CBCS CURRICULUM OF

P.G. MATHEMATICS PROGRAMME

SUBJECT CODE = MAT

FOR POST GRADUATE COURSES UNDER RANCHI UNIVERSITY

Implemented from
Academic Session 2018-2020

Members of Board of Studies for CBCS Syllabus of Mathematics Under Ranchi University, Ranchi.

1. **Chairman** –

   Dr. A.K. Mahato
   Professor & Head,
   University Department of Mathematics, Ranchi University, Ranchi

2. **Internal Members-**

   i. **Dr. M. M. P. Singh**
   Professor,
   University Department of Mathematics, Ranchi University, Ranchi

   ii. **Dr. M. K. Singh**
   Professor,
   University Department of Mathematics, Ranchi University, Ranchi

   iii. **Dr. Sahdeo Mahto**
   Associate Professor
   University Department of Mathematics, Ranchi University, Ranchi

   iv. **Dr. C. S. P. Lugun**
   Associate Professor,
   University Department of Mathematics, Ranchi University, Ranchi

3. **External Members :-**

   i. **Dr. S. K. Agarwal**
   Professor and Head,
   University Department of Mathematics, Vinoba Bhave University, Hazaribagh

   ii. **Dr. S. K. Mohan**
   Associate Professor,
   University Department of Mathematics, Nilamber Pitamber University, Medininagar

4. **Special Invitee:**

   i. **Dr. N. K. Agarwal**
   Prof. (Retd.)
   University Department of Mathematics, Ranchi University, Ranchi

DR. SAHDEO MAHTO
H.O.D.
Head,
Department of Mathematics
Ranchi University, Ranchi

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COURSE STUCTURE FOR M.A./ M.Sc. MATHEMATICS

Table AI-1: Distribution of 80 Credits [*wherever there is a practical there will be no tutorial and vice –versa.]

Course	Papers	Credits (Sc) Theory + Practical	Credits (Arts/Comm) Theory + Tutorial
I. Foundation Course (FC)			
1. Foundation Course Compulsory Foundation/ Elective Foundation	**(FC)** 1 Paper	1X5=5	1X5=5
II. Core Course (CC)	**(CC 1 to 10/11)**		
Theory	7 Papers/11 Papers	7X5=35	11X5=55
Practical/ Tutorial*	3 Papers/-----------	3X5=15	
Project	1 Paper	1X5=5	1X5=5
III. Elective Course (EC)			
A. Ability Enhancement Course of the Core Course opted	**(AE/EC 1)** 1 Paper	1X5=5	1X5=5
B. Discipline Centric Elective Theory + Practical	**(DC/EC 2&3)** 2 Papers 1 Paper	2X5=10 1x5=5	
OR Theory/Practical/Tutorial*	1Paper + 1 Practical/Dissertation		2X5=10
OR Generic Elective/ Interdisciplinary **(GE/EC 2&3)** Theory OR Theory/Practical/Tutorial*	2 Papers 1 Paper + 1 Practical/Dissertation		
		Total Credit = 80	**= 80**

Table AI-1.1: Course structure for M.A./M.Sc. Mathematics Programme

Semester	Subject (Core Courses) 12 Papers	Allied (Elective Courses) 3 Papers	Foundation Course (Compulsory Course) 1 Paper	Total Credits
Sem-I	C-1, C-2, C-3 (5+5+5=15 Credits)		Foundation Course FC (05 Credits)	20 Credits
Sem-II	C-4, C-5, C-6, C-7 (5+5+5+5=20 Credits)			20 Credits
Sem-III	C-8, C-9, C-10 (5+5+5=15 Credits)	EC1 (05 Credits)		20 Credits
Sem-IV	C-11, (05 Credits) C-12 (Project) (05 Credits)	EC2, EC3 (5+5=10 Credits)		20 Credits
				Total = 80 Credits

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COURSES OF STUDY FOR POSTGRADUATE, M.A./ M.Sc., MATHEMATICS PROGRAMME

Table AI-2 Subject Combinations allowed for M. A./M.Sc. Maths Programme (80 Credits)

Foundation Course FC 1 Paper	Core Subject CC 12 Papers	Ability Enhancement Course AE 1 Paper	Discipline Centric Elective/ Generic Elective Course DC/ GE 2 Papers

Table AI-2.1 Semester wise Examination Structure for Mid Sem & End Sem Examinations:

Sem	Paper	Paper Code	Credit	Name of Paper	Mid Semester Evaluation (F.M.)	End Semester Evaluation (F.M.)	End Semester Practical/ Viva (F.M.)
I	Foundation Course	FCMAT101	5	Foundation Course in Modern Algebra	30	70	----
	Core Course	CCMAT102	5	Real Analysis	30	70	----
	Core Course	CCMAT103	5	Topology	30	70	----
	Core Course	CCMAT104	5	Complex Analysis	30	70	----
II	Core Course	CCMAT201	5	Programming in C & MATLAB	30	70	----
	Core Course	CCMAT202	5	Ordinary Differential Equations	30	70	----
	Core Course	CCMAT203	5	Differential Geometry and Tensor Analysis	30	70	----
	Core Course	CCMAT204	5	Programming in C & MATLAB (Practical)	----	----	70 + 30
III	Ability Enhancement Course	ECMAT301	5	A. Adv. Discrete Mathematics/ B. Fourier & Wavelet Analysis/ C. Fluid Dynamics/ D. Hadamard Matrices and Combinatorial Designs	30	70	----
	Core Course	CCMAT302	5	Partial Differential Equation (PDE)	30	70	----
	Core Course	CCMAT303	5	Functional Analysis	30	70	----
	Core Course	CCMAT304	5	Analytical Dynamics and Calculus of Variations	30	70	----
IV	Elective	ECMAT401	5	A. Optimization Techniques/ B. Integral Transforms/ C. Probability & Statistics	30	70	----
	Elective	ECMAT402	5	A. Operations Research/ B. Integral Equations/ C. Mathematical Modelling	30	70	----
	Core Course	CCMAT403	5	Numerical Solution of ODE/PDE	30	70	----
	PROJECT/ Dissertation	PRMAT404	5	Project	----	----	70 + 30

SEMESTER I   **4 Papers**

Total 100 x 4 = 400 Marks

I.   COMPULSORY FOUNDATION COURSE   **[FCMAT101]:**

(Credits: Theory-05)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):

There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each,** out of which any three are to be answered.

