HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY
PATAN- 384 265

Proposed details of CBCS PROGRAMME Pattern for M Sc Mathematics(Semester System)

With effect from June : 2014 NEW

FACULTY : SCIENCE

SUBJECT : MATHEMATICS

CLASS: Master of Science.

SEMESTER : I to IV

TOTAL PAGE 01 TO 33 (WITH COURSE STRUCTURE)

DATE : 15th September -2014

M Sc in Mathematics : PROGRAMME Structure Under CBCS

With effect from June : 2014

M. B. Prajapati, ***Department of Mathematics,***
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(1) Department's VISION and Mission :

The Department of Mathematics is a premier academic institute in the North Gujarat region.
The Department was established in June-1993 to cater the need of this region for higher education in the mathematical field.
Mission : Our mission is to provide opportunities for developing high-quality mathematical skills and achievement for their betterment of life through scientific and technological development.
Learning outcomes: Logical Reasoning & Motivation ;Critical & Creative Thinking; Analysis & Problem solving; Information & Technology Proficiency.
Vision: To motivate Individuals to excel in the mathematical knowledge-driven environment of the 21st century through curriculum and train integrally human resources through teaching, research & extension to enhance and initiate human development and the quality of life.

We **Focus** on quality education and innovative research, activities reflecting the goals and objectives of the institution.

Presently, we teach and emphasize student's creativity, excellence, integrity through course work, extracurricular activities, advising and counseling, academic process and reach-as-we-practice.

(2) EDUCATIONAL AIMS :

Mathematics is one of the fundamental disciplines in science. It is the basic for all the disciplines. To make education more effective and learner centric, restructurisation of curriculum becomes essential. As a positive step in this direction and in order to respond to the emerging trends in the global scenario, it is decided to introduce the Choice Based Credit System (CBCS) from the academic year 2011-12. Under this system, the academic programme becomes student-oriented, relevant, interdisciplinary and flexible. Apart from the core subjects the student is at liberty to choose subjects of his/her choice offered by the department also. Besides, the student has an opportunity to learn extra subjects, for which classes will be conducted outside the regular working hours and he/she can earn extra credit in addition to the mandatory credits required of him/her to qualify for the degree, in accordance with the norm prescribed by the Department/University from time to time and availability of the academic infrastructures.

- General Objectives of Choice Based Credit System are as follows:

1. To enlarge and enrich the curriculum and to make education broad based, i.e., more knowledge and skill oriented.
2. To ensure flexibility in choosing intra and interdisciplinary subjects, according to the choice of the students.
3. To enable the interested students to earn extra credits.
4. To facilitate the students to learn at their own pace.

Besides all the above aspects, the MSc programme under CBCS in Mathematics is designed for B. Sc. Mathematics Students if he/she want to continue his/her studies by delving more deeply into particular aspects of pure , applied or applicable mathematics also.

(3) CONDITIONS FOR ADMISSION :

A candidate who has passed the B.Sc. Degree examination of this University with Mathematics or any other examinations accepted by the Syndicate as equivalent thereto shall be eligible for admission to this M Sc Programme in Mathematics on full-time basis of study.

INTAKE: 30 *students* but may vary from time to time with the permission from the university for the first semester. Other rules for admission are as per University notification from time to time.

Students are allowed to take admissions to successive semesters under carry over benefit facility.

(4) LEARNING OUTCOMES (Objectives and Aim)

The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:

- **Knowledge and understanding**

When one has completed this degree he/she will have knowledge and understanding of:

- the fundamental and advanced concepts, principles and techniques from a range of topic areas
- specific knowledge and understanding will be determined by his/her particular choice of courses, according to his/her particular needs and interests.

- **Cognitive skills**

When one has completed this degree he/she will be able to:

- understand how to solve some problems using the methods taught
- assimilate complex mathematical ideas and arguments
- develop abstract mathematical thinking
- develop mathematical and physical intuition.

- **Practical and/or professional skills and Key skills**

When you have completed this degree, you will be able to demonstrate the following skills:

- the ability to advance your own knowledge and understanding through independent learning
- communicate clearly knowledge, ideas and conclusions about mathematics
- develop problem-solving skills and apply them independently to problems in pure ,applied and applicable mathematics
- communicate effectively in writing about the subject
- improve his/her own learning and performance.

(5) DURATION OF THE COURSE:

The CBCS pattern M. Sc. programme with multidisciplinary approach in Mathematics is offered on a full-time basis. The duration of the course is of two academic years consisting of four semesters each of 15 weeks duration.

(6) TEACHING, LEARNING METHODS :

All relevant material is provided and taught in the course texts and through the study of set books. One will build up knowledge gradually, with sufficient in-text examples to support one's understanding. He/She will be able to assess his/her own progress and understanding by using the in-text problems and exercises at the end of each unit. Opportunity to engage with what is taught is provided by means of the assignment questions and understanding will be reinforced by personal feedback from the teacher in the form of comments based on the answers to one's assignments, seminars, unit-tests and project.

(7) COURSE OF STUDY :

The curriculum has seven major components:

1 Core / Principle / Fundamental Mathematical courses
2 Pure Mathematical Courses
3 Applied Mathematical Courses
4 Applicable / Application Oriented Mathematical Courses(disciplinary)
5 Soft Skill Based Courses (Inter-disciplinary)
6 Open Choice Based Courses (Disciplinary/Inter-disciplinary)
7 Cognitive Skill-Work Based Courses

There are at least total twenty COURSEs prescribed in the following classification, to be studied to acquire M.Sc. Degree in Mathematics.

(I) Principle/Core/Compulsory Courses (HARD CORE): (MTHP-1 to 8)

All Basic/Core courses carry 5 credits in 5 hours per week teaching and in each semester any two core courses to be selected from the list of MTHP_Group (various groups are listed on page number **10**)

with no repetitions i.e. there are total 8 Mathematical Core Courses to be selected from semester-I to semester-IV.

(II) Elective Disciplinary COURSEs (SOFT CORE): (MTHE-1 to 4)

All elective courses carry 4 credits in 4 Hours per week teaching. During the span of the programme, there are 4 Mathematical Elective Courses to be chosen from the lists of COURSEs of not more than Two groups : Three groups are *Group-A (Pure Mathematical Group) , Group-B(Applied Mathematical Group) and Group-C(Applicable Mathematical Group)*

(III) Choice Based Optional Courses: CB_Group (MCB-1 to 3)

All Choice based(disciplinary as well as inter-disciplinary) courses carry 2 credits in 2 hours per week teaching and there are 3 COURSEs to be chosen from the list of CB_Group.

(IV) Soft Skill Based Courses : SB_Group (SSB-1 to 4)

All Soft-skill based courses carry 2 credits in 2 hours per week teaching and 4 hours for practical. There are total 4 Courses to be chosen from the list of SSB_Group.

(V) Either Cognitive Skill-Work Project : MTHW_Group (MTHW)

OR

MTHE -5 ,MTHE-6 (selected from soft core subjects & MCB-4 (selected from CB group)

⇛ COURSE STRUCTURE ⊠

SEMESTER-I Course	Courses	Credit /course	Teaching Hrs Total	Total Credits	Examination Internal Marks	Hours/ Course	External Marks	Total Marks
Principle/Core Courses: MTHP-1,2	2	5	10	10	70	3	180	250
Elective Opt. Disciplinary: MTHE-1	1	4	4	4	30	3	70	100
Choice Base Theory: MCB-1	1	2	2	2	15	2	35	50
Soft Skill Elective Theory: SSB-1	1	2	2	2	0	2	50	50
Soft Skill based Practical: SSB-2	1	2	Minimum:4	2	0	2	50	50
Total	**6**		**22**	**20**	**115**		**385**	**500**
SEMESTER-II								
Principle/Core : MTHP-3,4	2	5	10	10	70	3	180	250
Elective Opt. Disciplinary: MTHE-2	1	4	4	4	30	3	70	100
Choice Base Theory: MCB-2	1	2	2	2	15	2	35	50
Soft Skill Elective Theory: SSB-3	1	2	2	2	0	2	50	50
Soft Skill based Practical: SSB-4	1	2	Minimum:4	2	0	2	50	50
Total	**6**		**22**	**20**	**115**		**385**	**500**
SEMESTER-III								
Principle/Core : MTHP-5,6	2	5	10	10	70	3	180	250
Elective Opt. Disciplinary:MTHE-3,4	2	4	8	8	60	3	140	200
Choice Base Theory: MCB-3 (Research Methodology)	1	2	2	2	15	2	35	50
Total	**5**		**20**	**20**	**145**		**355**	**500**
SEMESTER-IV								
Principle/Core :MTHP-7,8	2	5	10	10	70	3	180	250
AND EITHER								
Cognitive Skill-Project: MTHW	1	10	Minimu:16	10	75	1/studt	175	250
OR								

Elective Opt. Disciplinary:MTHE-5,6	2	4	10	10	10	60	3	140	200
Choice Base Theory: MCB-4	1	2		2	2	15	2	35	50
Total	**3 or 5**			**26***	**20**	**145**		**355**	**500**
Total	***20***			***90****	***80***	***520***		***1480***	***2000***

N.B. *Work-load depends on the number of students and the number of Batches/Groups , for practical and Cognitive-skill based Course.*

(8) ***ASSESSMENT AND EXAMINATION METHOD :***

A candidate's understanding of principles and concepts will be assessed through CIA and UE pattern as follow:

- **CONTINUOUS INTERNAL ASSESSMENT (CIA):**

The CIA is done by the course teachers and this will evaluated any five/six from the following NINE academic components having equal weightage.

1. Assignments, Quiz (announced or unannounced)
2. Individual viva or group viva
3. Short duration objective types tests/snap tests
4. Short answer/problem solving(15 to 30 minutes for assessment of cognitive ability)
5. Seminar (once in a semester is compulsory)
6. Unit test (written or oral)/internal test
7. Laboratory/field/practical work
8. Group Discussion(Once in a semester to asses originality, creativity, initiative, communication skills …etc)
9. Class-room attendance/punctuality/sincerity

- **University Examination (UE):**

There shall be four semester examinations, one at the end of each semester in each academic year. A candidate who does not pass the examination in any course(s) in a semester will be permitted to appear in such failed course(s) also, with subsequent semester examinations: University Examination (UE) only.

There is no Continuous Internal Assessment for any SSB Theory/practical. Also External University Examination for SSB Theory/practical is of 50 Marks/practical (Practical including Viva :Examination-40 marks + Record/journal book: 10 marks)

(9) REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER:

(i) Candidates shall register their name for the First Semester Examination after the admission in the M.Sc. Maths.

(ii) Candidates shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester examinations subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subsequent) semester subjects, in consultation with the Head of The Department and available faculties.

(iii) Candidates shall be eligible to go to subsequent semester, only if he/she earns sufficient attendance as prescribed thereof by the University from time to time. In the case of candidate earning less than the prescribed attendance in any one of the semesters due to any extraordinary circumstance, shall be permitted to proceed to the next semester and such candidate shall have to repeat the missed semester by

rejoining after completion of final semester of the course, after paying the higher-fee for the break of study as prescribed by the University from time to time.

(10) PASSING MINIMUM:

A candidate shall be declared to have successfully cleared in each course / Practical / Project , if he/she secures not less than 40 % of marks [in each of the continuous internal assessment (CIA) and the University examinations (External)], provided a minimum of 40% of marks secured in the University theory examination and a minimum of 40% marks in a Practical / Project / Viva-voce.

(11) GRADING SYSTEM and CLASSIFICATION OF SUCCESSFUL CANDIDATES:

The term grading system indicates a Ten (10) Point Scale of evaluation of the performances of students in terms of marks obtained in the CIA and External Examination, grade points and letter grade.

