હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી

NAAC A (3.02) State University

પો.બો.નં.–૨૧, યુનિવર્સિટી રોડ, પાટણ (ઉ.ગુ.) ૩૮૪૨૬૫

ફોનઃ(૦૨૭૬૬) ૨૨૨૭૪૫, ૨૩૦૫૨૯, ૨૩૦૭૪૩, ૨૩૩૬૪૮ ફેકસ : (૦૨૭૬૬) ૨૩૧૯૧૭

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પરિપત્ર ક્રમાંક – ૪૪ /૨૦૧૯

વિષયઃ વિજ્ઞાન વિદ્યાશાખાના અનુસ્નાતક કક્ષાના સેમેસ્ટર–૧ થી સેમેસ્ટર–૪ સુધીના નવા અભ્યાસક્રમોનું માળખું તેમજ નવા અભ્યાસક્રમ અંગે...

આ યુનિવર્સિટીના વિજ્ઞાન વિદ્યાશાખા અંતર્ગત વિષયોના અનુસ્નાતક વિભાગો તથા સંલગ્ન વિજ્ઞાન વિદ્યાશાખાની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, એકેડેમીક કાઉન્સિલ ની તા. ૫/૬/૨૦૧૮ ની સભા ના નિર્દિષ્ટ ઠરાવો અન્વયે UGC ની Model curriculum અંગેની Guideline સંદર્ભે વિજ્ઞાન વિદ્યાશાખા હેઠળના નીચેના વિષયોના અનુસ્નાતક કક્ષાના સામેલ પરિશિષ્ટ પ્રમાણેના નવા અભ્યાસક્રમનું માળખું તેમજ અભ્યાસક્રમો શૈક્ષણિક વર્ષઃ ૨૦૧૯–૨૦ થી ક્રમશઃ અમલ માં આવે તે રીતે મંજૂર કરેલ છે. જેનો અમલ કરવા સારૂ સબંધિતોને આ સાથે મોકલવામાં આવે છે.

ક્રમ નં.	અભ્યાસક્રમ	એકેડેમીક કાઉન્સિલની તારીખઃ૦૫/૦૬/૨૦૧૮ના ઠરાવ ક્રમાંક	સેમેસ્ટર
૧	અભ્યાસક્રમો નું માળખું	૦૭	તમામ સેમેસ્ટર
૨	રસાયણશાસ્ત્ર	૪૪	સેમ.–૧ થી સેમ.–૨
૩	પ્રાણીશાસ્ત્ર	૪૫	સેમ.– ૧થી સેમ.–૪
૪	બાયોટેકનોલોજી	૪૬	સેમ.– ૧ થી સેમ.–૪
૫	ગણિતશાસ્ત્ર	૪૭	સેમ.–૧ થી સેમ.–૪
૬	એમ.એસ.સી. ઈલેકટ્રોનિકસ	૪૯	સેમ.–૧ થી સેમ.–૪
૭	ભૌતિકશાસ્ત્ર	૫૦	સેમ.–૧ થી સેમ.–૪

આ બાબતની સબંધિત અધ્યાપકો તથા વિદ્યાર્થીઓને આપના સ્તરેથી જાણ કરવા વિનંતી છે.

નોધ :– (૧) વિદ્યાર્થીઓની જરૂરીયાત માટે પરિપત્રની એક નકલ કોલેજના ગ્રંથાલયમાં મૂકવાની રહેશે.
(૨) આ અભ્યાસક્રમ / સ્કીમ યુનિવર્સિટીની વેબ સાઈટ www.ngu.ac.in પર પણ ઉપલબ્ધ કરાવવામાં આવનાર છે.