End Semester Examination (ESE):

There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations

The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

FOUNDATION COURSE IN MODERN ALGEBRA

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I - Group Theory

Groups : Finite permutation groups S_n and A_n. Normal and Subnormal series, Jordan-Holder theorem, Solvable groups, Nilpotent groups. Group action, orbit -stabilizer theorem, Sylow's theorems (proofs using group actions).

Unit II- Linear Algebra

Matrix of a linear transformation, Canonical Forms – Similarity of linear transformations. Invariant subspaces. Eigen values and Eigen vectors, Reduction to diagonal, triangular and Jordan forms. The primary decomposition theorem.

Unit III – Field Extension

Field theory-Extension fields, finite extension, Algebraic and transcendental extensions. splitting fields-existence and uniqueness, Separable and inseparable extension. Normal extensions. Perfect fields.

Unit IV – Finite Field

Finite fields, Theorems on finite fields, Primitive elements. Algebraically closed fields. Automorphism of extensions, Galois extension. Fundamental theorem of Galois Theory.

Essential readings:

- D.S. Dummit, R.M. Foote,*Abstract Algebra* –John Wiley&Sons (2003)
- I.N. Herstein. *Topics in Algebra*, Wiley Eastern Ltd., New Delhi, 1975
- M. Artin. *Algebra*, Prentice-Hall of India, 1991.
- K. Hoffman and R. Kunze (2nd edition),*Linear Algebra*, Prentice Hall of India, New Delhi (1997)
- N.S. Gopala Krishnan, *University Algebra*, New Age Int.Publ.
- William J Gilbert, Madern Algebra with Applications, Wiley India, 2005.

II.   CORE COURSE   [CCMAT102]:   (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each**, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

REAL ANALYSIS   Theory: 60 Lectures; Tutorial:15 Hrs

Unit I- Uniform Convergence
Sequences and series of functions, pointwise and uniform convergence. Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence, uniform convergence and continuity, preservation of differentiability and integrability theorems.

Unit II – Functions Of Several Variables
Derivative of functions in an open subset of R^n into R^m as a linear transformation. Chain rule. Partial derivatives. Taylor's theorem. Inverse function theorem. Implicit function theorem, Jacobians.

Unit III Measure
Motivation and Concept of Measure of a set, Outer measure, Measurable sets, Lebesgue measures, A non-measurable set, Measurable functions, Littlewood's three principles.

Unit IV The Lebesgue Integral
Lebesgue integral o a bounded function over a finite measure, The integral of a non-negative unction, The general Lebesgue integral, Convergence theorems, Convergence in measure.

Essential readings:
- ☐ Walter Rudin, *Principles of Mathematical Analysis*, 3rd ed. McGraw-Hill
- ☐ T.M. Apostal, *Mathematical Analysis*, Narosa Publ., New Delhi, 1985.
- ☐ R G Bartle and Donaid R Sherbert, Real Analysis, John Wiley & Sons.
- ☐ H L Royden, Real Analysis, McMillan

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III.   CORE COURSE   [CCMAT103]:   (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each**, out of which any three are to be answered.

End Semester Examination (ESE):
There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six questions of fifteen marks each**, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
        The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

TOPOLOGY   Theory: 60 Lectures; Tutorial:15 Hrs

UNIT I Fundamentals of A Topological Space
Definition and examples of topological spaces. Closed sets, Closure. Dense subsets. Neighbourhoods, Interior, exterior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topologies. Quotient topology

Unit II Continuity and Connectedness
Continuity and homeomorphism, Product of topological spaces, connected space and its properties.

Unit III Countability and Separation Axioms
First and Second countable spaces. Lindelof's theorem, separable spaces, second countability and separability. Separation axioms T_0, T_1, T_2, T_3, T_4 : their Characterizations and basic properties. Urysohn's Lemma. Tietze extension theorem.

Unit IV Compactness
Compactness. continuous image of compact sets. Basic property of compactness. Compactness and finite intersection property Tychonoff's Theorem, One point compactification of a topological space.

Essential readings:
- K.D. Joshi. *Introduction to General Toplogy*, Wiley Eastern Ltd. 1983.
- W.J.Pervin. *Foundations of General Topology* Academic Press Inc. New York 1964.
- G.F. Simmons, *Introduction to Topology and Modern Analysis*, Mc Graw Hill Int.book company.
- J.R.Munkres, *Topolygy A first course*, Prentice hall India Pvt. Ltd.
- S.Lipschutz, *General Topology*, Schaum's out line series.

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IV.   CORE COURSE   [CCMAT104]:   (Credits: Theory-04, Tutorial-01)

> Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
There will be **two groups** of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):
There will be **two groups** of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
         The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

COMPLEX ANALYSIS   Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Complex Integration
Cauchy-Goursat Theorem, Cauchy's Integral formula, Higher order derivatives, Morera's Theorem, Cauchy's inequality, Liouville's theorem and Fundamental theorem of Algebra.

Unit II Power Series
Circle of Convergence. Absolute and uniform convergence. Taylor's theorem, Laurent's theorem. Maximum modulus principle.

