH-6411: Computational Fluid Dynamics
Credit hour-4.00

1. Introduction to computational fluid dynamics (CFD), Application of computational fluid dynamics in investigating fluid flow phenomena for different geometry.
2. Grid generation and grid refinement technique
3. Conservation laws of fluid motion and boundary conditions
4. Discretization of the governing equations by finite difference method or finite element method, Mathematical modeling of governing equations by stream function
5. The finite volume method for diffusion problems
6. The finite volume method for convection-diffusion problems
7. Solutions algorithms for pressure-velocity coupling in steady flows
8. Vorticity method, Primitive variable method or stream function velocity method.
9. Methods for dealing with complex geometries
10. Use of the body-fitted boundary condition,
11. Boundary value and eigen vector in CFD. Error analysis and stability of numerical method. Convergent list and acceleration technique of convergence.
12. Development of numerical code using appropriate method. Practicing by CFD available soft ware to solve the governing equation.

Reference Books:

1. An Introduction to Computational Fluid Dynamics- H. K. Versteeg and W. Malalasekera
2. Computational Methods for Fluid Dynamics-Joel H. Ferziger and Milovan Peric
3. Computational Fluid Dynamics: Principles and applications, J. Blazek.
4. Computational Fluid Dynamics, J. F. Wendt and J. D. Anderson.

MTH-6412: Magneto-hydrodynamics
Credit hour-4.00

1. Electromagnetic equation; equations of fluid dynamics of viscous fluids;
2. MHD approximations, MHD equations, the important non-dimensional parameters of fluid dynamics and magneto-hydrodynamics;
3. MHD boundary layer assumptions, two dimensional flow, the MHD boundary layer equations for two dimensional flow in case of small magnetic Reynold's number,
4. MHD boundary layer equations for two dimensional flow in case of large magnetic Reynold's number,
5. Suction and injection, free and forced convection, the boundary layer equations of motion of MHD free convection flow;
6. Equations of motion of viscous incompressible flow through porous medium,
7. Boundary layer equations in rotating coordinates, boundary layer equations of MHD with Hall currents.

Reference Books:

1. An Introduction to Magnetohydrodynamics, Peter Alan Davidson.
2. Magnetohydrodynamics, S. I. Pai.

MTH-6413: Numerical Heat Transfer and Fluid Flows
Credit hour-4.00

1. Overview of the Numerical Methods and Mathematical model on physical phenomena.
2. Discretization methods: Nature of numerical Schemes and techniques for deriving the Discretization equations, Taylor-series formulation, method of Weighted residuals, Grid and Control Volumes formulation.
3. Steady One-dimensional conduction: Grid spacing, Interface-Related Quantities,Treatment of Boundary

   Conditions, Nonlinearity, Source-term linearization,Calculation of the Boundary Flux.
4. General Discretization Equation for unsteady one-dimensional conduction, Explicit, Crank-Nicolson and fully implicit schemes.

5. Solution of the Discretization Equations, Over-relaxation and Under-relaxation, Relative Dependent Variable, Treatment of Irregular Geometries,
6. Flow and Heat Transfer in Ducts, Developing and Fully Developed Duct Flows,
7. Steady One-dimensional convection and diffusion, Discretization equation for two dimensions, Pressure and velocity corrections, Pressure-correction equation, SIMPLE algorithm.
8. Mathematical Formulation of the Temperature Field, Prescribed Local Heat Flux, Two- and three-dimensional parabolic flow, partially parabolic flows, Developing flow in a curved pipe, Combined convection in a Horizontal tube and melting around a vertical pipe, A periodic fully developed duct flow
9. Duct Flow Adaptation.

Reference Books:

1. Numerical Heat Transfer and Fluid Flow--- by Suhas V. Patankar.
2. Heat Transfer---- by Necati Ozisik.
3. An Introduction to Computational Fluid Dynamics---by H. K. Versteeg and W Malalasekera