Procedure of awarding the grades : Marks and Award of Grades:

The following TABLE-I gives the marks, numerically grades, letter grades and classification to indicate the performance of the candidate.

Table 1 : Conversion of Marks to Numerical Grade and Letter Grade (Course Performance)

Sr no.	Letter Grade	Numerical Grade	Grade Points	Performance
1	O	90 - 100	9.0 to 10.0	Out standing
2	A	80 – 89	8.0 to 8.9	Excellent
3	B	70 - 79	7.0 to 7.9	Distinction
4	C	60 - 69	6.0 to 6.9	Very Good
5	D	50 – 59	5.0 to 5.9	Good
6	E	40 - 49	4.0 to 4.9	Satisfactory
7	F	0 – 39	Below 4.0	Unsatisfactory / Fail
8	AAA	--	0.00	Absent

The result of successful candidates at the end of each semester shall be declared in terms of GRADE POINT AVERAGE (GPA) and letter grade. The result at the end of fourth semester shall be classified on the basis of the Cumulative Grade Point Average (CGPA) obtained in all the four semester and the corresponding overall letter sign grade. The TEN point grading system with the Numerical as well as the letter grade as described as above and shall be recommended to be adopted. The Grade Point Average (GPA) and the Cumulative Grade Point Average(CGPA) at the end of fourth semester shall be computed as follows.

Computation of Grade Point Average(GPA):

The letter grade is assigned a numerical grade value according to the Grading Systems- as shown in the Table 1. Each letter grade has a numeric grade point value assigned which is used to calculate Grade Point Average (GPA) and cumulative grade point average (CGPA).

The numerical grade in a course shall be assigned on the basis of actual marks scored at the semester end examination including Internal Assessment in that course as per the above Table 1 provided he/she secures

a minimum of 40% marks in the semester examination. The candidate securing less than 40% of marks in the end of semester examination (including Internal marks) in any course (may be a theory / practical / project work /dissertation ,etc.) shall be declared to have failed OR to be re-appear in the next exam in that course.

The Grade Point (GP) for each course shall then be calculated as the product of the Numerical Grade earned in that course and the credits for that course. The Grade Point Average (GPA) for each semester is obtained by adding the GP of all the courses of the semester dividing by total Credits of the semester (in science faculty it is 20 credits for each semester).

Procedure for GPA calculation: If Ci = Credits of the i^{th} course, G_i = the numerical Grade obtained for the i^{th} course and n= the number of courses (credited) offered in the semester, then the Grade Point (GP_i) for the i^{th} course of the semester is calculate as : GRADE POINT (GPi) = Gi x Ci

GRADE POINT AVERAGE [GPA] $= (GP_1 + GP_2 + \ldots + GP_n) / (C_1 + C_2 + \ldots + C_n)$

$= (GP_1 + GP_2 + \ldots + GP_n) / 20$ (since total credit for each semester=20)

$= (C_1 \times G_1 + C_2 \times G_2 + \ldots + C_n \times G_n) / (C_1 + C_2 + \ldots + C_n)$

$$\textbf{GPA} = \frac{\text{Sum of the multiplication of numerical grade by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

Note: The candidates who pass the subject at first appearance and within the prescribed semester of the PG Programme (Core, Elective, Non-major Electives and Extra-Disciplinary courses alone) only shall be eligible for the evaluation process of the Grade point of that subject. Those students who clear the examination at second or subsequent attempt or having skipped the first attempt in the subject shall be granted the numerical grade of only 4.0 (as the lowest one) instead of the higher numerical grade obtained by the candidate.

Calculation of CGPA for the entire programme : Cumulative GPA is a calculation of the average of all grades for all semesters and courses completed at the PG programme.

CUMULATIVE GRADE POINT AVERAGE [CGPA] =

$$= \frac{\text{Sum of the multiplication of GPA of the semester by the total credits of that semester}}{\text{Sum of the credits of the courses of the entire programme}}$$

Descriptions of each component described as follow:

Letter Grade	Numerical Grade	Grade Points	Performance	Letter Grade Description
A+	90 - 100	9.0 to 10.0	Out standing	Extra ordinary performance in the subject
A	80 – 89	8.0 to 9.0	Excellent	First Class Standing. Superior Performance showing comprehensive, in-depth understanding of subject matter. Demonstrates initiative and fluency of expression.
B+	70 - 79	7.0 to 8.0	Distinction	Basic understanding with knowledge of principles and facts at least adequate to communicate intelligently in the discipline.
B	60 - 69	6.0 to 7.0	Very Good	Clearly above average performance with knowledge of principles and facts generally complete and with no serious deficiencies.
C+	50 – 59	5.0 to 6.0	Good	Some understanding of principles and facts but with definite deficiencies.
C	40-49	4.0 to 5.0	Satisfactory	A passing grade indicating marginal performance. Student not likely to succeed in subsequent courses in the subject.
F	0 – 39	00.00	Unsatisfactory /	Knowledge of principles and facts is fragmentary;

			Fail	or student has failed to complete substantive course requirements.
AAA	--	0.00	Absent	Did not complete the course or less than 40% of course work completed.

(12). RANKING:

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / division as shown as above. In the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under Requirements for Proceeding to subsequent Semester are only eligible for Classification.

(13). PATTERN OF QUESTION PAPER:

Each COURSE possess four units having equal weightage . There should be five questions in a paper; each question should be from each unit and last one is of objective type from all units.

Two examiners , either both internal or one internal and one external can set the question paper. The internal examiner shall be the chairperson for the respective paper/COURSE.

(14). APPEARANCE FOR IMPROVEMENT:

Candidates who has already passed the semester-I,II&III Examination with seven optional COURSEs-MTHE-1,2,3,4& MCB-1,2,3 shell be allowed to reappear with another seven optional COURSEs (other than the previously ones) at semester-I , II & III examination to improve the result with the consent of the Head of The Department and the University. Such candidate shall have to get register for all the seven optional COURSEs in two additional terms; consecutive or alternative, and by paying the higher fees as prescribed by the university from time to time only after getting the prior permissions of the Department and the University. The result of such candidate will be declared on the basis of his/her mark sheet, in which the marks obtained by him/her in the other optional COURSEs have replaced the marks of old optional COURSEs. Such candidates are allowed to improve within a maximum period of 8 semesters counting from his/her first semester of his/her admission. If candidate improves his/her marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. No candidate will be allowed to improve marks in the Practical, Project, Viva-voce, Field work and any Core Subjects.

(15) Provisions for the Choice of Skill Based & Cognitive Work Subjects:

Faculty Advisor

To help the students to plan their optional COURSEs of the study and to offer general advice on the academic programmes, a student will be assigned to a member of the faculty (Major Dept) who will function as "Faculty Advisor" throughout his/her period of study.

The Faculty Advisor will counsel students on matters relating to the choice of subjects, withdrawal, etc. The student will meet his/her Faculty Advisor atleast three times during the semester.

Departmental Committee

Every major department will have a Departmental Committee consisting of

- The HOD - Convener
- The Faculty Advisors of the Department

- Student representative of each class

  The departmental committee is to meet at least thrice a semester to review all matters relevant to the academic programme. It is the responsibility of the faculty advisor to keep the records, Viz., the Agenda, Notes, Minutes, Diary etc.

Registration Procedure for Optional Subjects

Registration for the optional subjects should be done with the subject teacher in consultation with the HOD and Faculty Advisor. Students are expected to register for subjects intended to be credited during the next semester on specified dates.

(16). FORMAT FOR THE PREPARATION OF RECORD/PROJECT/COGNITIVE WORK:

The Rough Sketch of the Structure/Pattern provided herewith and are to be modified, time to time if needed.

(I) STRUCTURE FOR COMPUTER LABORATORY/PRACTICAL EXAMINATION.

Duration : 3 Hours Examination ,Maximum for Lab Course: 50 Marks. There is no Continuous Internal Assessment for any practical. University Exam. per practical : 50 Marks(Practical Examination: 40 marks + Journal: 10 marks)

(i) Record of Laboratory work for practical:

Title of the Course
Course Number --------- Year -------- Category ------- Semester ------- Credits ---- Course Code---Total Instructional Hours per week –

(a) Aim (b) Flowchart and Algorithm

(c) Source Code (d) Input/output specification

(e) Printout(s) (f) Remarks / Scope / Limitation of the Experiment.

(ii) FORMAT FOR THE COGNITIVE/PROJECT WORK.

Title of the Course
Paper Number --------- Year ----- Category ----- Semester ------- Credits ---- Course Code-------Total Instructional Hours per week –

(a) Title page : TITLE OF THE PROJECT

A project report Submitted for the partial fulfillment for the award of the Degree of Master of Science in Mathematics by Candidate's name (Register Number)
Under the guidance of Guide's name ----------
Name of the Department/College Name & Month and Year

(b) Bona fide Certificate

CERTIFICATE

This is to certify that the report entitled **"TITLE OF THE PROJECT"** *being submitted to the Hemchandracharya North Gujarat University of Patan* by Candidate's name for the partial fulfillment for the award of the Degree of **Master of Science in Mathematics** is a bona fide record of work carried out by him/her under my guidance and supervision

Date : Signature and Address of the Guide Signature of the HOD
Place:

Submitted for the viva-voce examination on……..…. at ----------Examiner-1 :

…….
(Signature and Name of the External Examiner)

Chairman of the examination:……. (Signature and Name of the External Examiner)

(c) Acknowledgement (d) Content

(e) Introduction (f) Chapters

(g) References (h) Appendices, if any.

(I) Principle/Core/Compulsory Courses: (MTHP-1 to 8)

All Basic/Core courses carry 5 credits in 5 hours per week teaching and in each semester any two core courses to be selected from the list of MTHP_Group with no repetitions i.e. there are total 8 following Mathematical Core Courses to be selected from semester-I to semester-IV.

(α) LIST OF COURSES FOR MTHP-GROUP (1 to 8) ANY TWO IN EACH SEMESTER

[MTHP-1]	Measure Theory	**[MTHP-2]**	Algebra-I
[**MTHP-3**]	Complex Analysis	**[MTHP-4]**	General Topology
[MTHP-5]	Advance Topology	**[MTHP-6]**	Functional Analysis-I
[MTHP-7]	Functional Analysis-II	**[MTHP-8]**	Field Theory

(II) ELECTIVE DISCIPLINARY COURSES: (MTHE-1 TO 4)

All elective courses carry 4 credits in 4 Hours per week teaching and there are 4 Mathematical Elective Courses to be chosen from the lists of COURSEs of not more than Two groups: three groups are Group-A, Group-B, Group-C ,

1. Group-A : Pure Mathematical Group

MTHE A-1	Differential Geometry
MTHE A-2	Techniques of Differential Equations
MTHE A-3	Number Theory
MTHE A-4	Algebraic Topology-I : Homotopy Theory
MTHE A-5	Algebraic Topology-II : Homology And Cohomology Theory
MTHE A-6	Functions of Several Variable
MTHE A-7	Differentiable Manifolds

2. Group-B : Applied Mathematical Group

MTHE B-1	Classical Mechanics-I	**MTHE B-2**	Classical Mechanics-II
MTHE B-3	Electrodynamics-I	**MTHE B-4**	Electrodynamics-II
MTHE B-5	Theory of Relativity	**MTHE B-6**	Relativity and Cosmology

Group – C: Applicable Mathematics Group

MTHE C-1	Mathematical Modelling
MTHE C-2	Mathematical Logic
MTHE C-3	Introduction To Artificial Intelligence
MTHE C-4	Operations Research
MTHE C-5	Advanced Operations Research
MTHE C-6	Statistical Methods
MTHE C-7	Mathematics Of Finance And Insurance PROBILITY AND STATICS
MTHE C-8	Computational Biology
MTHE C-9	Fuzzy Sets And Their Applications
MTHE C-10	BIO-MECHANICS
MTHE C-11	MATHEMATICS OF MONEY

(III) Choice Based Optional Courses: CB_Group (MCB- 1 to 3) ANY ONE

All Choice based (disciplinary as well as inter-disciplinary) courses carry 2 credits in 2 hours per week teaching and there are 3 COURSEs to be chosen from the list of CB_Group.