Unit III Singularities and Cauchy Residue Theorem.
Isolated singularities. Meromorphic functions. The argument principle, Rouche's theorem Poles and Zeros. Residues. Cauchy's residue theorem. Contour Integration. Evaluation of integrals

Unit IV Analytic Continuation and Its Application
Definition of Analytic continuations and related problems, Uniqueness theorem of Analytic continuation, Standard method/ Power series method of Analytic continuation along a curve, Singularity on the circle of convergence of power series.

Essential readings:
- Churchill and Brown, *Complex variables and applications*, McGraw-Hill Pub.Company.
- Walter Rudin. *Real and Complex Analysis*. Mc Graw Hill Book Co. 1966
- E.C. Titchmarsh. *The Theory of Functions*. Oxford University Press. London.

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SEMESTER II   4 Papers

Total 100 x 4 = 400 Marks

I. **CORE COURSE**   **[CCMAT201]:**   (Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each**, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

PROGRAMMING IN C & MATLAB   Theory: 60 Lectures; Tutorial:15 Hrs

Unit-I

Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving: Flowcharting, algorithms, pseudo code, decision table, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

Overview of C: History of C, Importance of C, Structure of a C Program.

Elements of C: C character set, identifiers and keywords, Data types, Constants and Variables, Assignment statement, Symbolic constant.

Input/output: Unformatted & formatted I/O function, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(), putch(), putchar(), puts().

Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity.

Decision making & branching: Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement.

Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue statement. Understanding header files: stdio.h, math.h, ctype.h and its function prototypes.

Unit-II

Functions: Definition, prototype, passing parameters, recursion.
Storage classes in C: auto, extern, register and static storage class, their scope, storage, & lifetime.
Structure, Union, enum

Arrays: Definition, types, initialization, processing an array, Strings & arrays.
Pointer and Its implementation using Function, Structure, Union, Array
File Handling: Needs of File Handling, File Modes, Type of Files, Open/Create, Read, Write, Delete,
Copy, Rename, Searching etc.

Unit III

Introduction to MATLAB, Elementary MATH Built-in –Functions, Creating Arrays, one dimensional,
two dimensional arrays, Variables, Strings. Mathematical operations with arrays, Sript files, Two
dimensional plots, Functions and Function files.

Unit IV

Programming in MATLAB, Relational and Logical operators, Conditional statements, the switch-case
statement., Loops, Nested Loops and Nested conditional statements, The break and continue
commands, , Polynomials, Curve Fitting and Interpolation, Applications to Numerical Analysis.

Essential readings:

- Yashwant Kanetker, *Working with C*, BPB
- Reema Tharej., *Programming with C*, Oxford
- Balagurusamy, E., *Computing Fundamentals and C Programming*, Tata McGraw-Hill
- Jeri R. Hanly & Elliot P. Koffman, *Problem Solving and Program Design in C*, Addison Wesley.
- Yashwant Kanetker, *Let us C*, BPB
- Rajaraman, V., *Computer Programming in C*, PHI
- Amos Gilat, *MATLAB- An Introduction with Applications*, Wiley India

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II.   CORE COURSE   [CCMAT202]:   (Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):
There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions** of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):
There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
         The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. **"Better of Two"** shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ORDINARY DIFFERENTIAL EQUATIONS

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I First Order ODE
Existence and uniqueness of the solution to ODE, Picard's existence theorem, Lipschitz condition, Uniqueness theorem, Picard's method of successive approximation.

Unit II Second and Higher Order ODE
Algebraic properties of solutions of homogeneous equations & Wronskian of second order ODE, nth order ODE, Wronskian of n functions and its properties, Annihilator method to solve non homogeneous ODE with constant coefficients, initial value problem, Existence and uniqueness theorem.

Unit III Linear System of ODE's
Linear system of ODEs, Existence and Uniqueness of linear system, linear homogeneous system with constant coefficients, method of eigen value and eigen vectors, Fundamental solution, Reduction of higher order linear equation into first order linear equations

Unit IV Boundary Value Problem
Strum-Lioville boundary value problem with homogenous boundary conditions.Green's function, Green's function techniques for solving self-adjoint boundary value problem

Essential readings:
- ☐ E.A. Coddington and N. Levinson. *Theory of Ordinary Differential Equations*. Mc Graw-Hill, NY (1955).
- ☐ M. Brawn, *Differential equations and their applications*, Springer-Verlag New York (1992
- ☐ Chakrabarti, *Elements of ordinary differential equations and special functions*, New Age, Int.Publ. (1990)
- ☐ M.D. Raisinghania, *Advanced differential equations*, S. Chand and Company, 2001
- ☐ A. Coddington, *An introduction to Ordinary Differential equations*, Prentice Hall of India, New delhi, 1987.

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III.   CORE COURSE   [CCMAT203]:   (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations
*   The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS
Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Curves in Space
Curvature and torsion. Serret-Frenet formula. Circular helix, the circle of curvature. Osculating sphere, Bertrand curves.

Unit II Curves on a Surface
Curves on a surface-parametric curves. fundamental magnitude, curvature of normal section. Principal directions and principal curvatures, lines of curvature, Rodrigue's formula. Dupin's theorem, theorem of Euler, Conjugate directions and Asymptotic lines.

Unit III   Family of Surfaces
One parameter family of surfaces – Envelope the edge of regression, Developables associated with space curves. Gaussian curvature, Surface of constant curvature.

Unit IV   Basics of Tensor
Tensors, Tensor Algebra, Contraction, Quotient theorem. Metric Tensor, Angle between two vectors.

Essential readings:
- ☐ C. E. Weatherburn. *Differential geometry of three dimensions.*
- ☐ C.E. Weatherburn. *Tensor calculus.*
- ☐ R.S. Mishra, *Tensor Calculus and Riemanian Geometry.*

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IV.   CORE COURSE   [CCMAT204]:   (Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100 | Pass Marks =45 |

Instruction to Question Setter:

End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.