MTH-6414: Dynamical Systems
Credit hour-4.00

1. **Bifurcations:** Dynamics of the Quadratic Map, Orbit Analysis of Quadrate Families. The Saddle-Node Bifurcation, The period-Doubling Bifurcation, The Transition to Chaos, The Cantor Middle-Third Set, Generalizations of Cantor Sets, Orbit Diagram, The Period-Doubling Route to Chaos, Windows in the Orbit Diagram, Symmetric Bifurcations and related properties.
2. **Symbolic Dynamics and Chaotic Behavior:** Itineraries, The Sequence Space, Shift Map, Conjugacy,Three Properties of Chaos, Other Chaotic Systems, Manifestations of Chaos, Feigenbaum's Constant, Period 3 Implies Chaos, Sarkovskii's Theorem, The Period 3 Window, Sub-shifts of Finite Type, Chaotic Behaviors in Higher Dimensional Maps, Applications of Chaos in Mathematical and Other sciences.
3. **Schwarzian Derivatives, Newton's Iteration Functions Associated to Real Functions**
4. **Fractals:** The Chaos Game, The Cantor Set Revisited, The Sierpinski Triangle, The Koch Snowflake, Topological Dimension, Fractal Dimension, Iterated Function Systems.
5. **Mandelbrot and Julia Sets:** Dynamics behavior of complex quadratic maps. Relationship Mandelbrot and Julia sets and their mathematician Formulations, Chaotic behavior of complex quadratic and higher dimensional maps. Topological conjugacy for complex maps.
6. **Perron-Frobenious Operator:** Radon Nykodym Derivative, Probability Density Functions, Property of sequence i**n** $L^1(X)$**,** and $L^{\infty}(x)$ spaces, Perron-Frobenius Operator associated with Maps with n-Laps (MWnL).
7. **Population Dynamics:** Two-Species Population Models. A Simple Prey-Predator Model, Numerical Analysis of Prey-Predator Model, Competition Model & its Numerical Analysis, Mathematical Models in medical and Other Sciences. On the Study of Finding Various Mathematical Models.
8. **Computer Simulations of Physical Phenomena using Partial Differential Equations (like Transport & Diffusions Equations etc.) in Solids.**

Reference Books:

1. A First course in chaotic dynamical systems, R. L. Devaney, West view Press 1992.
2. Dynamical Systems with Graphical representations, Payer Ahmed
3. Introduction to modern theory of dynamical systems, A. Katok and B. hasselblatt, Cambridge University Press, Cambridge 1995.
4. A First course in discrete dynamical systems, R. A. Holmgren, Springer 1996.
5. Chaos: An Introduction to dynamical systems, K. L. Alligood, T. D. Sauer, J. A. Yorke 1990.
6. The Geometry of fractal set, K. Falconer, Cambridge University Press, Cambridge 1958.
7. A Tool Kits of Dynamical Activities, R. L. Devaney.

MTH-6415: Lattice Theory
Credit hour-4.00

1. Concepts of lattice, ideal and congruence, complemented lattice,
2. Homomorphism theorem, Modular and Distributive lattices, Atoms and irreducible elements,
3. Boolean lattices, Stone's Separation theorem. Characterization and representation theorem. Congruence in distributive lattices.
4. Boolean algebras, Algebraic lattice, Distributive lattice with pseudo complementation, Stone algebra, Representation theorem, Minimal

prime ideals, Semi-modular lattices, Distributive, standard and neutral elements, 1st and 2nd Isomorphism theorems.

Reference Books:

1. Lattice theory, G. Birkhoff
2. Lattice theory, First concepts and distributive lattices, G. Gratzer
3. General lattice theory, G. Gratzer
4. Lattice theory, First concepts, B. K. Khanna.

MTH- 6416: Graph Theory
Credit hour-4.00

1. **Graphs and Subgraphs:** Graphs and Simple graphs, The Incidence and Adjacency Matrices, Subgraphs, Vertex degrees, Paths and Connection, Cycles.
2. Trees and Forests:
3. **Connectivity:** Complementary graphs, Cut-vertices and Bridges, Blocks. Construction of Reliable Communication Networks.
4. Euler Tours and Hamilton Cycles: Euler Tours, Hamilton Cycles, The Chinese Postman Problem, The Travelling Saleman problem.
5. **Vertex Colourings:** Chromatic number, Chromatic Polynomials, Brooks Theorem, A Storage Problem,
6. Edge Colourings:Edge chromatic number, Vizing's theorem, The time tabling problem.
7. Matchings, Factorization and coverings: The personal assignment problem.
8. **Planar and nonplanar Graphs:** Euler's formula, Dual graphs, Characterization of planar graphs, The Five colour theorem and the Four colour conjecture. NonHamiltonian planar graphs.
9. Independent sets and Cliques: Independent sets, Ramsey's theorem, Turan's theorem, Schur's theorem.
10. **Directed Graphs:** Directed graphs, Directed paths and cycles, A job sequencing problem.
11. **Networks:** Flows, Cuts, The Max-flow Min-cut theorem, Manger's theorem.
12. **Tournaments:** Elementary properties of tournaments, Hamiltonian tournaments, Score sequences.