MCB-1	Special Functions
MCB-2	Advanced Linear Algebra
MCB-3	Research Methodology
MCB-4	Fuzzy sets, Fuzzy Logic and Fuzzy Control System
MCB-5	Integral Transforms
MCB-6	Mathematics Of Finance And Insurance
MCB-7	Industrial Mathematics

(IV) Soft Skill Based Courses : SB_Group (SSB-1 to 4) ANY TWO

All Soft-skill based courses carry 2 credits in 2 hours per week teaching and 4 hours for practical. There are total 4 Courses to be chosen from the list of SSB_Group.

SSB-1	Introduction to Computer C Language	**SSB-2**	Programming in C and applications (practical)
SSB-3	Introduction to Computer Graphics	**SSB-4**	Programming in Computer Graphics(practical)
SSB-5	Object oriented computer C++ language	**SSB-6**	Programming in C++ and applications (practical)
SSB-7	Introduction to MATLAB	**SSB-8**	Programming in MATLAB (practical)

DETAILS OF M Sc PROGRAMME

There are at least total twenty COURSEs prescribed in the following classification, to be studied to acquire M.Sc. Degree in Mathematics.

(I) Principle/Core/Compulsory Courses: (MTHP-1 to 8)

All Basic/Core courses carry 5 credits in 5 hours per week teaching and in each semester any two core courses to be selected from the list of MTHP_Group with no repetitions i.e. there are total 8 following Mathematical Core Courses to be selected from semester-I to semester-IV.

(α) LIST OF COURSES FOR MTHP-GROUP (1 to 8)

1 Measure Theory
2 Complex Analysis
3 General Topology
4 Advance Topology
5 Algebra-I
6 Field Theory
7 Functional Analysis-I
8 Functional Analysis-II

[MTHP-1] MEASURE THEORY

Revision: Standard topology on R, structure of open sets, cantor set, lim sup, lim inf.

Unit-1 Algebra and σ-algebra of sets, σ-algebra of Borel sets, Lebesgue outer measure on **R**, measurable sets, Lebesgue measure

Unit-2 Measurable function, Littelwood's three principles, Egoroff's theorem,Integral of a simple function, Lebesgue integral of bounded functions, bounded convergence theorem.

Unit-3 Integral of nonnegative functions, general Lebesgue (integral), Fatou's lemma, monotone convergence theorem, Lebesgue's convergence theorem, convergence in measure.

Unit-4 Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolutely continuous functions and indefinite integrals.

The course is covered by "Real Analysis" by H. L. Ryoden, Macmillan Pub. Co. 3rd Ed.

Reference Books:

(1) "Theory of Functions of a Real Variable" – by I. N. Natansen, Fredrik Pub. Co., 1964.
(2) "Measure Theory" – by P. R. Halmos, East and West Press.
(3) "Introduction to Real Variable Theory" – by S. C. saxena and S. N. shah Prentice Hall of India, 1980.
(4) "Real and Complex Analysis", Rudin, W., 2nd Edition, Tata McGraw-Hill Publishing Co. Ltd., 1974.

[MTHP-2] ALGEBRA - I

Unit 1 [**Revision:** Group, Subgroup, Normal Subgroups, Quotient groups, Homomorphism of groups, Isomorphic groups, Permutation groups, Direct product of groups]
Cayley's theorem, Conjugacy relation on a group and its applications, Solvable groups.

Unit 2 Group actions, Sylow's theorem, , Finite abelian groups, Simple groups.

Unit 3 [**Revision:** Ring, subrings, ring homomorphisms, ideals and quotient rings, prime and maximal ideals, Polynomial rings]
Field of fractions of an integral domain, Divisibility in rings, Euclidean ring, Principal Ideal rings.

Unit 4 Polynomial ring over a rational field, irreducibility criteria, polynomial ring over a commutative ring, Unique factorization domain.

The course is indicated by "Topics in Algebra" by I. N. Herstain, John Wiley and Sons Inc., 2nd Edition.

Reference Books:

(1) "Basic Abstract Algebra" by Bhattacharya, Jain and Nagpal, 2nd Edition.
(2) "Algebra" by S. Mcclane and G. Birkhoff, 2nd Edition,
(3) "Basic Algebra" by N. Jacbson, Hind. Pub. Corp.1984.
(4) "A first course in Abstract Algebra" by John Fraleigh (3rd Edition), Narossa Publishing House, New Delhi.

[MTHP-3] COMPLEX ANALYSIS

Unit-1 [**Revision:** Complex numbers and its polar and exponential forms, powers and roots]
Regions in the complex plane, continuity and differentiability of complex functions, analytic functions, Cauchy-Riemann equations, harmonic Functions of two variables, Infinite series of complex numbers, power series functions.

Unit-2 The elementary Functions: exponential, trigonometric, hyperbolic functions, logarithmic functions and its branches, rectifiable arcs. Complex line integral, complex contour integral, Cauchy's theorem for triangular contours, anti-derivatives.

Unit-3 Cauchy's integral formula, derivative of analytic functions, Morera's theorem, Liouville's theorem, Fundamental theorem of algebra, Taylor expansions, Laurent expansions.

Unit-4 Singularities, zeros of analytic functions, poles, residues, Residue Theorem, residue at poles, evaluations of improper integrals.

The course is covered by the book: Complex Variables and Applications (Fourth edition) by Rule V Churchill and James W Brown, McGraw Hill, International Editions.

References:

1. John Duncan, The Elements of Complex Analysis, John Wiley & Sons Ltd, London. (1968)
2. L V Ahlfors, Complex Analysis, 3rd edition, McGraw Hill, International Editions, New York-1966
3. J B Conway, Functions of one complex variables, 2nd edition, Springer Verlag, New York (1973) (Indian edition: Narosa Publication House, New Delhi. (1982))
4. Serge Lang, Complex Analysis, Addison- Wesley, Publishing Co. (1997)
5. B Choudary, The Elements of Complex Analysis, 2nd edition, New Age International Ltd Publishers, New Delhi. (1992)
6.

[MTHP-4] GENERAL TOPOLOGY

Unit 1 Topological Spaces: Topological spaces, basis and sub-basis for a topology (definitions and examples only), The order topology, the product space Π Xi (for finitely many topological spaces ni), subspace topology , closed sets, limit points.

Unit 2 Continuous Functions: Continuous functions, Homeomorphisms, the pasting lemma, Map into products, the metric topology, the sequence lemma , Uniform limit theorem, The quotient topology.

Unit 3 Connectedness : connected spaces, path connected spaces, connected sets in the real line, components and path–components, locally connected spaces and path connected spaces.

Unit 4 Compactness: compact spaces, compact sets in the real line, limit–point compactness, locally compact spaces, one–point compactificaton.

Note: All results and examples are to be excluded which use the concept of the product topology of a collection of infinitely many topological spaces.

The course is covered by "Topology – A first course" – by J. R. Munkres, Prentice – Hall of India, 1992.

Reference Books

(1) "General Topology" – by S. Willard, Addison Wesley, 1970.
(2) "Topology" – by J. Dugundji, Prentice – Hall of India, 1975.
(3) "Aspects of Topology" – by C. O. Christonson and W. l. Voxman, Marcel Dekker Inc., 1977.
(4) "General Topology" – by J. L. Kelley, D. Van Nostraml, 1950.

[MTHP-5] ADVANCED TOPOLOGY

Unit 1 Countability Axioms: First countable space, second countable space, separable space, Lindeloff space

Unit 2 Separation axioms- Hausdorff space, regular space, normal space, Urysohn's lemma, Completely regular space, Tietze extension theorem.

Unit 3 **I**mbedding of Manifolds, Partition of unity, Tychonoff theorem (statement only), The Stone-cech Compactifications and uniqueness.

Unit 4 Complete metric space, Compactness in metric spaces, Ascoli's theorem, Bair spaces, Baire category theorem.

Note: All results and examples are to be excluded which use the concept of the product topology of a collection of infinitely many topological spaces.

The course is covered by "Topology – A first course" – by J. R. Munkres, Prentice Hall of India, 1992.

Reference Books

(1) "General Topology" – by S. Willard, Addison Wesley, 1970.
(2) "Topology" – by J. Dugundji, Prentice – Hall of India, 1975.
(3) "Aspects of Topology" – by C. O. Christonson and W. l. Voxman, Marcel Dekker Inc., 1977.
(4) "General Topology" – by J. L. Kelley, D. Van Nostraml, 1950.

(5)

[MTHP-6] FUNCTIONAL ANALYSIS-I

Unit 1 Normed linear space: definition and examples, continuous linear transformations, spaces BL(X,Y), BL(X) and BL(X,X), l^p & L^p (for $0 \leq p \leq \aleph$) Banach spaces.

Unit 2 Hahn-Banach theorem and its applications, open mapping theorem, Dual normed spaces, natural imbedding of normed space into double dual space of normed spaces.

Unit 3 Closed graph theorem, uniform boundedness principle, conjugate of an operator, bounded inverse mapping theorem.

Unit 4 Hilbert space: definition and examples, orthogonal complement, orthonormal set, Bessel's inequality, Projection theorem, Riesz Representation theorem.

Note: The course is roughly covered by the following books:

1. G. F. Simmons: Introduction to Topology and Modern Analysis, Tata McGraw,1963

2. B. V. Limaye: Functional Analysis, 2nd Edition, New Age International Ltd. Publishers.

Reference Books:

(1). S. K. Berberain: Lectures in Functional Analysis and Operator theory, Springer Verlag.
(2). Goffman and George Padre: First course in Functional Analysis, Prentice Hall of India.
(3) Martin Schechter: Principles of Functional Analysis (student edition) Academic Press, N York.

[MTHP-7] FUNCTIONAL ANALYSIS-II

Unit 1 Dual and transpose of a Hilbert spaces, adjoint of an operator, self-adjoint, normal, unitary operators, projections.

Unit 2 Finite dimensional spectral theorem, Weak and weak* convergence..

Unit 3 Banach algebra: definition and examples, regular and singular elements , topological divisiors of zero, spectral of an element and spectral radius, radical and simplicity..

Unit 4 Gelfand mapping, applications of the formula of the spectral radius, involutions in Banach algebra, Ideals in C(X), Banach-Stone theorem, Commutative C*-algebras, Stone-Weierstras theorem, Gelfand-Naimark theorem for commutative C*-algebra.

Note: The course is roughly covered by the following books:

1.G. F. Simmons:Introduction to Topology and Modern Analysis, McGraw Hill,1963.

2.B. V. Limaye: Functional Analysis, 2nd Edition, New Age International Limited, 2nd edition.

Reference Books:

(1). R Larson : Banach Algebra, Marcell Dekker,1973.
(2) H G Dales : Automatic Continuity, Cambridge, 2000
(3) S. K. Berberain: Lectures in Functional Analysis and Operator theory, Springer Verlag.
(4). Goffman and George Padre: First course in Functional Analysis, Prentice Hall of India.
(5) Martin Schechter: Principles of Functional Analysis (stud. ed.) Academic Press, New York.