Note:
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks)

PROGRAMMING IN C & MATLAB (PRACTICAL)
Theory: 60 Lectures; Tutorial:15 Hrs

Programming in C:
Write programs to understand different logics using Flow chart.

Write programs to understand printf, scanf, gets, getchar, puts, sqrt etc functions.

Write programs to illustrate the concepts of constants, variables and data types.

Write programs to illustrate operators and expressions in C.

Write programs to illustrate decision making and branching in C.

Write programs to illustrate decision making and looping in C

Analysis of various programs, i.e, Find the syntax error, logical error and outputs.

Write programs to illustrate array in C.

Write programs to illustrate of user defined functions.

Write programs to illustrate structures and unions.

Write programs to illustrate concept of pointers, character strings and string manipulations.

Write programs to illustrate of user defined functions using pointers, array, structure, union etc.

Write programs to illustrate File Handling in C.

Programming in MATLAB:
Write programs to illustrate Built-in functions and Arrays

Write Programs to illustrate Script files, functions and function files

Write programs to illustrate two dimensional plots

Write programs to illustrate curve fitting and interpolation

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SEMESTER III   4 Papers

Total 100 x 4 = 400 Marks

I.   ABILITY ENHANCEMENT COURSE   [ECMAT301A]:

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each**, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six questions of fifteen marks each**, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

A.   ADVANCE DISCRETE MATHEMATICS

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Automata Theory

Finite state automata & types of automata, deterministic and non deterministic finite state automata, non deterministic finite state automata (NDFSA), transition diagram. Moor Machine, Mealy Machine Turing Machine.

Unit II Eulerian and Hamiltonian Graphs

Eulerian graph and its characterizations, Hamiltonian graph and sufficient conditions for a graph to be Hamiltonian.

Unit III Planar graph and vertex coloring of a graph

Planar graphs, Platonic graphs. Euler's theorem for planar graphs. Vertex coloring, chromatic number, chromatic polynomial, Brooks theorem, edge coloring, chromatic index, map coloring. Five color theorem.

Unit IV Algorithms in graph theory

NP - complete problems, good algorithms, Connector problem and Kruskal's algorithm. Algorithms for Chinese postman problem. The Shortest path problem, Dijkstra's algorithm.

Essential readings:

- R. J. Wilson, Introduction to *Graph Theory*, 5th ed., Addison Wesley, 2012.
- John Clark and Derek Allan Holton, *A first look at Graph Theory*, World Sc., 1991
- Narsingh Deo, *Graph theory*, PHI New Delhi
- Uday Singh Rajpoot, *Advanced Discreet Mathematics*, PHI (Eastern economic edition)

Session 2018-20 Onwards

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OR
ABILITY ENHANCEMENT COURSE _____ [ECMAT301B]:

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100 | Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):

There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):

There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations

The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

B.   FOURIER & WAVELET ANALYSIS

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Fourier series of periodic functions

Fourier Coefficients, partial sums, the Dirichlet and Fejer kernels, convergence theorems. Fourier integrals: convolution, inversion, Plancherel's formula. Generalized Fourier Series, Orthogonality and completeness

Unit II The Fourier Transform

Basic properties, Inversion, Convolution, Plancherrel Theorem, The Fourier Transform for L2 functions, Dilatations, Translations, and Modulations. Windowed Fourier Transform, Discrete Fourier Transform.

Unit III Haar System And Haar Transform

The Haar System, Dyadic Step Functions, Haar bases on [0, 1]. Comparison of Haar series and Fourier Series. The Discrete Haar Transform (DHT), the DHT in two dimensions, Image analysis with the DHT.

Unit IV Orthognormal wavelet bases and Multiresolution analysis:

Definition and examples, Construction of Orthonormal wavelet bases, Scaling functions and their properties. The Discrete Wavelet Transform, Wavelet frames, Multiscale Analysis, DWT for finite signals.The Continuous Wavelet Transform, Inverse CWT and admissibility conditions.

Essential readings:

- D F Walnut, *An Introduction to Wavelet Analysis*, Birkhauser
- M A Pinsky, *Introduction to Fourier Analysis and Wavelets*,AMS.
- J S Walker, *A Primer on Wavelets and Their Scientific Applications*, CRC, 1999.
- R M Rao, A S Bopardikar, *Wavelet Transforms*, Pearsons, India,2010
- I. Daubechies, *Ten Lectures on Wavelets*, SIAM,1992
- Y Meyer, *Wavelets: Algorithms and Applications*, SIAM, 1993
- S V Narasinmhan et al, *Introduction to Wavelet Transform*, Narosa, India, 2012.
- A K Louis et al, *Wavelets: Theory and Applications*, John Wiley & Sons, 1998.

OR

ABILITY ENHANCEMENT COURSE   [ECMAT301C]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** five questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

C.   FLUID DYNAMICS   Theory: 60 Lectures; Tutorial:15 Hrs

UNIT I Kinematics

Lagrangian and Eulerian methods, Equation of continuity in different coordinate systems, Boundary surfaces, Stream lines, Path lines and streak lines. Velocity potential, Irrotational and rotational motions. Vortex lines.

UNIT II Equations of Motion

Lagrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Impulsive actions. Stream function, Irrotational motion.

UNIT III

Complex velocity potential. Sources, sinks doublets and their images in two dimension. Conformal mapping. Milne-Thomson circle theorem.

UNIT IV

Two-dimensional Irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Theorem of Blasius. Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere.

Essential readings:

- W.H.Besant,A. S. Ramsey. *A Treatise on Hydro Mechanics.*   Part II. CBS Publ.,2006.
- G.K. Batchelor. *An Introduction of Fluid Mechanics.* Camb. Unov. Press, 2000.
- F. Choriton. *Textbook of Fluid Dynamics.* C.B.S. Publishers.Delhi 1985.
- R K Bansal, *A Text Book of Fluid mechanics,* Laxmi Publ.,2008
- M.D. Raisinghania, *Fluid dynamics,* S Chand Publ.