Reference Books:

1. J. A. Bondy and U.S.R. Murty, Graph Theory with Applications.
2. Mehdi Behzad, Gary Chartrand and Linda Lesniak Foster, Graphs and Digraphs.
3. John Clark and Derek Allan Holton, A First Look at Graph Theory.

MTH- 6417: Theory of Rings
Credit hour-4.00

1. Rings, Subrings, Ideals, Sum and Product of Ideals, Direct Sum and Product of Rings and Ideals.
2. Prime Ideals, Maximal Ideals, Principle Ideals.
3. Integral domains, Division Ring, Field, Quotient Ring/Factor Ring.
4. Homomorphism and Isomorphism of Rings, Isomorphism Theorems.
5. Characteristics of Rings.
6. Polynomial Rings, Division Algorithm, Irreducibility Criterion for Polynomials, Prime Elements, Principal Ideal Domains, Euclidian Domains, Unique Factorization Domains.
7. Extension Field, Algebraic Extensions, Splitting Fields, Wedderburn's Theorem.
8. Noetherian Rings, Artinian Rings, Gamma Rings, Fuzzy Rings.

Reference Books

1. Introduction to Abstract Algebra, second edition, J Wiley 1999- W.K. Nicholson.
2. Introduction to Modern Algebra- Neal H Mecoy.
3. Abstract Algebra- Hiram Paley and P.M. Weichsel.
4. Basic Abstract Algebra, 2nd Edition- P.B. Bhattachary, J.K. Jain, S.R. NagPaul.
5. Algebra- M. Artin..

MTH-6418: Control Theory
100 Marks: 04 Credits

Optimal Control:
Optimization techniques: basic optimal control problems; definition and problem formulation of optimal control; Hamiltonian; dynamic programming; applications and examples.
Functional analysis: Convex and non-convex functions; Lipschitz continuity; algebra and sigma-algebra; measure theory.
Calculus of Variations: Variational techniques; the fundamental lemma of the calculus of variations; some examples; Lagrange multipliers; adjoint variables; Pontryagin maximum principle; necessary conditions of optimality.

Systems Theory:
Modeling with differential equations: Analytical solution; Laplace transform; numerical solution; simulation.
Variational calculus: Euler–Lagrange equation; applications and examples; multivariable calculus; gradient and Hessian matrix; dynamical systems; objective functions; state and control variables; optimal trajectories; Lagrange multipliers techniques.

Modern Control Theory:
The histories and analysis of dynamical systems; vector and matrix analysis; Kronecker product; transition matrix; method of differential; State equation; Lyapunov equation; Lyapunov stability; optimal control; properties of Riccati equations; Newton's method for solving nonlinear matrix equations; Schur method; Stability for continuous-time systems; stability for the discrete-time system; design of controller via state feedback and simulation experiment.

Applications:
Some academic examples: Formation of the problems; write down the Hamiltonian; solutions for optimal state and control trajectories; Bang-bang control; singular control; examples.
Applications in biology: Epidemic model; SIR model; SEIR model; HIV model; cancer model; glucose model; Applications to biology-fish harvesting model; bacteria model; timber harvesting model.
Some real-life problems: renewable resource management; applications to process management and economics; applications to environmental systems and ecological models; other engineering applications.

Evaluation:
Final exam (Theory, 4 hours): 60 marks. Eight questions will be set (each question contains equal value), of which five are to be answered. 30 marks for midterms and 10 marks for class attendance.

Text/Reference Books

1. Mostak Ahmed, H_∞-Constrained Dynamic Games for Linear Stochastic Systems with Multiple Decision Makers, PhD Thesis, Hiroshima University, Japan, 2018.
2. M. H. A. Biswas, Necessary Conditions for Optimal Control Problems with State Constraints: Theory and Applications, PhD Thesis, University of Porto, Portugal, 2013
3. Richard Vinter, Optimal Control, Birkhauser, Boston, 2000.
4. Suzanne Lenhart and John T. Workman, Optimal Control Applied to Biological Models, Chapman and Hall/CRC, 2007.
5. Francis Clarke, Functional Analysis, Calculus of Variations and Optimal Control, Springer, 2013.
6. Enid R. Pinch, "Optimal Control and the Calculus of Variations", Oxford University Press Inc., New York, 1993.
7. M. Gelfand and S. V. Fomin, "Calculus of Variations", Dover Publications Inc., New York, 1963.

MTHV- 6419: Viva-Voce
2.0 Credits (50 Marks)

JAGANNATH UNIVERSITY
RULES AND REGULATIONS FOR THE DEGREE OF MASTER OF PHILOSOPHY (M. Phil.)