[MTHP-8] ALGEBRA-II (FIELD THEORY)

Unit 1 Extensions of field, Finite, algebraic and simple field extensions, algebraic and transcendental numbers.

Unit 2 Roots of polynomials, the splitting field of a polynomial over a field, construction with straightedge and compass.

Unit 3 The fixed field of a group of automophisms, the theorem on symmetric polynomials, normal field extension, the Galois group of a polynomial.

Unit 4 The fundamental theorem of Galois theory, solvability by radicals, Galois group over the rationals, finite fields,

Note: The topics are roughly covered by chapter 5 (all articles) and chapter 7 (7.1 and 7.2 only) of the book, entitled "Topics in Algebra" by I. N. Herstein 2nd Edition. Wiley Eastern Ltd., 1975.

Reference Books:

1. "Basic Algebra" by Jacobson Vol. I & II Hindustan Publishing Co., 1984.
2. "Basic Abstract Algebra" by P B Bhattacharya, S K Jain, S R Nagpaul, 2nd Edition, Cambridge University Press, 1995.
3. "Algebra", by Lang S, Addison – Wesley, Reading, Mass, 1965.
4. "Algebra", by Artin M, Prentice Hall, Englewood Cliffs N J, 1991.
5. "Abstract Algebra" by David S. Dummit and Richard M – Foote, Prentice Hall, Englewood.
6. "University Algebra" by Vijay Krishnan.
7. "A first course in Abstract Algebra" by John Fraleigh, Nawsa Publishing 3rd Edition House.
8. A textbook of Modern Abstract Algebra" by Shantinaryan & Satpal, S. Chane & Company.

(II) ELECTIVE DISCIPLINARY COURSES: (MTHE-1 TO 4)

All elective courses carry 4 credits in 4 Hours per week teaching and there are 4 Mathematical Elective Courses to be chosen from the lists of COURSEs of not more than Two groups: three groups are Group-A, Group-B, Group-C ,

1. Group-A : Pure Mathematical Group

1. **Differential Geometry**
2. **Techniques of Differential Equations**
3. **Number Theory**
4. **Algebraic Topology-I : Homotopy Theory**
5. **Algebraic Topology-II : Homology And Cohomology Theory**
6. **Functions of Several Variable**
7. **Differentiable Manifolds**

(**β**) LIST OF COURSES FOR GROUP-A

[MTHE A-1] DIFFERENTIAL GEOMETRY

Unit 1 Velocity vector and tangent vector field, reparametrization, curvature, the Serret – Frenet apparatus and Serret – Frenet theorem.

Unit 2 The fundamental existence and uniqueness theorem for curves, non–unit speed curves. C^k coordinate patch, C^k coordinate transformation, tangent vectors to a simple surface, C^k surface in $\mathbf{R}^3$,

Unit 3 Metric coefficients, The first fundamental form and arc length, normal curvature, geodesic curvature and Gauss's formulas, second fundamental form and the Christoffel symbols,

Unit 4 Geodesics, generalizations of the properties of the straight lines to curves on surfaces. Parallel vector fields along a curve and parallelism, the second fundamental form and the Weingarten map, principal, Gaussian, mean and normal curvatures,

Note: The course is roughly covered by the book, entitled,
"Elements of Differential Geometry" by R. S. Millman and G. D. Parker, Prentice Hall, 1977.

Reference Books:

1."Elementary Differential Geometry" by B. O'Neill, Academic Press,1966
2. "Introduction to Differential Geometry" by A. Goetz, Addison – Wesley, 1970.
3. "Differential Geometry of Curves and Surfaces" by M. Do Carma, Prentice Hall, 1976.
4. "Differential Geometry" by J. Stocker, New York, Inter Science, 1969.
5. "Introduction to Differentiable Manifolds and Reimannian Geoemetry" by W. Boothby, Academic Press, .
6. "Notes on Differential Geometry" by N. Hicks, Van Nostrand, 1965.

[MTHE A-2] TECHNIQUES OF DIFFERENTIAL EQUATIONS

Unit 1 Simultaneous ordinary differential equations of first order and first degree, pfaffian method, total differential equations, partial differential equations of the first order.

Unit 2 Cauchy's Problem (Only Statement), Geometrical interpretation, linear equations, nonlinear equations,

Charpit's method, Jacobi's method.

Unit 3 Equation of second order, linear equations with constant and variable coefficients , the three canonical forms, method of separation of variables, Monge's method for Rr + Ss +Tt = V.

Unit 4 Laplace's Equations: Elementary solutions boundary value problems, separation of variables, solution with axial symmetry, the two dimensional equation.Wave Equations: One dimensional equation, three dimensional problems, general solutions of Kirchoff, diffusion equation, boundary value problems, elementary solutions, separation of variables.

The Syllabus is roughly covered by:

I. N. Snedden "Elements of Partial Differential Equations" (McGraw – Hill). Chapter – 1 (Omit 4, 7, 8), Chapter – 2 (Omit 8) Chapter – 3 (Omit 6, 7, 10), Chapter – 4 (Omit 7,8,9,10,13), Chapter – 5 (Omit 3,4,7,8,9,10), Chapter – 6 (Omit 5,6,7).

Reference Books

1. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand & Co.
2. Gerald B Folland, Introduction to Partial Differential Equations, 2nd edition, Prentice-Hall of India.(2001)

[MTHE A-3] NUMBER THEORY

Unit 1 Divisibility, G.C.D., Primes, the fundamental theorem of arithmetic, the Euclidean algorithm, The greatest integer function, the Mobius function μ, the Euler function Φ, the divisor functions σ_k for $k \geq 0$ integer, properties of these functions, multiplicative functions, Mobius inversion formula.

Unit 2 Congruence, complete residue systems, Linear Congruence, reduced residue systems, Euler–Fermat theorem, the Chinese remainder theorem, The exponents of a number mod *m*, primitive roots.

Unit 3 Quadratic residues, Legendre Symbol and its properties, Gauss' Lemma, the quadratic reciprocity law, the Jacobi Symbol.

Unit 4 Diophantine Equations ax + by = c and its positive solutions, the equation $X^2 + Y^2 = Z^2$, the equation $X^4 + Y^4 = Z^2$ and the equation $X^4 + Y^4 = Z^4$, sum of squares, the Fermat's Last theorem.

Note: The course is roughly covered by the book, entitled "Elementary Number Theory", 2nd edition, by David M. Burton (Wm. C. Brown Publishers, 1989).

Reference Books:

1. I. Niven and H. Zukerman "An introduction to the theory of Numbers" 3rd edition, Wiley Eastern University Edition, New Delhi, 1985.
2. T. M. Apostol, "Introduction to Analytic Number Theorem", Springer studt edition, 1995.
3. Baker Alan, "A concise Introduction to the theory of Numbers", Cambridge, University, press, 1984.
4. Rose H. E., "A course in number theory", Oxford University Press, 1988.
5. Shapiro, Harold, "Introduction to the theory of Numbers", John Wiley and Sons, 1983.
6. Hardy, G. H. and E. M. Wright "An Introduction to the theory of Numbers", 5th edition, Oxford University Press, 1975.
7. T. Nagell "Introduction to Number Theory", 2nd edition, chelsea, 1984.

[MTHE A-4] ALGEBRAIC TOPOLOGY-I : HOMOTOPY THEORY

Unit I Homotopy theory: Homotopy of paths and loops , Product of two loops, Fundamental group, homomorphism induced by homotopy, retraction.

Unit II Covering spaces ,The fundamental groups of the circle , Lifting of a path, Path lifting theorem, Lifting correspondence, generator and order, Retractions and fixed points, no retraction theorem, Brouwer fixed-point theorem.

Unit III The fundamental theorem of algebra,The Borsuk-Ulam theorem, Deformation retracts and homotopy type, first fundamental group of doubly punctured plane and theta-space, homotoy equivalence, the fundamental group of the punctured plane, the n-sphere S^n .

Unit IV Fundamental group of some surfaces: figure eight, tourus and double torus, projective plane, The Jordan Separation Theorem and Nulhomotopy lemma for S^2.

Note: The course of unit-I to IV is roughly covered by the book, entitled: "Topology" by James R Munkres, second edition-Pearson education, 2004.

Reference Books:

1. Elements of Algebraic Topology" by James R. Munkres Addison – Wesley Pub. Co., 1984.

2. "Basic Concepts of Algebraic Topology" by Fred H. Croom Springer, Verlag, 1978.
3. "Algebraic Topology: An Introduction" by W. S. Massey Springer Verlag, 1977.
4. "Homology Theory" by S. T. Hu, Holden–Day, Inc. San Francisco, 1966.
5. Algebraic Topology" by C. R. F. Maunder Van Nostrand Reinhold Co., 1970.
6. "Algebraic Topology" by E.H. Spanier, McGraw – Hill Book Co., 1966.
7. "Aspects of Topology" by Charles O. Christenson and William L. Voxman, Marcel Dekker Inc.,
8. "Algebraic Topology: An Introduction" by W. S. Massey Harcourt Brace Jovanovich, 1967.
9. "Algebraic Topology" by E. H. Spanier, McGraw-Hill Book Co. 1966.

[MTHE A-5] ALGEBRAIC TOPOLOGY-II : HOMOLOGY AND COHOMOLOGY THEORY

Unit 1 Simplicial Homology Groups: Geometric complexes and polyhedra, orientation of complexes, Homology, groups, The structure of Homology groups.

Unit II The Euler–Poincare theorem, the computability of homology groups, pseudomanifolds and the Homology groups of S^n.

Unit III Simplicial Approximation and the Topological Invariance of the Homology Groups: Simplicial approximation, Barycentric subdivision, Simplicial approximation theorem, Induced homomorphisms on the homology groups.

Unit IV Topological invariance of the homology groups, the Brouwer fixed–point theorem and the related results, Developments in the Cohomology Theory: The Lefschtz fixed–point theorem, Relative homology and Exact homology.

Note: The course is roughly covered by the book, entitled. "Elements of Algebraic Topology" by James R. Munkres Addison – Wesley Publishing Co., 1984.

Reference Books:

1. "Basic Concepts of Algebraic Topology" by Fred H. Croom , Springer Verlag, 1978.
2. "Algebraic Topology: An Introduction" by W. S. Massey Springer Verlag, 1977.
3. "Homology Theory" by S. T. Hu, Holden–Day, Inc. San Francisco, 1966.
4. "Algebraic Topology" by C. R. F. Maunder Van Nostrand Reinhold Co., 1970.
5. "Algebraic Topology" by E.H. Spanier, McGraw – Hill Book Co., 1966.

[MTHE A-6] FUNCTIONS OF SEVERAL VARIABLES

Unit 1 **Mappings and their Differentials:** Continuous mapping, definition of a differential, differentiability implies continuity, special cases, functions of class **C**, mapping of Class C, compositions of differentiable mappings, higher differentials.

Unit 2 **Mapping into the Reals:** Taylor's theorem for one variable and for *n*-variables, absolute maxima and minima, location of maxima and minima.

Unit 3 Volume of a set, integral on a closed interval, condition for integrability, integral on an open set, iterated integral, volume of n–ball, interchange of order of integration with differentiation.

Unit 4 **Main theorems on Mappings:** Regular elements in L(E.F), inverse of a mapping, implicit function theorem, determinant, oriented volume, change of variables in integration, length and area.

Note: The course is covered by "Calculus of Several Variables" - by Casper Goffman, Jointly Pub: Harper & Row, New York and John Weatherhill, Inc., Tokyo, 1965.