OR

ABILITY ENHANCEMENT COURSE   [ECMAT301D]:

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100 | Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):

There will be **two groups** of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each**, out of which any three are to be answered.

End Semester Examination (ESE):

There will be **two groups** of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations

The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

B.   HADAMARD MATRICES AND COMBINATORIAL DESIGNS

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Introduction to Hadamard Matrices

Order of Hadamard Matrix, Hadamard Matrix Conjecture, Kronecker Product of Hadamard Matrices, Sylvestor Hadamard Matrices, Equivalence of Hadamard matrices, Maximum Determinant Theorem.

Unit II Construction of Hadamard Matrices

Hadamard matrices by Paley type I and type II methods, Williamson's method of construction. Number of in-equivalent Hadamard matrices of order 16 & 20,

Unit III Orthogonal Designs

Orthogonal-design, Weighing and Conference matrices, Baumert-Hall method for the construction of Hadamard matrices.

Unit IV Application of Hadamard Matrices

Construction of BIBD's from Hadamard matrices. Error correcting codes. Application of Hadamard matrices in the construction of error correcting codes.

Essential readings

☐ Marshal Hall (Jr.), *Combinatorial Theory*, Blaisdel Publishing house, 1986

II.   CORE COURSE   [CCMAT302]:   (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations
           The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "Better of Two" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

PARTIAL DIFFERENTIAL EQUATION (PDE)
Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Classification of 2nd order PDE & Laplace equation
Classification of second order PDE & reduction to Canonical forms, Fundamental solutions of two dimensional Laplace equation in Cartesian form.

Unit II Heat equation
Derivation and fundamental solution of one dimensional Heat equation in Cartesian form. Application problems.

Unit III Wave equation
Derivation and fundamental solution of one dimensional wave equation in Cartesian form. Application problems.

Unit IV Integral Transforms and Green's function Methods of Solution
Solutions of p.d.e. using Separation of variables, Fourier transform and Laplace transform, Green's function and solutions of boundary value problems using Laplace transformation.

Essential readings:
- L.C. Evans, *Partial Differential Equations*, Graduate
- Studies in Mathematics, Volume 19,AMS,1998.
- I.N. Sneddon, *Use of integrals transforms*, McGraw Hill.
- P. Prasad and R. Ravindran , *Partial Differential equation*.
- K. Sankara Rao, Partial diffential eqution, new age.
- E. Kreyszing, *Advanced Engineering Mathematics*, John Wiley & Sons.

III.   CORE COURSE   [CCMAT303]:   (Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):
There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):
There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
      The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. **"Better of Two"** shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

FUNCTIONAL ANALYSIS   Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Normed Linear Spaces
Normed Linear Space: Definition and Examples, NLS as a metric space, Open sets, closed sets etc in a NLS, Convergence and Continuity. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms.

Unit II Transformation on Linear Spaces
Bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples. Hahn-Banach theorem Open mapping and closed graph theorem, the natural imbedding of N in N**. Reflexive spaces.

Unit III Hilbert Space
Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Projection theorem. Rietz representation theorem Reflexivity of Hilbert spaces

Unit IV Operators in Hilbert Space
Linear transformation & linear functionals. Adjoint of an operator on a Hilbert space.. Self-adjoint operators. Positive, normal and Unitary operators.

Essential readings:
- G.F. Simmons, Topology and modern analysis TMH.
- G. Bachman and L. Narici, Functional Analysis, A P.
- R.E. Edwards, Functional Analysis. Holt Rinehart and Winston, New York 1958
- C. Goffman and G. Pedrick. First Course in Functional Analysis, PHI, 1987
- Kreyszig, Functional analysis with application, John Wiley and sons.

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IV.   CORE COURSE   [CCMAT304]:   (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
There will be **two groups** of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions** of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):
There will be **two groups** of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
           The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. **"Better of Two"** shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ANALYTICAL DYNAMICS AND CALCULUS OF VARIATIONS
Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Lagrangian Dynamics
Generalized coordinates, Holonomic and Non-holonomic systems, Scleronomic and Rheonomic systems, Generalized potential. Lagrange's equations of first and second kind, Energy equation for conservative fields.

Unit II Equations of Hamilton and Routh
Hamilton canonical equations. Equation of energy from Hamilton's equations, Cyclic coordinates, Routh's equations, Jacobi-Poisson Theorem.

Unit III Calculus of Variations
Motivating problems of calculus of variations fundamental lemma of calculus of variations Euler's equation, Brachistochrone problem Shortest distance, Geodesic, Minimum surface of revolution.

Unit IV Variational Principal in Dynamics and Brackets
Hamilton's Principle, Principle of least action. Jacobi's equations. Hamilton-Jacobi equations. Jacobi theorem. Lagrange brackets and Poisson brackets. Invariance of Langrange brackets and Poisson brackets under canonical transformations.

Essential readings:
- ☐ H.Goldstein,*Classical Mechanics*(2nd edition),Narosa Publishing House, New Delhi.
- ☐ I.M.Gelfand and S.V.Fomin, *Calculus of variation*, prentice   Hall.
- ☐ S.L. Loney, *An elementary treatise on Statics*, Kalyani Publishers, N. Delhi 1979.
- ☐ A.S.Ramsey, *Newtonian Gravitation*. The English Language Book Society and the Cambridge University Press.
- ☐ N.C. Rana & P.S.Chandra Joag, *Classical Mechanics*. Tata McGraw Hill 1991.
- ☐ Lours N. Hand and Janel, D. Finch, *Analytical Mechanics*, Cambridge University Press.