1. NATURE OF DEGREE:

The degree of Master of Philosophy (M. Phil.) shall be awarded by this University in recognition of the successful completion of the M. Phil. Courses of Studies and Research as prescribed by the Academic Council. The terms and conditions regarding admission, examination, evaluation and other matters relating to the M. Phil. degree shall be prescribed by the rules & regulations enacted by the Academic Council and Syndicate.

2. QUALIFICATIONS FOR ADMISSION:

Candidates for admission to the courses of studies leading to M. Phil. degree must have the following qualifications:

(a) Candidates must possess Master's Degree or an equivalent degree of this University or of a recognized University in the relevant subject or in a related subject. Graduate (Honours) and Post-Graduate level candidates having minimum 50% marks in relevant and related subjects and in grading system candidates having at least CGPA 3.25 (out of 4 scale point) in both levels shall be eligible for admission.

OR

A candidate who does not have Graduate (Honours) degree shall be eligible for admission to the M. Phil. Program provided that he/she has to his/her credit either a first division or CGPA 3.50 in the Degree Pass examination or a first class or CGPA 3.50 (Out of 4.00 scale point) in the Master's Degree.

OR

Candidates having MBBS degree with 55% marks or CGPA 3.25 (Out of 4.00 scale point) shall be eligible for admission to the M. Phil. Program.

OR

Regular teachers/officers (having requisite qualification) of Jagannath University shall be eligible for admission to the M.Phil. Program.

(b) Candidates having 3rd division in either SSC/HSC/equivalent level shall not be eligible for admission to the M. Phil. Program. This condition may however, be relaxed in case of a candidate having first class both in Graduate (Honours) and Post Graduate level or CGPA 3.50 and having an outstanding contribution in the field of his/her research interest.

3. ADMISSION:

(a) Applicants for admission to the M.Phil. Program shall apply in the prescribed form to the Registrar through the Department concerned and the relevant Faculty. The Academic Committee of the Department shall recommend the admission and approve the proposed field of study, the title of the thesis and the name of the supervisor(s).

(b) The candidate must submit his/her research proposal recommended by the Supervisor(s) to the Chairman of the Department. On approval of the relevant Academic Committee and the Faculty, it shall be placed before the Board of Advanced Studies and the Academic Council for final approval.

(c) Application for admission to the M.Phil. program will be invited once in a year. Teachers of this university who are eligible for admission to the M.Phil. program may however submit their applications at any time of the year for consideration.

(d) Any change of the Supervisor(s) or the Title of dissertation shall have to be recommended by the Academic Committee of the concerned Department and the Faculty and approved by the Board of Advanced Studies and the Academic Council.

4. REGISTRATION/ID:

A candidate selected for admission to the Course of the Degree of Master of Philosophy must be registered for M.Phil. course of this University on payment of approved fees. He will get a unique identification number (ID).

(a) Fees: Fees will be fixed as may be deemed fit by the authority from time to time. But the previous fees will be in force so long the new rate of fees will be fixed up by the authority.

(b) In the second year, fees are due to be paid off within one month from the date of publication of the result of the M.Phil. course work examination.

(c) The registration of a candidate for the M. Phil. degree shall be valid for 03 (three) academic years. The registration shall automatically be cancelled if the candidate fails to submit his/her thesis within three years from the date of his/her registration. Academic Council may extend this period for one more academic year on the recommendation of the supervisor(s) and the Academic Committee of the concerned Department. In any special situations, the Academic Council may allow another maximum 4 (four) months only for submission of the thesis. A candidate, however, shall not be permitted to submit his/her thesis before two years from the date of his/her registration.

5. COURSE OF STUDIES:

(a) Candidates admitted to the M.Phil. course shall be full time students of this University. Candidates serving in any other organizations/institutions shall be required to take leave for at least one year at the time of joining the M.Phil. course. Joining letter will not be accepted without the submission of leave document.

(b) The courses of studies shall be designed and conducted including the examinations by a 'Faculty Committee' consisting of Dean (as chairman) and Chairmen (as members) of the departments under the concerned faculties. Chairman of any department may nominate any teacher not below the rank of

Association Professor as a member of the Faculty Committee. The syllabus shall be recommended by the concerned Executive Committee of the Faculty and the Academic Council.

(c) The duration of the M.Phil. course work shall be one academic year (July to June). Distribution of weeks of one academic year shall be as follows:

(i) Class teaching (actual class) = 25 weeks
(ii) Preparation time for examination = 06 weeks
(iii) Final Examination = 05 weeks
Total = 36 weeks

(d) A student admitted to the M. Phil. course shall be required to complete his/her course works of 14 credits (350 marks of which 300 theoretical and 50 viva-voce by the end of the first year as a full time student. Each theoretical course shall be of 100 marks (04 credits) and viva-voce 50 marks (02 credits).