Reference Books:

(1) "Calculus on Manifolds" – by M. Spivak.
(2) "Functions of Several Variables" – by W. H. Fleming, Addison Wesley Pub. Co.
(3) "Advanced Calculus" – by H. K. Nikerson, D. C. Spencer and N. E. Steenrod, Affiliated East and West Pvt. Ltd., New Delhi.
(4) "Calculus of Several Variables" – by S. Lang.

[MTHE A-7] DIFFERENTIABLE MANIFOLDS

Unit 1 **Introduction to Manifolds:** Topological manifolds, Cutting and Pasting, Abstract Manifolds and examples. **Functions of Several Variables and mappings: D**ifferentiability for functions of several variables.

Unit 2 **D**ifferentiability of mapping and Jacobians, The space of tangent vectors at a point of $\mathbf{R}^n$, another definition of $T_n(R^n)$, Vector fields on open subsets of $\mathbf{R}^n$.

Unit 3 The inverse function theorem. The rank of a mapping, Differentiable manifolds and submanifolds: Differentiable manifolds and examples, Differentiable functions and mappings.

Unit 4 Rank of a mapping, Immersions, Submanifolds , Lie Groups, the action of a lie group on a manifold.

Note: The syllabus is roughly indicated by "An Introduction to Differentiable Manifolds and Riemannian Geometry" William, M. Boothby, Academic press Chap. 1 to 3.

Reference Books:

1. "Introductions to Differentiable Manifolds" – Serge Lang, Interscience publishers.
2. "Differentiable Manifolds" – Matsushima, Marcel Dekker, Inc.
3. "Calculus on Manifolds" – M. Spivak, Benjamin.
4. "Differentiable Manifolds" – S. T. Hu. Holt, Rienhart and Winston, Inc.

2. Group-B : Applied Mathematical Group

1. Classical Mechanics-I
2. Classical Mechanics-II
3. Electrodynamics-I
4. Electrodynamics-I
5. Theory of Relativity
6. Relativity and Cosmology

(γ) LIST OF COURSES FOR GROUP-B

[MTHE B-1] CLASSICAL MECHANICS-I

Unit I Generalized co-ordinates, holonormic, non–holonormic, rheonomous and scleronomous constraints, derivation of Largrange's equations from D'Alembert's principle.

Unit II **V**elocity dependent potentials (electromagnetic case to be omitted); Rayeigh's dissipation function and applications, Hamilton's principle and derivation of Largrange's equations from Hamilton's principle.

Unit III Extensions of Hamilton's principle to non–conservative and non–holonomic dynamical systems.

Unit IV **C**yclic coordinates and Routa's properties, applications of LaGrange's formalism to two–body problem.

Note: The course is roughly covered by the book "Classical Mechanics' by H. Goldstein (2nd Edition), Narosa Publishing House, 1985.

Reference Books:

1. H. C. Corhen and P. Stechle: "Classical Mechanics", Wiley, New York, 1950.
2. J. B. Griffith: "The theory of Classical Dynamics", Cambridge Uni., Press, 1985.
3. L. D. Landan and E. M. Lifshiftz: "Mechanics", Pergenion Press, 1969.

[MTHE B-2] CLASSICAL MECHANICS-II

Unit I Derivation of Hamilton's canonical equations of motion from both differential and integral principles; canonical transformations and the four types of generating functions.

Unit II Poisson's brackets as canonical invariants, Hamilton's canonical equations in Poisson bracket notation and conservation theorems, the Hamilton's – Jacobi equation and it's solution.

Unit III The number of independent coordinates of a rigid body; Eulerian angles, rate of change of a vector and coriolis force. angular momentum and kinetic energy of a body about a point.

Unit IV inertia tensor and the moment of inertia, Euler's equations of motion for rigid body and their solution for torque free motion; motion of a heavy symmetrical top with one point fixed.

Note: The course is roughly covered by the book "Classical Mechanics' by H. Goldstein (2nd Edition), Narosa Publishing House, 1985.

Reference Books:

1 H. C. Corhen and P. Stechle: "Classical Mechanics", Wiley, New York, 1950.
2 J. B. Griffith: "The theory of Classical Dynamics", Cambridge Uni., Press, 1985.
3 L. D. Landan and E. M. Lifshiftz: "Mechanics", Pergenion Press, 1969.

[MTHE B-3] ELECTRODYNAMICS-I

Unit 1 Introduction to Electrostatics: Coulomb's Law, Gauss's Law, equations of electrostatics.

Unit II Green's theorem, electrostatic potential energy and energy density.

Unit III Boundary Value Problems in Electrostatics: Method of images, some illustrations of the method of images, boundary value problems with azimuthal symmetry.

Unit IV Electrostatics of Marocoscopic Media, Dielectrics: Elementary treatment of electrostatics with ponderable media, boundary value problems with dielectrics, electrostatic energy in dielectric media.

Note: The course is roughly covered by "Classical Electrodynamics" by J. D. Jackson, Wiley Eastern Ltd., 2nd Edition, 1978.

Reference Books:

(1) "Introduction to Electrodynamics" by David J. Griffith, Prentice Hall of India, 2nd Edition.

(2) "Classical Electrodynamics" by Wajedmiah

[MTHE B-4] ELECTRODYNAMICS-II

Unit I Magnetostatics: Biot and Savart Law, differential equations of magnetostatics. Ampere's law, magnetic fields, magnetic moment, macroscopic equations, boundary value problems in magnetostatics, time–varying fields, Maxwell's equations.

Unit II Faraday's law, energy in magnetic field, displacement current and Maxwell's equations, vector and scalar potentials, equations of macroscopic electromagnetism, Poynting theorem.

Unit III Special Theory of Relativity and Electromagnetic Fields: Einstein's two postulates, Lorentz transformations and basic kinematic results of special relativity, four-velocity, mathematical properties of space – time of special relativity.

UNIT IV Transformations of electromagnetic fields, the question of obtaining the magnetic field, magnetic force and Maxwell's equations from Coulomb's law and Special Relativity, Lagrangian for electromagnetic field, canonical and symmetric stress tensors and conservation laws, solution of the wave equation in covariant form.

Note: The course is roughly covered by of the book, entitled,"Classical Electrodynamics" by J. D. Jackson, Wiley Eastern Ltd., 2nd Edition, 1978.

Reference Books:

(1) "Introduction to Electrodynamics" by David J. Griffith, Prentice Hall of India, 2nd Edition.

(2) "Classical Electrodynamics" by Wajedmiah

[MTHE B-5] THEORY OF RELATIVITY

Unit 1 Space – Time Curvature: Geodesics, geodesic deviation, parallel transport along an extended curve, curvature tensor, the Ricci tensor, scalar curvature and Einstein tensor.

Unit II Space – Time symmetries, displacement of space–time, some properties of killing vectors, homogeneity and isotropy space – time of constant curvature, symmetric subspaces.

Unit III Energy Momentum Tensors, the action principle, the electromagnetic theory, Energy momentum tensors (general), conservation laws.

Unit IV Einstein Equations of Gravitation: Accelerated observers in Minkowski space–time, Einstein's equations: a heuristic derivation, Einstein's equations from an action principle, the Newtonian approximation, the principle of equivalence, gravitational waves.

Note: The course is roughly covered by the book, entitled "Lectures on General Relativity and Cosmology" by J. V. Narlikar, The Macmillan Company of India, N.Delhi, 1978.

Reference Books:

1. "A Papapetron Lectures on General Relativity", D. Reidel, Dordrecht, The Netherlands, 1974.
2. R. Alder, M – Bazine and M. Schiffer, "Introduction to General Relativity", McGraw Hill – Kogakusha,Tokyo, 1975.

[MTHE B-6] RELATIVITY AND COSMOLOGY

Unit I The Schwarzschild Solution: The spherically symmetric space–time, field equations, the Schwarzschild solution, particle orbits in Schwarzschild space–time, photon orbits.

Unit II Experimental Tests of General Relativity, the gravitational red–shift, planetary motion, the bending of light, the Radar echodelay.
Strong Gravitational Fields (I): Equilibrium of massive spherical objects, binding energy, gravitational Collapse of a dust ball.

Unit III Strong Gravitational Fields (II): The external Schwarzschild solution, The Kruskal – Szekers diagram, The Kerz – Newman solution.

Unit IV The Friedmean Models: The cosmological field equations, the dust models, Radiation models, cosmologies with a non–zero Λ.
Cosmology: The observational background the cosmological postulates, observable parameters in Robertson–Walker models.

Note: The course is roughly covered by the book, entitled "Lectures on General Relativity and Cosmology" by J. V. Narlikar, The Macmillan Company of India, N Delhi, 1978.

Reference Books:

1 "A Papapetron Lectures on General Relativity", D. Reidel, Dordrecht, The Netherlands, 1974.
2 R. Alder, M – Bazine and M. Schiffer, "Introduction to General Relativity", McGraw Hill – Kogakusha, Tokyo, 1975.

3. Group – C: Applicable Mathematics Group

1. Mathematical Modelling
2. Mathematical Logic
3. Introduction To Artificial Intelligence
4. Operations Research
5. Advanced Operations Research
6. Statistical Methods

7. Mathematics Of Finance And Insurance
8. Computational Biology
9. Fuzzy Sets And Their Applications
10. BIO-MECHANICS
11. MATHEMATICS OF MONEY

(δ) LIST OF COURSES FOR GROUP-C

[MTHE C-1] MATHEMATICAL MODELLING

Unit 1 Introduction to the subject, its scope and limitation, classification of models. Dimensional Homogeneity, Technique of dimensional analysis, an arithmetic model of Gravity, Simple population growth model, Logistic population growth model, Geometric interpretation of logistic growth function.

Unit 2 Two Species Population Models: Prey–Predator models for population dynamics, Geometric interpretation and stability of Prey-Predator model, competition model, Epidemic Models, Simple deterministic model, SIS Model, Epidemic Models with constant number of carriers, Epidemic model with removal.

Unit 3 Diffusion and Glucose in the Blood stream, Model for diabetes Mellitus, Genetics Models: Hardy-Weinberg law model for genetics, Genetics model for Blood groups.

Unit 4 Traffic Models: Macroscopic Highway traffic model, continuum hypotheses and the fundamental diagram, linear-car-following models.

Note: The course is roughly covered by the following two books:

1. J. N. Kapur, *Mathematical Modeling*, Wiley Eastern Ltd., 1988.
2. J. N. Kapur, *Mathematical Models in Biology and Medicine*, East–West press Pvt. Ltd., 1992.

Reference Books:

1. Braum, Colemem & Drew, *Differential Equation Models*, Springer–Verlag, 1983.
2. Martin Braun, *Differential Equation and their applications*, Springer-Verlag, 1977.
3. Dym & Ivey, *Principles of Mathematics Modeling*, , Academic press – 1980.
4. Lucas & Roberts, *Discrete and system models*, Springer Verlag, 1983.
5. Haberman, *Mathematical Model*, Prentice–Hall Inc., 1977.

[MTHE C-2] MATHEMATICAL LOGIC

Unit 1 PROPOSITIONAL LOGIC: Syntax: Atomic formulae; logical connectives: $\neg$ *and V*; formulae; defined logical connectives: $\wedge, \Rightarrow, \Leftrightarrow$.Semantics: Truth valuation as a map ν from the set of all atomic formulae int $\{T, F\}$, Extension of ν to the set of all formulae, Truth table, Tautological consequences and Tautologies. Axioms and Rules of Inferences: Propositional Axioms; Extension, Contraction, Associative and cut rules; The notion of a proof and of a theorem of Propositional Logic.Tautological Equivalence and Conjunctive Normal Form of A Formula: Algorithm to find a conjunctive normal form of a formula.Post's Tautology Theorem (Completeness of Propositional Logic).