કુલસચિવવતી

બિડાણ : ઉપર મુજબ

નં.–એકે/અ×સ/ ૧૦૧૬૩ /૨૦૧૯
તારીખ : ૧૮/૦૩/૨૦૧૯

પ્રતિ,
૧. અધ્યક્ષશ્રી/ કો.ઓર્ડીનેટરશ્રી–વિજ્ઞાન વિદ્યાશાખા અંતર્ગત વિષયોના અનુસ્નાતક વિભાગો, હેમ. ઉ.ગુ. યુનિવર્સિટી, પાટણ.
૨. સંલગ્ન સાયન્સ કોલેજોના આચાર્યશ્રીઓ
૩. ડૉ. એમ. બી. પ્રજાપતિ (ડીનશ્રી),ગણિતશાસ્ત્ર ભવન, હેમ. ઉ.ગુ. યુનિવર્સિટી, પાટણ.
૪. પરીક્ષા નિયામકશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ. (પાંચ નકલ)
૫. ગ્રંથપાલશ્રી, હેમ.ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ. (વિદ્યાર્થીઓના ઉપયોગ સારૂ રેકર્ડ ફાઈલ માટે)
૬. સિસ્ટમ એનાલીસ્ટશ્રી, કોમ્પ્યુટર (રીઝલ્ટ) સેન્ટર, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ. તરફ પરિણામ માટે તથા વેબસાઈટ પર મૂકવા સારૂ.
૭. માન.કુલપતિશ્રી/ કુલસચિવશ્રીનું કાર્યાલય, હેમ.ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ.
૮. અનુસ્નાતક પ્રશાખા (એકેડેમીક શાખા) હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ.
૯. મુખ્ય હિસાબી અધિકારીશ્રી (મહેકમ), હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી, પાટણ તરફ → પરિપત્રની ફાઈલ અર્થે
૧૦. સિલેકટ ફાઈલે. (૨ નકલ)

Hemchandracharya North Gujarat University

Accredited by NAAC with "A" Grade (CGPA 3.02)

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The Proposed New Structure for M.Sc. Course is based on choice Based Credit System (CBCS) which is in force from June – 2018

CBCS Course Pattern

1. This programme is divided into four Semesters (Two Years) . The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. 24 credit each year X 4 semester= 96 credits master level.
2. There will be three categories of courses / papers in this programme :
   - A. Four Compulsory – Core theory courses with 4 credits each in each semester.
   - B. One Choice Based Elective Course (disciplinary / interdisciplinary) with 2 credits in each semester.
   - C. Two Practical's each of Three credits in each semesters .
   - D. In the IV Semester as above a,b,c or instead of above A,B, C ; a student can undertake Three core theory courses (12 - credits) and project / field work (12 - credits), OR Major Dissertation (24 - credits) OR as per decided by BOS.
3. Detailed Course Pattern for each Semester is given bellow.

M.Sc. : Semester – I

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper - I	Core-I	2 : 30	70	30	100	4	4
Paper – II	Core-II	2 : 30	70	30	100	4	4
Paper – III	Core-III	2 : 30	70	30	100	4	4
Paper – IV	Core-IV	2 : 30	70	30	100	4	4
Practical : Paper – I	Pract-I	3/4	75	--	75	6	3
Practical : Paper – II	Pract-II	3/4	75	--	75	6	3
Elective Course (Any One) Disciplinary / Interdisciplinary		2 : 00	50	--	50	2	2
TOTAL			480	120	600	30	24

M.Sc. : Semester – II

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – V	Core-V	2 : 30	70	30	100	4	4
Paper – VI	Core-VI	2 : 30	70	30	100	4	4
Paper – VII	Core-VII	2 : 30	70	30	100	4	4
Paper – VIII	Core-VIII	2 : 30	70	30	100	4	4
Practical : Paper – III	Pract-III	3/4	75	--	75	6	3
Practical : Paper – IV	Pract-IV	3/4	75	--	75	6	3
Elective Course (Any One) Disciplinary / Interdisciplinary		2 : 00	50	--	50	2	2
TOTAL			480	120	600	30	24

M.Sc. : Semester – III

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – IX	Core-IX	2 : 30	70	30	100	4	4
Paper – X	Core-X	2 : 30	70	30	100	4	4
Paper – XI	Core-XI	2 : 30	70	30	100	4	4
Paper – XII	Core-XII	2 : 30	70	30	100	4	4
Practical : Paper – V	Pract-V	3/4	75	--	75	6	3
Practical : Paper – VI	Pract-VI	3/4	75	--	75	6	3
Elective Course (Any One) Disciplinary / Interdisciplinary		2 : 00	50	--	50	2	2
TOTAL			480	120	600	30	24

M.Sc. : Semester – IV

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – XIII	Core-XIII	2 : 30	70	30	100	4	4
Paper – XIV	Core-XIV	2 : 30	70	30	100	4	4
Paper – XV	Core-XV	2 : 30	70	30	100	4	4
Paper – XVI	Core -XVI	2 : 30	70	30	100	4	4
Practical : Paper – VII	Pract-VII	3/4	75	--	75	6	3
Practical : Paper – VIII	Pract-VIII	3/4	75	--	75	6	3
Elective Course (Any One) Disciplinary / Interdisciplinary		2 : 00	50	--	50	2	2
TOTAL			480	120	600	30	24