(e) There shall be at least two lecture-hour for each course in a week and ten academic task-hours in the whole year for open academic and research discussion. Therefore, in total, there shall be at least 15 (fifteen) contact hours for each theoretical credit point throughout the academic year.

(f) Students shall appear at the viva-voce examination (oral examination) at the end of 1st year (course work).

(g) A teacher/officer of this University may be allowed to pursue the M.Phil. course. In this case candidates shall be required to take leave for at least one year at the time of joining the M.Phil. course.

(h) Only a teacher of this University who has minimum 03 (three) years teaching experience at the University level may be exempted from taking the course work on recommendation of the Academic Committee of the concerned Department.

6. COURSE EXAMINATION:

(a) An M.Phil. student is required to fill in the examination entry form and pay the university dues within the time specified by concerned authority for appearing course final examination. The Dean of the faculty shall send these examination entry forms to the Controller of Examinations. At the end of course work, the Faculty Committee shall prepare the examination schedule and the chairman of the committee shall send it to the relevant departments and the Controller of Examinations for necessary action.

(b) The Faculty Committee shall recommend an Examination Committee for each academic year/batch. The Examination Committee shall be composed of 04 (four) members (one chairman, two internal members and one external member appointed from any other Public University not below the rank of professor). In case of any vacancy, absence or inability on the part of any one of the members of the examination committee, the examination work shall not be invalidated. If any member of the examination committee remains on any leave for more than 06 (six) months, the Academic Council shall appoint another member in his/her place on recommendation of the Faculty Committee of the concerned faculty.

(c) The internal members of the relevant examination committee shall send the names of the question setters and examiners for each theoretical course to the Controller of Examinations who shall issue appointment letters subject to the approval of the Vice-Chancellor.

(d) The Controller of Examinations shall supply the total answer scripts along with the supporting papers of the examination to the chairman of the Department concerned at least 03 days before the examination.

(e) The concerned examination committee shall arrange tabulation works. The tabulation works shall not begin until marks of all courses are received.

(f) The result shall be published within two months after the end of the last examination.

7. EVALUATION SYSTEM:

(a) The examination of each course shall be of 03 (three) hours duration.
(b) The total marks of course work shall be distributed as follows:

(i) Continuous Assessment	**Marks**
Mid-term/In course examination (minimum two)	= 20
Assignment/Case Study/Practical/Field work	= 10
Class Attendance	= 10
(ii) Final Examination (written)	= 60
Total	**= 100**

(c) Class Attendance*:* The marks allocated for class attendance shall be given as following proportions:

Attendance	**Marks**	**Example**
95% and above	100%	10 out of 10
90% to 94%	90%	9 out of 10
85% to 89%	80%	8 out of 10
80% to 84%	70%	7 out of 10
75% to 79%	60%	6 out of 10
70% to 74%	50%	5 out of 10
65% to 69%	40%	4 out of 10
60% to 64%	30%	3 out of 10
Less than 60%	00%	0 out of 10.

(d) There shall be two question setters and examiners (1st and 2nd) for each course. The arithmetic mean of the marks given by two examiners shall be taken as final. If the marks given by 1st and 2nd examiners differ by 20% or more, the examination committee shall recommend a 3rd examiner to examine the script(s). Re-examination of any script shall not be allowed.

(e) Total marks of the courses and oral (viva-voce) examination shall be converted into LG (Letter Grade) and GP (Grade Point) as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A+	3.75
70% to less than 75%	A–	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B+	3.00
55% to less than 60%	B–	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C+	2.25
40% to less than 45%	D+	2.00
Less than 40%	F+	0.00

(f) Each student requires to earn minimum GPA 2.75 to complete the M.Phil. course work. Students earning less than GPA 2.75 are required to earn minimum GPA 2.75 appearing at the course final examination with the next batch.

(g) For appearing at the examination with the next batch, a student shall have to pay two times of the normal examination fee

(h) If a student fails to earn required GPA i.e. total credit points within his/her registration period, he/she will be dropped out from the M.Phil. Program and will no more be allowed to continue his/her research work with other M.Phil. Students.

8. TRANSFER TO PH.D. PROGRAM:

A candidate registered for M.Phil. Degree may be transferred to the Ph.D. program with retrospective registration if he/she fulfills the following conditions:-

(a) He/She has to successfully complete the M.Phil. course work and earn minimumGPA 3.50.