Unit 2 FIRST ORDER LOGIC: Sytax: Variables, propositional connectives: $\neg$ and V, Quantifier $\exists$, Equality symbol = ; Non–logical constant, function and predicate symbols; defined connective: $\forall$; Terms, Atomic formulae, formulae, subformulae of a formula, bound and free occurrence of a variable in a formula, closed formula, substitutability. Semantics: Structure of a first order language, The notion of truth of a formula in a structure (via name of each element of the universe). Axioms and Rules of Inferences: Logical axioms–propositional identity, equality and substitution axioms; Rules of inferences–Expansion, contraction, associative, cut and $\exists$-introduction rules; Non–logical axioms; Notion of a first order theory + some examples of first order theories. Models: The notion of a proof and theorem of first order theory, Model of a first order theories; validity (or soundness) Theorem.

Unit 3THEOREMS IN FIRST ORDER THEORIES: autology Theorem for First Order Theories: [and few simple applications, Induction on theorems]. Results on Quantifiers: $\forall$-introduction rule, Generalization and Substitution Rules, Substitution Theorem,Distribution Rule and Closure Theorem. The Deduction Theorem: Deduction Theoremand Theorem on constants. The Equivalence and Equality Theorems: EquivalenceTheorem, Variant Theorem, Symmetry and Equality Theorems. The Prenex NormalForm: Including the Algorithm to reduce a formula in prenex normal form.

Unit 4 THE COMPLEMENTS THEOREM:
Reduction Theorem for Consistency: Consistent theories, Reduction Theorem for consistency, conservative extension, Equivalent Theories, statement of completeness theorem. Complete Theories: Complete Theories, Henkin theories, Henkin Model of a complete Henking theory.

Reference Books:

1. Shoenfield – "Mathematical Logic", Addison Wesley.2. Change, C. L. and Lee, R. T. C. – "Symbolic Logic and Mechanical Theorem Proving", Academic Press.

[MTHE C-3] INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Unit 1 PROOF OF COMPLETENESS THEOREM: Henkin Extension of a consistent theory, Lindenbaum's theorem, the proof of completeness theorem.
Extensions by Definitions and Interpretations: Proof of Completeness Theorem, Compactness Theorem

Unit 2 RECURSIVE FUNCTIONS:
Initial functions composition and minimization; Definition of recursive function, Examples of recursive function and predicates; Sequence Numbers, Godel's β-function, Closure under primitive recursion, Recursively Enumerable predicates, Characterization of recursive predicates as recursively enumerable predicate whose negation is also recursively enumerable.

Unit 3 AN INTRODUCTION TO ARTIFICIAL INTELLIGENCE:
Resolution Method for Propositional Logic: Atoms, Literals, clauses. Resolvant of two clauses; Refutation of a set of clauses; Tree of a set of clauses, failure nodes, closed subtrees of semantic tree, Inference mode; Equivalence of unsatisfiability of a set of clauses and its refutation.
Skolemization and Herbrand Universe: Skolem normal form, Algorithm to reduce a formula in Skolen normal form; Herbrand universe and Herbrand interpretations; A set *S* of clauses is satisfiable iff a Herbrand interpretation of *S* is sastisfiable; Herbrand base of a set of clauses, ground instance.

Unit 4 Herbrand theorem showing that if a set *S* of clause is unsatisfiable then there is a finite unsatisfiable set of ground instance of clauses of *S*.

The Resolution Principle for Predicate Calculus: Substitution and instances of expressions; Refutation of a set *S* of clauses; Resolution procedure.

The Unification Algorithm: A unifier of a set of expressions – most general unifier; the unification Algorithm; the unification theorem.

Reference Books:

1. Shoenfield – "Mathematical Logic", Addison Wesley.
2. Change, C. L. and Lee, R. T. C. – "Symbolic Logic and Mechanical Theorem Proving", Academic Press.

[MTHE C-4] OPERATIONS RESEARCH

UNIT – I Development – Definition– Characteristics and Phases – Types of models – operation Research models – applications. ALLOCATION: Linear programming Problem Formulation – Graphical solution – Simplex method –Artificial variables techniques - Big-M method – Duality Principle.

UNIT – II TRANSPORTATION PROBLEM: Formulation – Optimal solution, unbalanced transportation problem – Degeneracy – Maximization case. ASSIGNMENT PROBLEM: Formulation – Optimal solution – Variants of Assignment Problem.

UNIT – III THEORY OF GAMES: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – dominance principle – m X 2 & 2 X n games -graphical method.

UNIT – IV PROJECT MANAGEMENT (CPM & PERT): Network concepts components– rules for network construction – critical path method (CPM) – Project evaluation and Review Techniques (PERT) PRODUCTION SCHEDULING (JOB SEQUENCING): Introduction, Johnson's algorithm for n jobs 2 machines, Johnson's algorithm for N jobs m machines, 2 jobs m machines using graphical method.

Books:

1. J. K. Sharma, "Operations Research – Theory and Application", 4th Edition, Macmillan Publishers India Ltd.
2. N H Shah, Ravi Gor, Hardik Soni, "Operations Research", PHI

[MTHE C-5] ADVANCE OPERATIONS RESEARCH (OPTIMIZATION TECHNIQUES)

UNIT – I Introduction to optimization - Statement of an Optimization Problem - Classification of Optimization Problems - Optimization Techniques Advance topic in LPP: Introduction - Revised Simplex Method- Sensitivity or Post optimality Analysis- Karmarkar's Interior Method-Quadratic Programming

UNIT – II Classical Optimization Techniques - Single-Variable Optimization - Multivariable Optimization with No Constraints - Multivariable Optimization with Equality Constraints - Multivariable Optimization with Inequality Constraints

UNIT – III INTEGER PROGRAMMING: Integer Linear Programming - Gomory's Cutting Plane Method – Integer Nonlinear Programming - Branch-and-Bound Method - Sequential Linear Discrete Programming

UNIT – IV DYNAMIC PROGRAMMING: Introduction - Multistage Decision Processes - Concept of Sub optimization and Principle of Optimality - Computational Procedure in Dynamic Programming – Example Illustrating the Calculus Method of Solution, the Tabular Method of Solution – Conversion of a Final Value Problem into an Initial Value Problem

Books:

1. Singiresu S. Rao, "Engineering Optimization: Theory and Practice," 4th Edition, John Wiley & Sons, Inc.
2. Stephen Boyd and Lieven Vandenberghe, "Convex Optimization", CAMBRIDGE UNIVERSITY PRESS

[MTHE C-6] STATISTICAL METHODS

Unit-1: Descriptive Statistics and Correlation

- Introduction to Statistics
- Applications in Business & Economics; Data: Summarizing Qualitative & Quantitative Data

- Exploratory Data Analysis: The Stem-and-leaf Display; Cross Tabulation & Scatter Diagrams
- Measures of location: Mean, Median, Mode, Percentiles, Quartiles; Measures of Variability: Range, Inter-quartile Range, Variance, Standard Deviation, Coefficient of Variation
- Measures of Distribution Shape, Relative Location and Detecting Outliers
- Measures of Association Between Two Variables; Covariance, Correlation

Unit-2: Probability & Probability Distribution

- Probability: Basic probability concepts (Experiment, sample space, events, exclusive events, exhaustive events, independent events, dependent events), methods for assigning probability (Classical method, relative frequency method, subjective method), events and their probability, addition rule (not to be proved or derived), conditional probability, multiplication rule (not to be proved or derived), Bayes' theorem (statement only, not to be proved or derived)
- Probability distribution: Random variable, Discrete and continuous random variable, expected value and variance of random variable, Probability distribution, Binomial distribution, Poisson distribution, Hypergeometric distribution, Uniform distribution, Normal distribution, Normal approximation of Binomial, exponential distribution, relationship between Poisson and Exponential distribution
- Note: Discuss pmf/pdf, properties and applications of all distribution

Unit-3: Statistical Inference

- Sampling methods, sampling distribution, central limit theorem (statement only), point and interval estimation, sampling distribution of sample mean, sampling distribution of sample proportion, Hypothesis tests: Null & alternative hypothesis, Type I & II errors, one and two tailed test, rejection rule using p-value and critical value approach, test of hypothesis about population mean (σ known, σ unknown and small sample), test of hypothesis about population proportion, Sampling distribution and test of hypothesis about difference between two population means (known and unknown σ_1 and σ_2) , sampling distribution and test of hypothesis about difference between two population proportions, analysis of variance (1-way, two-way).

Unit-4: Regression

- Introduction to Regression; Simple linear Regression Model; least Square Method; Coefficient of Determination; Correlation Coefficient;
- Model Assumptions; Residual Analysis: Validating Model Assumptions; Outliers and Influential Observations
- Using the Estimated Regression Equation for Estimation & Prediction

Main Reference Book:

1. Anderson, Sweeney, Williams, "Statistics for business and economics", 9th edition, Cengage Publication
2. Glyn Davis & Branko Pecar, "Business statistics using Excel", OXFORD University press (Indian Edition).

[MTHE C-7] Probability and statistics

Unit-I Combinatorial probability and urn models , Conditional probability, independence, Discrete and continuous sample spaces , Random variables.

Unit-II Distributions and density functions, mean and measures, Moment generating functions - probability laws (binomial, geometric, negative binomial, hypergeometric,Poisson, uniform, exponential, gamma)

Unit-III Standard discrete distributions uniform, binomial, Poisson, geometric, hypergeometric , Independence of random variables, joint and conditional discrete distributions , Densities: normal, exponential, gamma, Chi-square, beta, Cauchy

Unit-IV Expectation and moments of continuous random variables , Transformation of univariate random variables, Tchebychev's inequality and weak law of large numbers , Inferential statistics, estimation of parameters by method of moments and maximum likelihood.

References:

1. Harold J. Larson: Introduction to Probability Theory and Statistical Inference. Wiley 1982.
2. V. K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics. John Wiley & Sons 1976.
3. John Freund: Introduction to Probability. Dover Publications.
4. Marylees Miller, John E. Freund, Irwin Miller: John E. Freund's Mathematical Statistics: With Applications.

Prentice Hall, 2003.
5. William Feller: Introduction to Probability Theory and Its Application (Vol 1 and vol. 2). Wiley.
6. G. R. Grimmett, David R. Stirzaker: Probability and Random Processes. Oxford University Press, 2001.

[MTHE C-8] Computational Biology

Unit -1 Basic concepts of Molecular biology, DNA and Proteins, The Central Dogma, Gene and Genome Sequences.
Unit - 2- Restriction Maps - Graphs, Interval graphs. Measuring Fragment sizes, Algorithms for double digest problem ,(DDP) - Algorithms and complexity, Approaches to DDP.
Unit 3- Integer programming, Partition Problems, Traveling Salesman Problem (TSP) simulated annealing Sequence.
Unit 4- Assembly - Sequencing strategies, Assembly in practices, fragment overlap statistics.

Text Books:-

1- Introduction to Computational Biology by M.S, Waterman Chapman & Hall, 1995.
2- Bio informatics - A practical Guide to the analysis of Genes and Proteins by A. Baxevanis and B. Ouelette, WileyInterscience (1998).

Reference Books:-

1- Introduction to Bio informatics by Attwood.
2- Bioinformatics-Sequence and Genome analysis by David W.Mount.

[MTHE C-9] FUZZY SETS AND THEIR APPLICATIONS

Unit-1: Basics of Fuzzy Theory

(1) Fuzzy Set: Definition of Fuzzy set and set theoretic operations, Alpha-set, Normality, Extension Principle, Triangular norms (t-norms) and triangular conorms (t-conorms).