Session 2018-20 Onwards

SEMESTER IV   4 Papers

Total 100 x 4 = 400 Marks

I.   GENERIC/ DISCIPLINE CENTRIC ELECTIVE   [ECMAT401A]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
There will be ***two*** *groups of questions in written examinations of 20 marks.* ***Group A is compulsory*** *and will contain five questions of* ***very short answer type*** *consisting of 1 mark each.* ***Group B will contain descriptive type five*** *questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
There will be ***two*** *groups of questions.* ***Group A is compulsory*** *and will contain two questions.* ***Question No.1 will be very short answer type*** *consisting of five questions of 1 mark each.* ***Question No.2 will be short answer type*** *of 5 marks.* ***Group B will contain descriptive type six*** *questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations
The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. ***"Better of Two"*** *shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

A.   OPTIMIZATION TECHNIQUES

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Dual Simplex Method
Infeasible optimal initial solution, Dual simplex method, Its advantage over simplex method, difference between simplex and dual simplex method.

Unit II Sensitivity Analysis
Changes in coefficients in the objective function, Changes in the structure of the LPP due to addition of new variable/Deleting of existing variable/ Addition of new constraints/Deletion of existing constraints.

Unit III Theory Of Games
Characteristics of game theory, maximin criteria and optimal strategy, solution of game with saddle points, Rectangular games without saddle points and its solutions by linear programming.

Unit IV Queuing Theory
Basic characteristics of queueing system, different performance measures, Steady state solution of Markovian queueing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space.

Essential readings:
- S.D.Sharma, *Operation Research*, Kedar Nath, Ram Nath and Company (1972)
- H.A.Taha, *Operations Research*, Prentice-Hall of India Private Limited (2003)
- R. K. Gupta, *Operations Research*, Krishna Prakashan.

Session 2018-20 Onwards

OR

GENERIC/ DISCIPLINE CENTRIC ELECTIVE _____ **[ECMAT401B]:**

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):

There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):

There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations

The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. **"Better of Two"** shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

B.   INTEGRAL TRANSFORMS   Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Laplace and Stieltjes Transforms

Laplace Transform: Definition and convergence theorems, Absolute convergence, Uniform Convergence, Complex inversion formula. Convolution theorem, Tauberian Theorems. Stieltjes Transform: Definition and convergence theorem, Hardy and Littlewood theorem.

Unit II Fourier Transforms

Fourier Transform, Fourier Cosine Transform, Fourier Sine Transform, Conditions for existence of Fourier Transforms, Convolution Integral, Parseval's Theorem, Inversion Theorem.

Unit III Mellin Transform

Definition and elementary properties of Mellin transform, Mellin Transform of derivatives and integrals, The Mellin inversion theorem, Convolution theorems, solution of some integral equations via Mellin transform.

Unit IV Hankel Transform

Definition and elementary properties of Hankel Transform, Inversion theorem, Transform of elementary functions, Transform of derivatives of functions, Parseval relation, Relation between Fourier and Hankel transform.

Essential readings:

- D V Widder, *The Laplace Transform*, Princeton Univ. Press.
- Ian N. Sneddon, *The use of Integral Transforms*, McGraw Hill.
- Ian N. Sneddon, *Fourier Transforms*, Dover Publications, 2010.
- Loknath Debnath, *Integral Transforms and their Applications*, Chapman and Hall/CRC; 2nd ed., 2006.
- R N Bracewell, *The Fourier Transform and Its Applications*, TMH, India.

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OR

GENERIC/ DISCIPLINE CENTRIC ELECTIVE   [ECMAT401C]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five questions of five marks each**, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations

*   The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

C.   PROBABILITY & STATISTICS   Theory: 60 Lectures; Tutorial:15 Hrs

Unit I

Introduction to descriptive statistics and exploratory data analysis, sample space, discrete probability, independent events, Bayes theorem, random variables distribution functions, expectation and moments, marginal probability distribution, central limit theorem.

Unit II

Theoretical distributions, Standard discrete and continuous univariable distributions, Sampling distributions, standard errors such as statistical, biased or unibiased etc, Methods of estimation, Properties of estimators, Confidence intervals, Tests of hypothesis.

Unit III

Large sample tests, tests of single proportions, difference of proportions, tests of significance for single mean, difference of mean and difference of standard deviation. Chi-square distribution, goodness of fit, Chi-square, test for independence of attributes, degree of freedom, population variance.

Unit IV

Tests of significance based on t, F and Z distributions.

Essential readings:

- S.C. Gupta: Fundamental of Statistics. Himalaya Publishing House, 1981.
- Richard A. Johson, Miller and Freonts: Probability and Statistics for Engineers.
- B. Rouser: Fundamental of Biostatistics, Duxbury Thompson Learning, 2000.

IV.   GENERIC/DISCIPLINE CENTRIC ELECTIVE   [ECCHE402A]:

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter: .

Mid Semester Examination (MSE):
There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.

End Semester Examination (ESE):
There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
          The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. **"Better of Two"** shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

A.   OPERATIONS RESEARCH

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Integer Programming
Branch and bound technique, Gomory's cutting plane method.

Unit II Non Linear Programming
One and multi variable, Unconstrained optimization, Kuhn-Tucker Conditions for costrained optimization, Quadratic programming, Wolf's and Beal's method.

Unit III Inventory
Known demand, probabilistic demand, Deterministic Models and probabilistic models without lead-time.

Unit IV Project Planning and Control With PERT-CPM
Rules of network construction, Time calculation in networks, Critical path method, PERT, PERT calculation, advantages of network (PERT/CPM), Difference between CPM and PERT.

Essential readings:
- S.D.Sharma, *Operation Research*, Kedar Nath, Ram Nath and Company (1972)
- H.A.Taha, *Operations Research*, PHI,2003.
- R. K. Gupta, *Operations Research*, Krishna Prakashan.