(b) He/She has minimum 01 (one) research publication at his/her own credit in recognised Journal.

(c) He/She must give one transfer seminar in the field of his/her research interest leading to Ph.D. degree provided that the candidate has requisite academic qualification for admission to Ph.D. Degree program

(d) The candidate shall have to submit a synopsis of the Ph.D. program with the recommendation of the supervisor(s).

(e) The recommendation for transfer from M.Phil. to Ph.D. Program shall be sent by the Academic Committee of the concerned Department (along with relevant documents) through the Faculty to the Board of Advanced Studies and the Academic Council for the final approval.

9. SUPERVISION AND GUIDANCE:

(a) An M.Phil. student shall be required to perform his/her research work under the guidance of a supervisor(s) who shall be a teacher of a relevant Department of this University not below the rank of Assistant Professor having Ph.D. degree in the relevant field.

(b) No near relation, specified by the examination rule of this University shall be supervised or examined.

(c) The number of the research students of M.Phil. and Ph.D. program for an Associate Professor and Professor shall not exceed 06 (six) and 08 (eight) respectively at a time. An Assistant Professor shall not take more than 04 (four) M.Phil. research students at a time.

(d) An M.Phil. candidate shall be required to give at least one seminar open to all during the period of his/her research study to be designed and organized by the relevant Department. Seminar shall be given minimum three months before the submission of the thesis.

10. DISSERTATION:

(a) A candidate for the M.Phil Degree shall be required to submit a dissertation on his/her research work in accordance with the period allowed in clause 4(d) of the Rules & Regulations to the Controller of Examinations through his/her supervisor(s) and the relevant Department.

(b) The dissertation submitted for the M.Phil. degree shall be written in Bangla/English. In the case of Arabic and Islamic Studies if the thesis is written in Arabic, a Bangla or English version must be added.

(c) The dissertation shall be an original piece of investigation and a distinct contribution to the advancement of existing knowledge.

(d) Five copies of the dissertations shall have to be submitted to the Controller of Examinations on or before the date of the expiry of registration. Each dissertation must be type written/printed and bound.

11. EXAMINATION OF DISSERTATION:

(a) For each candidate, the Academic Council, on the recommendation of the concerned Academic Committee and Executive Committee of the Faculty, shall appoint an Examination Committee for every candidate of three members one of whom shall be the supervisor(s) of the student. One of the members of the examination committee other than the supervisor(s) shall be the Chairman of the examination committee. At least one of the members of the examination committee shall be from outside this university. In the case of joint supervision, the supervisor of the candidate shall be the member of the committee.

(b) Each dissertation shall be examined by all three members of the examination committee. The examiners shall send their reports in sealed cover to the Controller of Examinations who will send it to the Chairman of the Examination Committee with the permission of the Vice-Chancellor.

(c) On receipt of the unanimous opinion that the thesis is of standard that justifies an oral examination, the Chairman of the Examination Committee in consultation with the Controller of Examinations shall arrange an oral Examination for the candidate to defend his/her thesis. The Chairman of the Examination Committee shall preside over the oral Examination.

(d) If the opinion of the examiners is not in favour of awarding the degree, the Examination Committee on the basis of the reports of examiners shall decide either to reject the dissertation or may recommend the Vice Chancellor to allow the student to resubmit his/her thesis with necessary changes and modifications as suggested by the examiners within 06 (six) months from the date of notification by the Controller of Examinations. In such case further registration will not be necessary. The examination committee shall report their decision to the Controller of Examinations.

(e) In case a candidate is unable to satisfy the viva voce examination even though the thesis is adjudged adequate, the Examination Committee may recommend to the Academic Council that the candidate may be permitted to appear at another oral examination after a lapse of 06 (six) month from the first oral examination. Provided that no candidate shall be allowed to appear at the oral examination of the same thesis more than twice.

12. AWARD OF DEGREE:

(a) The Vice Chancellor shall place the reports of the examiners for consideration of the Academic Council which shall recommend to the syndicate for the award of the Degree

(b) The Controller of Examinations shall notify the results in accordance with the decision of the Syndicate.

13. ADDITION, Alteration, Change or Modification in the rules and regulations

In order to make any addition, alteration, change or modification in the rules and regulations (if required), it must be placed to the 'Departmental Academic Committee', 'Executive Committee' of the concerned Faculty and the 'Academic Council' for approval. If any difficulty arises with respect to any provision of this rules & regulations, the interpretation/decision given by the Vice-Chancellor shall be final.

JAGANNATH UNIVERSITY
RULES AND REGULATIONS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.)