OR

Course	Name of the Course	Exam. Duration (Hours)	Ext. Marks	Int. Marks	Total Marks	Teach, Hours Per week	Credit point
Paper – XIII	Core-XIII	2 : 30	70	30	100	4	4
Paper – XIV	Core-XIV	2 : 30	70	30	100	4	4
Paper – XV	Core-XV	2 : 30	70	30	100	4	4
Major Dissertation			210	90	300	18	12
TOTAL			420	180	600	30	24

NOTE :

1. For 4 credit course: Each syllabus is of 4 Units having equal weightage.
2. For 2 credit course: Each syllabus is of 2 Units having equal weightage.
3. There is no section in semester end examinations i.e. questions Paper is without sections.
4. For question paper of 70 marks: Each Question paper contains 4 questions: Q-1 from unit-I of 18 marks, Q-2 from unit-II of 17 marks, Q-3 from unit-III of 18 marks and last Q-4 from unit-Iv of 17 marks from entire course.
5. For question paper of 50 marks: Each Question paper contains 3 questions: Q-1 from unit-I of 20 marks, Q-2 from unit-II of 20 marks, and last Q-3 is of objective types having 10 marks from entire course.

[BOS may add some specifications with reference to above structure.]

HEMCHANDRACHRAYA NORTH GUJARAT UNIVERSITY

NAAC A (3.02) State University

PATAN – 384265

Faculty of Science

M.Sc.-Mathematics

Syllabus/Scheme

Sem – 1 to 4

Sem / CBCS / Grading Pattern

W.E.F. June -2019 (and thereafter)

DATE : 05/06/2018

TOTAL PAGE – 42

EMCHANDRACHARYA NORTH GUJARAT UNIVERSITY
PATAN- 384 265

Detailed CBCS Curriculum
M. Sc. MATHEMATICS

(First time adopted CBCS Semester wise curriculum from June 2011,
Modified and adopted from June 2014 &
As per New Norms of UGC, Modified and implemented from June 2018)

With Effect from June: ~~2018~~ 2019

FACULTY : **SCIENCE**

SUBJECT : **MATHEMATICS**

CLASS : **Master of Science.**

SEMESTER : **I to IV**

TOTAL PAGE : **01 TO ~~31~~ 42 (WITH COURSE STRUCTURE)**

DATE : **31st May -2018**

M. Sc. MATHEMATICS

As per New Norms of UGC; Modified Programme Structure Under CBCS

With Effect from June: ~~2018~~ 2019

M. B. Prajapati, ***Department of Mathematics,***
Hemchandracharya North Gujarat University, Patan-384265.

(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 field of Mathematics.

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: Four Major Focusing Areas: 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, restructuration 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 was decided to introduce first time the Choice Based Credit System (CBCS) from the academic year 2011-12 and was modified it after three years and adopted from June 2014 & as per new norms of UGC guidelines of 2016 we have adopted new CBCS course from June 2018. 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. Besides that, 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.

The M.Sc. 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.

(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; having minimum 40%, marks shall be eligible for admission for this M.Sc. in Mathematics which is a full time course.

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 of Mathematics.
- 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 one has completed this degree, he/she 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 their 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 and 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 Structure:

The M.Sc. Mathematics is a **96 credit** two years (Four Semester) fill time program with each semester of 15 weeks.

Note: Cognitive skill-work based Project carries 12 credits in at least 18 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 Project Given. OR (Instead of Project Group, Candidate shell be allowed to offer additional elective theory and practical courses selected from the respective groups).