(2) Fuzzy numbers and fuzzy arithmetic: Interval arithmetic, Fuzzy numbers and their representation, Arithmetic of fuzzy numbers, Special types of fuzzy numbers and their arithmetic, Ranking of fuzzy numbers

Unit-2:

(1) Classical relation and fuzzy relation: Crisp relations, fuzzy relations, Tolerance and equivalence relations, fuzzy tolerance and equivalence relation.

(2) Properties of Membership Functions, Fuzzification and Defuzzification: Features of membership functions, fuzzification, defuzzification to crisp sets, lambda-cuts for fuzzy relations, defuzzification to scalars

Unit-3: Logic and Fuzzy System

Logic: Classical logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System

(1) Development of Membership Functions: Membership value assignments by intuition, inference, rank ordering, inductive reasoning

(2) Automated Methods for Fuzzy Systems: Definitions, Batch Least squares algorithm, recursive least squares algorithm, gradient method, clustering method, learning from example, modified learning from example

(3) Rule-base Reduction Methods: Fuzzy system theory and Rule Reduction, Singular Value Decomposition, Combs method.

Unit-4: Fuzzy Logic Control Systems

Introduction, Control System Design, Architecture and Operation of FLC System, FLC system models, Applications of FLC systems

Main Reference Book:

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India (P) Ltd.
2. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer.
3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Wiley & Sons.
4. C. R. Bector and S. Chandra, "Fuzzy Mathematical Programming and Fuzzy Matrix Games", Springer.

[MTHE C-10] BIO-MECHANICS

Unit 1 Bio-physics of Human Cardio - vascular system: Types of Blood Vessels, Properties of Blood, Flow in Tubes, Poiseuibles law, Erythrocyte Sedimentation Rate , Stroke's law , Palatial flow in elastic vessels.

Unit 2- Bio - physics of Human Thermo- Regulation Head Flow in Human Dermal and Subdermal parts; Derivation of Governing partial differential equations Incorporating Microcirculation and perspiration.

Unit 3- Solution of steady state and Unsteady - state flow problems in one dimesion, application of finite element method and exact solutions.

Unit 4- Diffusion processes in biology ; diffusion in Tissue Fick's principle, One, two and three Dimensional diffusion problems and their solution, Water Transport, Diffusion through membranes.

Text books:

1- Introduction to Mathematical Biology by S.I. Rubinow, J. Wiley & Sons.

2- Biomechanics by Y.C, Fung, Springer - Verlag.

3- Introduction to Biomathematics by V.P. Saxena, Vishwa Prakashan (Wiley eastern)

Reference Book :-

1- Bio-fluid Dynamics by Mazumdar.

[MTHE C-11] MATHEMATICS OF MONEY

Unit-I The Simple Interest Theorem, Consesequenceis of the theorem, Financial Digression, Ambiguities when interest period is meseared in days, Number of days calulations, The Compound Interest Theorem, Consesequenceis of the theorem, The annual effective rate, time diagram and cash flows, interest rate of return (IRR), Financial Digression, The IRR uniquness theorem and its consequencies, the rule of 72,Inflation, The purchasing power theorem, consumer price index(CPI), personal taxes, the tax theorem.

Unit-II An ordinary annuity, the future value of an ordinary annuity theorem(OAT), consequences of OAT, the interest value of an OAT and its appications, An annuity due, the future value of an annuity due theorem(ADT), the present value of an ADT, perpetuities, loans and risks, examples of loans(bond, zero coupon bond, creditcard load)

Unit-III Amortization tables, the amortization theorem, periodic payments, the periodic payment theorem(PPT), consequencies of PPT, linear interpolations, credit cards payments, the credit card theorem and its appications, credit card numbers.

Unit-IV Bonds, noncallable bonds, the bond theorem, the price-yield theorem, accrued interest, duration, modified duration, convexity, portfolio, buying and selling stocks, the dollar cost averaging theorem, the long sale maintence level theorem, the short sale maintencence level theorem and its examples.

Books: Course covered by the book: An Introduction to the Mathematics of Money:Savings and Investing, David,Mendel and Wright,Springer,2000.

Reference books:

1. Investments, Bodie,Kane and Marcus, McGraw Hill, 2005, 6th ed.
2. Black-Scholes and Beyond:Option Pricing Models, McGraw Hill, 1997.
3. The Banker's Secret, Eisenson, Villard Books, New York, 1990.
4. The Handbook of Fixed Income Securities, Fabozzi and Mann, McGraw Hill, NY(2005), 7th ed.
5. Options, Futures and Other Derivatives, Hull, Prentice Hall,Upper Saddle River,New Jersey,2006,6th ed.
6. Interest Rate Modelling, Jemes and Webber, John Wiley and sons, NY,2000.
7. Investment Science, Luenberger, Oxford Uni. Press,NY,1997.

(III) Choice Based Optional Courses: CB_Group (MCB- 1 to 3)

All Choice based(disciplinary as well as inter-disciplinary) courses carry 2 credits in 2 hours per week teaching and there are 3 COURSEs to be chosen from the list of CB_Group.

1. Special Functions
2. Advanced Linear Algebra
3. Research Methodology
4. Fuzzy sets, Fuzzy Logic and Fuzzy Control System
5. Integral Transforms
6. Mathematics Of Finance And Insurance
7. Industrial Mathematics

(μ) LIST OF COURSES FOR MCB GROUP

[MCB-1] SPECIAL FUNCTIONS

Unit 1: Power series solutions, Gauss's Hypergeometric function.

Unit 2 Hermite Polynomials., Chebyshev Polynomials.

Unit 3: Legendre Polynomials.

Unit 4: Bessel Functions.

The Syllabus is roughly indicated by George F. Simmons: "Differential equations with applications and historical notes". Tata McGraw-Hill, Publishing Co. Ltd., New Delhi, 1974.

Reference Books:

1. An Introduction to Ordinary Differential Equations – E. A. Coddington, Prentice-Hall of India Private Ltd., New Delhi, 2001 .
2. Elementary Differential Equations (3rd Edition) – W. T. Martain and E. Relssner, Addison Wesley Publishing Company, inc., 1995.
3. Theory of Ordinary Differential Equations – E. A. Codington and N. Levinson, Tata McGraw hill Publishing co. Ltd. New Delhi, 1999.

[MCB-2] ADVANCED LINEAR ALGEBRA

Revision: Vector spaces, subspaces, bases and dimensions, dual spaces, linear transformations.

Unit-1 The algebra of linear transformations, characteristic roots, matrices.

Unit-2 Triangular canonical forms, nilpotent linear transformations.

Unit-3 Trace and transpose, a decomposition theorem, Jordan canonical forms,

Unit-4 Rational canonical forms., Determinants.

The course is roughly covered by the book entitled "Topics in Algebra", 2nd edition, by I N Herstein, John Wiley & Sons, Student Edition, New York. (2004)

References:

1. Kenneth Hoffman, Ray Kunze, Linear Algebra, 2nd edition, Prentice Hall of India, New Delhi. (1971)
2. P.B. Bhattacharya, Phani Bhushan Bhattacharya, S. K Jain, S. R. Nagpaul , First course in linear algebra, , New Age International Ltd Publishers, New Delhi. (2008)
3. Steven Roman, Advanced linear algebra, 3rd edition, Springer. (2008)

[MCB-3] RESEARCH METHODOLOGY

Unit 1 What is research? Science and research, Basic and applied research, Essential steps in research. Characteristic of scientific research. Research and experimental design.

Unit 2 Statistics: Definition and scope, data collection, classification, tabulation of data and its graphical and diagrammatic presentation. Measures of central tendency, dispersion and standard error, Probability, distributions, binomial, Poisson and normal distribution.

Unit 3 Statistical significance: Hypothesis testing, types of error, level of significance, various test and Chi-square goodness of fit, Simple linear regression and correlation analysis.

Unit 4 Scientific Writing , Research Proposal, Research Paper, Review Paper, Thesis, Conference Report, Book Review and Project Report (any two), Reference Writing, Scientific Abbreviations. Preparation and Delivery of Scientific Presentations, Research Report / Thesis Formatting and Typing (Computing),Title page, Certificate, Declaration, Acknowledgement, List of Table, Figures, Abbreviations and Symbols, Chapters Quotations, Table, Figures, Summary, Appendices, References etc.

References

1 How to write and publish a scientific paper by Day, R.A.
2 Guide to write scientific papers by Garson, G.D.
3 Developing Bioinformatics computer skill by Gibas.
4 Instrumental methods of analysis by D.A. Skoog

[MCB-4] FUZZY SETS, FUZZY LOGIC AND FUZZY CONTROL SYSTEM

Unit-1: Fuzzy Set Theory

Fuzzy versus Crisp, Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations

Unit-2: Fuzzy Systems

Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods, Applications

Unit-3: Fuzzy Logic Control Systems

Introduction, Control System Design, Architecture and Operation of FLC System

Unit-4: FLC system models, Applications of FLC systems

Main Reference Book:

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India (P) Ltd.
2. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer.
3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Wiley & Sons.

[MCB-5] INTEGRAL TRANSFORMS

Unit 1 Laplace transform- Definition and its properties. Rules of manipulation. Laplace transform of derivatives and integrals.

Unit 2 Properties of inverse Laplace transform. Convolution theorem. Complex inversion formula.

Unit 3 Fourier transform - Definition and properties of Fourier sine, cosine and complex transforms.

Unit 4 Convolution theorem. Inversion theorems. Fourier transform of derivatives.Mellin transform-Definition and elementary properties. Mellin transforms of derivatives and integrals. Inversion theorem. Convolution theorem.

List of books:

- The Fourier Transforms and its applications, by Ronald Bracewell
- Schaum's outline of Fourier analysis with applications to Boundary value problems, by Murray Spiegel
- The Laplace Transform: Theory and applications, by Joel L. Schiff
- Schaum's outline of Laplace Transforms, by Murray Spiegel
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[MCB-6] MATHEMATICS OF FINANCE AND INSURANCE

Unit-1	Elements of Theory of Interest
Unit-2	Flow Valuation Annuities
Unit-3	Amortization and Sinking Funds, brief review of probability theory.
Unit-4	Survival Distributions , Life Tables, Valuing Contingent Payment Life insurance,

Text Books:

1 Options, Futures and other Drivatives by Jhon C. Hull Prentice –Hall of India Pvt. Ltd.
2 An introduction to Mathematic Finance by Cheldon M. Ross, Cambridge University Press

Reference Books:

1 An Introduction to Mathematics of Financial Derivatives by Salih N.Neftci, Academic Press.
2 Mathematics of Financial markets by Ribert J. Elliot & P.E. Kopp Springer Verlag, New York.

[MCB-7] INDUSTRIAL MATHEMATICS

Unit 1 Application to problems of industry with Partial differential equations and techniques of solution. Finite difference methods for solving PDE,

Unit 2 Linear Programming problems. Computational procedure of Simplex method, Two-phase Simplex method, Big-M-method, Revised Simplex method, Duality in linear programming, Duality and Simplex method.

Unit 3 Application to problems of industry with Assignment models. Mathematical formulation, Hungarian method. Travelling Salesman problem. Transportation models. Mathematical formulation. Initial basic feasible solution. Degeneracy and unbalanced transportation problems

Unit 4 Inventory Models. EOQ models with and without shortages. EOQ models with constraints. Replacement and Reliability models.