1. NATURE OF DEGREE:

The degree of Doctor of Philosophy (Ph.D.) shall be awarded by the University in recognition of the successful completion of the Ph.D. program as prescribed by the Academic Council. The terms and conditions regarding admission, evaluation and other matters related to the Ph.D. degree shall be prescribed by the Rules & Regulations enacted by the Academic Council and Syndicate.

2. QUALIFICATIONS FOR ADMISSION:

A Candidate for admission to Ph.D. program shall satisfy the following conditions:

(i) Candidates must possess Master's Degree or an equivalent degree of this University or of a recognized University in the relevant subject or in a related subject, and

(ii) Graduate (Honours) and Post-Graduate level candidates having minimum 50% marks in any one and in another level minimum 55% for Science and 50% for Arts & Social Science in numerical system (traditional) and in grading system candidates having at least CGPA 3.25 (out of 4 scale point) in both levels, and

(iii) Candidate having minimum 03 (three) years teaching/research experience in any public University/Govt. Research Institute or 05 (five) years teaching experience in Graduate (Honours) and Post Graduate level in any Private University/College/ Institute or Research experience in any recognized research organization, and

(iv) Candidate having minimum 02 (two) publications in the field of their research interest in recognized academic journals shall be eligible for admission.

OR

Candidates having M.Phil./equivalent degree of this University or a recognized University shall be eligible for admission to the Ph.D. program.

OR

Teachers of this University who have not required marks/grade point (mentioned earlier) shall be eligible to apply for admission to the Ph.D. Program, provided that they have minimum 02 (two) years teaching and research experience in any Public University/Govt. College/Govt. Research Institute or 05 (five) years teaching experience in Bachelor with Graduate (Honours) and Post Graduate level in any private University/College/Institute or research experience in any recognized research organization and have also minimum 02 (two) publications in the field of their research interest in recognized academic journals.

(v) Candidates having 3rd class/division in any exam/degree shall not be eligible for admission for Ph.D. Program.

3. ADMISSION:

(a) Applicants for admission to the Ph.D. Program shall apply in the prescribed form to the Registrar through the Department concerned and the relevant Faculty. The Academic Committee of the Department shall recommend the admission and approve the proposed field of study, the title of the thesis and the name of the supervisor(s).

(b) The candidate must submit his/her research proposal recommended by the Supervisor(s) to the Chairman of the Department. On approval of the relevant Academic Committee and the Faculty, it shall be placed before the Board of Advanced Studies and the Academic Council for final approval.

(c) Application for admission to the Ph.D. program will be invited once in a year. Teachers/ Officers of this university who are eligible for admission to the Ph.D. program may, however, submit their applications at any time of the year for consideration.

(d) Any change of the Supervisor(s) or the Title of dissertation shall have to be recommended by the Academic Committee of the concerned Department and Executive Committee of the Faculty and approved by the Board of Advanced Studies and the Academic Council.

(e) Foreigners may submit their applications (along with research proposal, consent of the Supervisor(s) and other necessary documents) to the Registrar at any time of the year for consideration. The Registrar will send it to the relevant Department. On approval of the relevant Academic Committee and Executive Committee of the Faculty, it shall be placed before the Board of Advanced Studies and the Academic Council for final approval.

4. REGISTRATION/ID:

A candidate selected for admission to the Program of the Degree of Doctor of Philosophy must be registered for Ph.D. Program of this university on payment of approved fees. He will get a unique identification number (ID).

(a) Fees: Fees will be fixed as may be deemed fit by the authority from time to time. The previous fees will be in force so long the new rate of fees will be fixed up by the authority.

(b) The registration of a candidate for Ph.D. degree shall be valid for 05 (five) academic years. The registration shall automatically be cancelled if the candidate fails to submit his/her thesis within 05 (five) years from the date of his/her registration. The Academic Council may extend this period for one more academic year on the recommendation of the supervisor(s) and the Academic Committee of the concerned Department and the Faculty. In any special situations, the Academic Council may allow another maximum 6 (six) months only for submission of the thesis. A Candidate, however, shall not be permitted to submit his/her thesis before three years from the date of his/her registration.

(c) A Ph.D. candidate serving in any organization including the University shall be required to take permission from the concerned authority at the time of joining the Ph.D. program.

(d) An M.Phil. student of this University who has successfully completed the first year courses of studies for M.Phil program shall be eligible for transfer to the Ph.D. Program in accordance with the clause 8(a-e) of M.Phil rules & regulation of this University. A candidate who will be transferred from M.Phil to Ph.D. program shall be registered as a Ph.D. student on payment of prescribed fees and dues.