OR

GENERIC/DISCIPLINE CENTRIC ELECTIVE   [ECCHE402B]:

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100 | Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

<u>Mid Semester Examination (MSE):</u>
There will be **two groups** of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.

<u>End Semester Examination (ESE):</u>
There will be **two groups** of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.

Note: There may be subdivisions in each question asked in Theory Examinations
            The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

B.   INTEGRAL EQUATIONS   Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Classification of Linear Integral Equations
Fredholm, Volterra, Integro-Differential Equations, Singular Integral Equations, Converting Volterra Equation to ODE, Conversion of IVP to Volterra equation, Conversion of BVP to Fredholm equation.

Unit II Fredholm Integral Equations
Decomposition method, Direct Computation method, successive approximation method, metho of successive substitutions, Homogeneous Fredholm Equations, Comparison between alternative methods.

Unit III Volterra Integral Equation
Solution of VIE, Series solution method, Successive Approximation method, Successive substitution method, Comparison between alternative methods.

Unit IV Singular Integral Equations
Abel problem, Generalized Abel Integral Equation, Existence and uniqueness of solutions using fixed-point theorems in case of Linear and nonlinear Volterra and Fredholm integral equations. Solution of Integral equations by Laplace, Fourier transforms methods.

Essential readings
- [ ] Murry R. Spiegal, *Laplace Transform*(SCHAUM Outline Series), McGraw-Hill.
- [ ] Abdul J. jerry, *Introduction to integral equations with applications*, Marcel Dekkar Inc. NY.
- [ ] R. P. Kanwal, *Linear Integral equations*, Springer Sc.,1997.
- [ ] Harry Hochsdedt, *Integral Equations*, John Wiley & Sons.

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OR

GENERIC/DISCIPLINE CENTRIC ELECTIVE   [ECCHE402C]:

(Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100 | Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations
*   The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

C.   MATHEMATICAL MODELING

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Introduction to mathematical modeling
Simple situations requiring mathematical modeling, techniques of mathematical modeling, classifications, characteristics and limitations of mathematical models, some simple illustrations.

Unit II Mathematical modeling through differential equations
Linear growth and decay models, non linear growth and decay models, Compartment models, Mathematical modeling in dynamics through ordinary differential equations of first order.

Unit III Mathematical models through difference equations
Some simple mathematical models, basic theory of linear difference equations with constant coefficients

Unit IV Application of mathematical modeling in economics, finance & genetics
Mathematical modeling through difference equations in economics and finance, mathematical modeling through difference equations in population dynamics and genetics.

Essential readings:
- ☐ J. N. Kapur, *Mathematical Modeling*, Wiley Eastern.
- ☐ D. N. Burghes, *Mathematical modeling in social Management and Life Science*, Ellie Herwood and John Wiley.
- ☐ F. Charlton, *Ordinary Differential and Difference Equations*, Van Nostrand.

III. CORE COURSE   [CCMAT403]:   (Credits: Theory-04, Tutorial-01)

| Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100   Pass Marks (MSE:17 + ESE:28)=45 |

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be two groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: There may be subdivisions in each question asked in Theory Examinations
*   The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Better of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

NUMERICAL SOLUTION OF ODE/PDE

Theory: 60 Lectures; Tutorial:15 Hrs

Unit I Numerical solutions of parabolic PDE in one space
Two and three levels explicit and implicit difference schemes. Convergence and stability analysis.

Unit II Numerical solutions of parabolic PDE of second order in two space dimension
Implicit methods, alternating direction implicit (ADI) methods. Non linear initial BVP. Difference schemes for parabolic PDE in spherical and cylindrical cooprdinate systems in one dimension.

Unit III Numerical solutions of hyperbolic PDE in one and two space dimension
Explicit and implicit schemes. ADI methods. Difference schemes for first order equations.

Unit IV Numerical Solutions of some equations and Operators
Numerical solutions of elliptic equations, approximation of Laplace and biharmonic operators. Solution of Dirichlet, Neuman and mixed type problems

Essential readings:
- ☐ M. K. Jain, S. R. K. Iyenger and R. K. Jain, *Computational Methods for Partial differential equations*, Wiley eastern,1994.
- ☐ M. K. Jain, *Numerical solution of Differential Equations*, second edition, Wiley Eastern.
- ☐ S. S. Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall India, 2002.
- ☐ V. Griffiths and I. M. Smith, *Numerical Methods of Engineers*, Oxford University Press, 1993.
- ☐ F. General and P.O. Wheatley, *Applied Numerical Analysis*, Addison-Wesley, 1998.
- ☐ K E Atkinson, An Introduction to Numerical Analysis, John Wiley & Sons.

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III.   CORE COURSE (PROJECT)   [PRMAT404]:   (Credits: 05)

Marks : 100 (ESE: 3Hrs)=100	Pass Marks =45

Guidelines to Examiners for

End Semester Examination (ESE):

Evaluation of project dissertation work may be as per the following guidelines:

Project model (if any) and the Project record notebook   = 70 marks
Project presentation and viva-voce   = 30 marks

Overall project dissertation may be evaluated under the following heads:
- *Motivation for the choice of topic*
- *Project dissertation design*
- *Methodology and Content depth*
- *Results and Discussion*
- *Future Scope & References*
- *Presentation style*
- *Viva-voce*

DISSRERTATION/ PAPER PRESENTATION

➢ Student alone or in a group of not more than five, shall undertake one Project approved by the Subject Teacher/H.O.D. of the Department/College concerned. The progress of the Project shall be monitored by the faculty members at regular intervals.

   OR

➢ PROJECT ON ANY ONE OF SPECIAL PAPER

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DISTRIBUTION OF CREDITS FOR P.G. PROGRAMME (SEMESTER-WISE) FOR POSTGRADUATE 'P.G. Voc./M.Sc./M.A./M.Com' PROGRAMME

Table B-1: Semester wise distribution of 80 Credits for Subjects with Practical Papers.