List of Books:

1. Nonlinear Ordinary Differential Equations : An Introduction For Scientist And Engineers, Jordan D. W. , Oxford University Press
2. Textbook Of Ordinary Differential Equations, Mondal C.R., Prentice Hall Of India Pvt. Ltd.
3. Elements Of Partial Differential Equations, Sneddon I N, Tata Macgraw Hill
4. Advanced Partial Differential Equations : With Boundary Value Problems, Pundir Sudhir K., Tata Macgraw Hill
5. Partial Differential Equations, Evans Lawrence, American Mathematical Society
6. Operations Research : Methods And Applications, Sharma J. K, Macmillan Press Ltd.
7. Operations Research : Problems And Solutions, Sharma J. K, Macmillan Press Ltd.
8. Optimization Methods In Operations Research And Systems Analysis, Mittal K. V., New Age International Pvt Ltd

(IV) Soft Skill Based Courses : SB_Group (SSB-1 to 4)

All Soft-skill based courses carry 2 credits in 2 hours per week teaching and 4 hours for practical. There are total 4 Courses to be chosen from the list of SSB_Group.

1 Introduction to Computer C Language
2 Programming in C and applications (practical)
3 Object oriented computer C++ language
4 Programming in C++ and applications (practical)
5 Introduction to MATLAB
6 Programming in MATLAB (practical)
7 Introduction to Computer Graphics
8 Programming in Computer Graphics(practical)

(σ) LIST OF COURSES FOR SSB GROUP

[SSB-1] INTRODUCTION TO COMPUTER "C" LANGUAGE

Unit 1 Constants, variables and data types, operators and expressions, managing input and output operators

Unit 2 Conditional statements, Decision making and branching , Decision making and looping.

Unit 3 Defining and manipulating Arrays, Logical expression and more control statements, handling of character strings

Unit 4 User-defined functions , Some mathematical C- programs.

The course is roughly covered by the book, entitled "Programming in ANSI C" by E. Balagurusamy, The McGraw-Hill Pub. Co. Ltd., 1992.

Reference Books:

1. **C**omputer programming in C, V Rajaraman, PHI-2002

2 "The C Programming Language" by B. W. Kernighan and B. M. Ritchie. Prentice-Hall, 1977.

3 "The C Primer" by L. Hancock and M. Krieger, McGraw-Hill, 1987.

[SSB-2] PROGRAMMING IN 'C' AND APPLICATIONS (PRACTICAL)

The following programs are to be practised:

1. Largest among the numbers, Sum of individual digits of a given number
2. Reverse order of a given number, evaluations of operators,

3 . Determination of roots of quadratic equations, $Ax^2+Bx+C=0$,

4 . Arranging given set of numbers in increasing/decreasing order, calculation of Mean.

5 . Evaluation of sum of power series eg. e^x, sin x, cos x, log (1 + x).

6. Calculation of GCD/LCM of two integers, sum of given numbers, Fibonacci numbers

7. Evaluation of factorial of a positive integer and evaluation of binomial coefficients.

8. Evaluation of Prime and Armstrong numbers, Generation of twin primes, automorphic numbers

9. Addition, subtraction and multiplication of matrices, Transpose, determinant…etc

10 Writing a given number in words using function, Arranging a set of names in alphabetical order.

11. Operations with strings and sorting. ….etc

Reference Books:

1. "Programming in ANSI C" by E. Balagurusamy, The McGraw-Hill Pub. Co. Ltd., 1992.

2 **"C**omputer programming in C", V Rajaraman, PHI-2002

3 "The C Programming Language" by B. W. Kernighan and B. M. Ritchie. Prentice-Hall, 1977.

4 "The C Primer" by L. Hancock and M. Krieger, McGraw-Hill, 1987.

[SSB-3] COMPUTER GRAPHICS

Unit 1 Introduction to Computer Graphics and 2-D computer graphics-line, introduction, DBplay devices, DBplay-File interpreter, structure and algorithms, DBplay control, frame butter, normalized device coordinates.

Unit 2 Two- Dimensional Graphics: 2-D geometry, line generation, antialiasing of lines, character generation.

Unit 3 Polygons, transformations, segments, windowing, clipping and iteration.
Basics of Polygons, polygon filling, scaling and rotation transformations, segment creation, closing and deleting segments, concepts of window and view-port, viewing transformation, line and polygon clipping, intersection.

Unit 4 Three dimensional graphics, 3-D geometry, primitive transformations, rotation and scaling, parallel and perspective projection, viewing parameter, clipping in three dimensions, 3-D viewing transformations.

Reference Books:

1. "Computer Graphics' (2nd Ed.) by Steven Harington McGraw-Hill ,International Edition, 1988.
2. "Computer Graphics" by Plastock and Kelley, McGraw-Hill, 1986.

[SSB-4] PROGRAMMING IN COMPUTER GRAPHICS (PRACTICAL)

The students are expected to write and run the computer programs on the following topics:

1. Implication of line and circle algorithm
2. Modification in line algorithm to generate dashech line.
3. Character-display.
4. Polygon filling.
5. Transformation of objects.
6. Use of segments in forming pictures from given objects.
7. Zooming the portion of windows and display in view ports.
8. Line clipping and polygon clipping.
9. Displaying 3-D objects on 2-D surfaces.

Reference Books:

1 "Computer Graphics' (2nd Ed.) by Steven Harington McGraw-Hill ,International Edition, 1988.
2 "Computer Graphics" by Plastock and Kelley, McGraw-Hill, 1986.

[SSB-5] OBJECT ORIENTED "C" LANGUAGE

Unit 1 Array-declaration/initialization, array structure, Classes-objects, array as class members data, array of objects, string as a class members, user defined string type.

Unit 2 **F**unction-declaration/initialization, variables and storage classes, calling function, passing arguments (constants, variables, array , structure variables, objects) to function, passing arguments (simple data type, structure variables, objects) by reference.

Unit 3 processing character strings, character data type, manipulating of characters, string processing , input and output of strings, enumerated data type and stacks.

Unit 4 Structures, use of structure in arrays and arrays in structures, Pointer data type and its applications, pointers and functions , file management in C, Developing a C program.

Reference Books:

1 "The C Programming Language" by B. W. Kernighan and B. M. Ritchie. Prentice-Hall, 1977.
2 Computer programming in C, V Rajaraman, PHI-2002
3 "Programming in ANSI C" by E. Balagurusamy, The McGraw-Hill Pub. Co. Ltd., 1992.
4 "The C Primer" by L. Hancock and M. Krieger, McGraw-Hill, 1987.
5 Mahpatra P B, Thinking in C:Including Object Oriented Programming with C, Wheeler Pub.

[SSB-6] PROGRAMMING IN OBJECT ORIENTED "C" AND APPLICATIONS (PRACTICAL)

List of practical to be performed on computers:

1. Statistical data processing programs
2. Functions programs to calculate interest …etc
3. Operations on Matrices, Gauss elimination method and its applications.
4. Sequences-sorting, searching and merging, program related to functions
5. Function to read a line and store in buffer , find length and so on..
6. String processing programs, programs related to enumerated data tpes and stacks

7. Programs related to structures , pointers and functions
8. Netwon's form of polynomial, interpolation polynomial, divided difference table
9. Numerical integration, numerical solutions of differential equations.

Reference Books:

1 "The C Programming Language" by B. W. Kernighan and B. M. Ritchie. Prentice-Hall, 1977.
2 Computer programming in C, V Rajaraman, PHI-2002
3 "Programming in ANSI C" by E. Balagurusamy, The McGraw-Hill Pub. Co. Ltd., 1992.
4 "The C Primer" by L. Hancock and M. Krieger, McGraw-Hill, 1987.
5 Mahpatra P B, Thinking in C:Including Object Oriented Programming with C, Wheeler Pub.

[SSB-7] INTRODUCTION TO MATLAB

Unit-I & II Introduction to Matlab

1. Matlab Interface 2. Menus and the toolbar
3. Computing with Matlab 4. Script files and the Editor Debugger
5. Matlab Help System

Arrays and Matrices

1. Arrays 2. Multidimensional Arrays
3. Element by Element Operations 4. Polynomial Operations Using Arrays
5. Cell Arrays 6. Structure Arrays 7. Matrices
8. Referencing Individual Entries 9. Matrix Operations
10. Submatrices and Colon Notation

Functions & Files

1. Elementary Mathematical Functions 2. User Defined Functions
3. Advanced Function Programming 4. Working with Data Files

Unit-III & IV Programming Techniques

1. Program Design and Development 2. Relational Operators and Logical Variables
3. Logical Operators and Functions 4. Conditional Statements
5. Loops 6. The Switch Structure 7. Debugging Mat Lab Programs

Plotting

1. XY- plotting functions 2. Subplots and Overlay plots
3. Special Plot types 4. Interactive plotting
5. Function Discovery 6. 3-D plots

Polynomials

1. Roots 2. Multiplication 3. Addition 4. Division
5. Derivatives and Integrals 6. Evaluation

7. Rational Polynomials 8. Curve Fitting

Integration and Differentiation

1. Integration 2. Differentiation

Main Book :

1. Introduction to Matlab 7 for Engineers, by William J. Palm III, McGraw Hill 2005.
2. Mastering Matlab 7, by Duane Hanselman, Bruce Littlefield, Pearson Education 2005.
3. Learning Matlab-7, Oxford,2008

[SSB-8] Programming in MATLAB (Practicals)

Practical related to the followings:

1. Mat lab Environment: MATLAB user interface, commands and variables
2. Built in Mat lab Functions
3. Vector and matrix data, data types
4. Plotting
5. User Defined Functions
6. Mathematical/Engineering case studies

Main Book :

1. Introduction to Mat lab-7 for Engineers, by William J. Palm III, McGraw Hill 2005.
2. Mastering Mat lab-7, by Duane Hanselman, Bruce Littlefield, Pearson Education 2005.
3. Learning Matlab-7, Oxford,2008

(V) Cognitive Skill-Work Project : MTHW_Group (MTHW-I)

COURSE: MTHW-I Cognitive Skill-Work Project

AIM : *To develop student's cognitive abilities to solve assignment/problem …….etc, problems in a longer time frame than in usual in other courses. Students will learn how to search for known results and techniques related the project work. On completion of the project work, each student is expected to Submit a written document describing the results, mathematical developments, background material, bibliographical search etc. Present orally in a seminar setting of the work done in the project work. The students will meet regularly with the project guide to work out problems that appear and adjust the goals and time frame accordingly. The project should be carried out individually/ jointly are acceptable only with prior permission of the Guide.*

Cognitive skill-work based Project carries 10 credits in at least 16 hours depending on the number of students and the number of Batches/Groups) per week teaching and two work-Project to be chosen from the list of MTHW Group.

MTHW Group: Any TWO from the followings.

1 BOOK REVIEW
2 PROJECT WORK/FIELD WOR
3 PROBLEM SOLVING WORK
4 FOUNDATION OF MATHEMATICS
5 HISTORY OF MATHEMATICS
6 MATHEMATICS EDUCATION
7 MINI DISSERTATION ON SPECIAL TOPICS OF MATHEMATICAL SUBJECTS (to be suggested by the faculty)

8 Any Special Topics to be selected by the faculty which may includes: supportive courses, life oriented education, personality development activities, leisure hour activity ….etc.

Scheme of Evalution :

A project/cognitive report will be the outcome of the assignment given by the faculty in the fourth semester. The project work should be an individual one. The final semester project work will be evaluated by any two examiners : The Subject teacher, The Chairman of the Examination and an external examiner (appointed by the University) .

Project Report/cognitive work : 250 Marks, Passing Minimum for the Project: 45% marks

Total 250 marks divided as :

75 marks for Internal &

175 marks of External Exam separated as

75 marks for Presentation + 100 marks for Viva-voce Examination.

N.B.: More Elective/Soft Skill based courses can be added from time to time as and when needed, subject to the availability of the faculties , GOVT./UNIVERSITY's policy matter and demand/requirement of the students.