5. SUPERVISION AND GUIDANCE:

(a) A Ph.D. Candidate shall be required to perform his/her research work under the guidance of a supervisor(s) who shall be a teacher of this University not below the rank of Associate Professor or an expert of a reputed Research Institution. The supervisor(s) shall possess Ph.D. or equivalent degree in the concerned subject and have publications in the national and international Journals. This condition, however, shall not be applicable if the supervisor is a Professor of the University.

(b) A Ph.D. candidate shall be required to give at least two seminar open to all during the period of his/her research study to be designed an organized by the relevant Department. One seminar will be offered at the time of data collection/actual research and another shall be offered before 4 (four) months of submitting the thesis.

(c) The number of the research students of M.Phil and Ph.D. Program for an Associate Professor and Professor shall not exceed 06 (six) and 08 (eight) respectively at a time. After submission of the thesis by one candidate, one seat will be vacant for the supervision.

(d) No near relation, specified by the examination rule of this University shall be supervised or examined.

6. THESIS:

On completion of the research work the candidate shall submit of his/her thesis and shall comply with the following conditions:

(a) The thesis submitted for the degree of Ph.D. shall be written in Bangla/English. In the case of Arabic and Islamic Studies if the thesis is written in Arabic, a Bangla or English version must be added.

(b) The thesis shall be a piece of original research work. It should make a distinct contribution to the advancement of existing knowledge either by the discovery of new facts or fresh interpretation of known facts and theories.

(c) The thesis shall conform with standard research methodology usually followed in the discipline of research and satisfy the norms of literary presentation and be suitable for publication in recognized journals or in the form of book.

(d) A candidate may incorporate in his/her thesis contents of any work which he/she may have published on the subject, but he/she shall not submit his/her thesis, any work which has been approved any other University for any degree/prize etc.

(e) Five copies of the thesis shall have to be submitted to the Controller of Examinations on or before the date of the expiry of the registration. Each thesis must be type written/printed and bound.

7. EXAMINATION OF THESIS:

(a) For each candidate, the Academic Council on recommendation of the concerned Academic Committee and Executive Committee of the Faculty, shall appoint an Examination Committee of three members, one of whom shall be the supervisor(s) of the student, one shall be form outside the country and one from within the country but outside this University. In case of self supervision the academic committee will propose another names of examiners. One of the members of the Examination Committee other than the supervisor shall be the Chairman of the Examination Committee. All three members of Examination Committee shall examine the thesis. The thesis examiners shall send their reports in sealed cover to the Controller of Examinations who will send it to the Chairman of the Examination Committee. The unanimity of the members shall be bindings for awarding the degree of Ph.D.

(b) The Examiners may recommend that the thesis be accepted for the award of the Ph.D. degree or the thesis be rejected or that the thesis be allowed to be resubmitted.

(c) On receipt of the unanimous opinions that the thesis is of standard that justifies an oral examination, the Chairman of the Examination Committee in consultation with Controller of Examinations shall arrange an Oral Examination for the candidate to defend his/her thesis. The Viva Voce Examination may be conducted if two out of three members of the Committee are present. The Chairman of the Examination Committee shall preside over the oral Examination.

(d) If the opinion of the examiners is not in favour of awarding the degree, the Examination Committee on the basis of the reports of examiners shall decide either to reject the dissertation or may recommend the Vice Chancellor to allow the student to resubmit his/her thesis with necessary changes and modifications as suggested by the examiners within 06 (six) months from the date of notification by the Controller of Examinations. In such case further registration will not be necessary. The examination committee shall report their decision to the Controller of Examinations.

(e) In case a candidate is unable to do well in the viva voce examination even though the thesis is adjudge adequate, the Examination Committee may recommend to the Academic Council that the candidate may be permitted to appear at another oral examination after a lapse of 06 (six) months from the first oral examination. No candidate shall be allowed to appear at the oral examination of the same thesis more than twice.

8. AWARD OF DEGREE:

(a) The Vice Chancellor shall place the reports of the examiners for consideration of the Academic Council which shall recommend to the Syndicate for the award of the Ph.D. Degree.

(b) The Controller of Examinations shall notify the results in accordance with the decision of the Syndicate.

9. ADDITION, Alteration, Change or Modification in the rules and regulations

In order to make any addition, alteration, change or modification in the rules and regulations (if required), it must be placed to the 'Departmental Academic Committee', 'Executive Committee' of the concerned Faculty and the Academic Council for approval. If any difficulty arises with respect to any provision of this rules & regulations, the interpretation/decision given by the Vice-Chancellor shall be final.