Semester	CC	FC	GE/DC	AE	Total credits
Semester I	15	05			20
Semester II	20				20
Semester III	15			05	20
Semester IV	5		15		20
	55	**05**	**15**	**05**	**80**

Table B-1: Semester wise distribution of 80 Credits for Subjects without Practical Papers.

Semester	CC	FC	GE/DC	AE	Total credits
Semester I	15	05			20
Semester II	20				20
Semester III	15			05	20
Semester IV	10		10		20
	60	**05**	**10**	**05**	**80**

CC=Core Course; FC=Foundation Compulsory/Elective Course; GE=Generic Elective; SE=Skill Enhancement Course; DC=Discipline Centric Elective

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SAMPLE CALCULATION FOR SGPA & CGPA FOR POSTGRADUATE 'P.G. Voc./M.Sc./M.A./M.Com' PROGRAMME

Table B-2: Sample calculation for SGPA for M.Sc./M.A./M.Com Programme

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit X Grade)	SGPA (Credit Point/Credit)
Semester I					
FC	05	A	8	40	
C-1	05	B+	7	35	
C-2	05	B	6	30	
C-3/CP	05	B	6	30	
Total	**20**			**135**	**6.60 (135/20)**
Semester II					
C-4	05	B	6	30	
C-5	05	C	5	25	
C-6	05	B+	7	35	
C-7/CP	05	A+	9	45	
Total	**20**			**135**	**6.60 (135/20)**
Semester III					
EC-1	05	A+	9	45	
C-8	05	0	10	50	
C-9	05	A	8	40	
C-10/CP	05	A	8	40	
Total	**20**			**175**	**8.75 (175/20)**
Semester IV					
EC-2/EC-2	05	B	6	30	
EC-3/EC-3	05	A+	9	45	
C11/EP	05	B	6	30	
Project	05	A+	9	45	
Total	**20**			**150**	**7.50 (150/20)**
CGPA					
Grand Total	**80**			**595**	**7.44 (595/80)**

Table B-3: Sample calculation for CGPA for P.G. Vocational M.Sc./M.A./M.Com Programme

Semester I	Semester II	Semester III	Semester IV
Credit:20; SGPA:6.60	Credit:20; SGPA: 6.60	Credit:20; SGPA: 8.75	Credit:20; SGPA: 7.50

Thus CGPA= (20x6.60+20x6.60+20x8.75+20x7.50)/80=7.36

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DISTRIBUTION OF MARKS FOR EXAMINATIONS AND FORMAT OF QUESTION PAPERS

Distribution of Marks for Mid Semester Evaluation:

Table No. 15: Distribution of marks of Theory Examinations of Mid Semester

Topic	Code	Full Marks	Pass Marks	Time	Group-A (Very short answer type Compulsory Questions) No. of Questions x Marks = F.M.	Group-B (Descriptive Questions) No. of Questions x Marks = F.M.	Total No. of Questions to Set	
							Group A	Group B
Mid Sem*	T30*	30 (20 +5 +5)	17	1 Hr	5 x1 =5	3 (out of 5) x5 =15	05	5

*There shall be 20 marks theory examination for mid sem, 05 marks for attendance/ regular interactions & 05 marks for seminar/ assignment/ term paper given by faculty concerned in classrooms.

Distribution of Marks for End Semester Theory Examinations:

Table No. 16: Marks distribution of Theory Examinations of End Semester

Topic	Code	Full Marks	Pass Marks	Time	Group-A# (Very short answer type Compulsory Questions) No. of Questions x Marks = F.M.	Group-B (Descriptive Questions) No. of Questions x Marks = F.M.	Total No. of Questions to Set	
							Group A#	Group B
End Sem	T50	50	--	3 Hrs	2 x5 =10	2 (out of 3) x20 =40	2	3
	T70	70	28	3 Hrs	Q.No.1 (5x1) + 1x5 =10	4 (out of 6) x15 =60	2	6

Question No.1 in Group-A carries very short answer type questions of 1 Mark

Note   :   There may be subdivisions in each question asked in Theory Examinations.

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FORMAT OF QUESTION PAPER FOR MID SEM EXAMINATION

20 MARKS

Ranchi University, Ranchi

Mid Sem No.   Exam Year

Subject/ Code

F.M. =20   Time=1Hr.

General Instructions:
समान्य निर्देश :

 i.   **Group A** carries very short answer type compulsory questions.
      (खंड 'A' में अत्यंत लघु उत्तरीय अनिवार्य प्रश्न हैं।)
 ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
      (खंड 'B' के पाँच में से किन्हीं तीन विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)
 iii. Answer in your own words as far as practicable.
      (यथासंभव अपने शब्दों में उत्तर दें।)
 iv. Answer all sub parts of a question at one place.
      (एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
 v.   Numbers in right indicate full marks of the question.
      (पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1. ....   [5x1=5]
2. ....
3. ....
4. ....
5. ....

Group B

6. ....   [5]
7. ....   [5]
8. ....   [5]
9. ....   [5]
10. ....   [5]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

70 MARKS

Ranchi University, Ranchi

End Sem No.   Exam Year

Subject/ Code

F.M. =70   **P.M.**=28   **Time**=3Hrs.

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.

ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.

(खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)

iii. Answer in your own words as far as practicable.

(यथासंभव अपने शब्दों में उत्तर दें।)

iv. Answer all sub parts of a question at one place.

(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)

v. Numbers in right indicate full marks of the question.

(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1.   [5x1=5]

       i.   ....

       ii.   ....

       iii.   ....

       iv.   ....

       v.   ....

2. ....   [5]

Group B

3. ....   [15]

4. ....   [15]

5. ....   [15]

6. ....   [15]

7. ....   [15]

8. ....   [15]

Note: There may be subdivisions in each question asked in Theory Examination.