Sem	Course Code	Course	Nature of the course	Exam Duration	External Marks	Internal Marks	Total Marks	Teaching Hours per week	Credit
M.Sc. Sem – I	MSM1101	Measure Theory	CORE	2:30	70	30	100	4	4
	MSM1102	General Topology	CORE	2:30	70	30	100	4	4
	MSM1103	Theory of Ordinary Differential Equations	CORE	2:30	70	30	100	4	4
	MSM1104	Mathematical Modelling	CORE	2:30	70	30	100	4	4
	MSM3101	Elementary Matlab Programming	Skill Enha	2:00	50	0	50	4*	3
	MSM3102	Advanced Matlab Programming	Skill Enha	2:00	50	0	50	4*	3
	MSM4101	Integral Transforms	Soft	2:00	35	15	50	2	2
	Semester Total				**415**	**135**	**550**	**26***	**24**
M.Sc. Sem - II	MSM1201	Advanced Topology	CORE	2:30	70	30	100	4	4
	MSM1202	Algebra-I	CORE	2:30	70	30	100	4	4
	MSM1203	Theory of Partial Differential Equations	CORE	2:30	70	30	100	4	4
	MSM1204	Statistical Methods	CORE	2:30	70	30	100	4*	4
	MSM3201	ODE Matlab Programming	Skill Enha	2:00	50	0	50	4*	3
	MSM3202	Numerical Methods with Matlab	Skill Enha	2:00	50	0	50	4	3
	MSM4201	Research Methodology	Soft	2:00	35	15	50	2	2
	Semester Total				**415**	**135**	**550**	**26***	**24**

Sem	Course Code	Course	Nature of the course	Exam Duration	External Marks	Internal Marks	Total Marks	Teaching Hours per week	Credit
M.Sc. Sem - III	MSM1301	Functional Analysis-I	CORE	2:30	70	30	100	4	4
	MSM1302	Complex Analysis	CORE	2:30	70	30	100	4	4
	MSM1303	Number Theory	CORE	2:30	70	30	100	4	4
	MSM23**	DS Elective (Group - 1)	Elective	2:30	70	30	100	4	4
	MSM3301	PDE Matlab Programming	Skill Enha	2:00	50	0	50	4*	3
	MSM3302	LaTeX Programming	Skill Enha	2:00	50	0	50	4*	3
	MSM43**	Generic Electives (Group-3)	Soft	2:00	35	15	50	2	2
	Semester Total				**415**	**135**	**550**	**26***	**24**
M.Sc. Sem – IV	MSM1401	Functional Analysis-II	CORE	2:30	70	30	100	4	4
	MSM1402	Field Theory	CORE	2:30	70	30	100	4	4
	MSM1403	Graph Theory	CORE	2:30	70	30	100	4	4
	MSM24**	DS Elective (Group - 2)	Elective	2:30	70	30	100	4	4
	MSM3401	Computer Graphics Programming	Skill Enha	2:00	50	0	50	4*	3
	MSM3402	C language Programming	Practical	2:00	50	0	50	4*	3
	MSM44**	Generic Electives (Group-4)	Soft	2:00	35	15	50	2	2
	Semester Total				**415**	**135**	**550**	**26***	**24**
	OR								
	MSM1401	Functional Analysis-II	CORE	2:30	70	30	100	4	4
	MSM1402	Field Theory	CORE	2:30	70	30	100	4	4
	MSM1403	Graph Theory	CORE	2:30	70	30	100	4	4
	MSM4402	Cognitive Skill-Work Project	Project		205	45	250	14*	12
	Semester Total				**415**	**135**	**550**	**26***	**24**
Grand Total							**2200**		**96**

DS Elective Group – 1 For Sem-III		DS Elective Group – 2 For Sem-IV	
Course Code	Course	Course Code	Course
MSM2301	Differential Geometry	MSM2401	Algebraic Topology
MSM2302	Functions of several variables	MSM2402	Operations Research
MSM2303	Mathematics of Money	MSM2403	Cryptography
MSM2304	Fuzzy Sets And Their Applications	MSM2404	BIO-MECHANICS
MSM2305	**Classical Mechanics-I**	MSM2405	Classical Mechanics-II
MSM2306	**Theory of Relativity**	MSM2406	**Relativity and Cosmology**
Msm2307	**ODE Modeling-II**	MSM2407	**ODE Modeling-II**

Generic Elective Group – 3 For Sem-III		Generic Elective Group – 4 For Sem-IV	
Course Code	Course	Course Code	Course
MSM4301	Advanced Linear Algebra	MSM4401	Fuzzy Logic and Control System
MSM4302	Computational Biology	MSM4402	Financial Mathematics
MSM4303	Mathematical Hydrology	MSM4403	Mathematical Ecology
MSM4304	Mathematical Population Biology-I	MSM4404	Mathematical Population Biology-Ii
MSM4305	Applications of Mathematics in Insurance	MSM4505	Application Of Mathematics In Environmental Studies

Note: * *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:

Understanding of mathematical principles and concepts will be assessed through CIA and UE pattern as follow:

❖ **Continuous Internal Assessment (CIA):**

The CIA of each student is evaluated from the following academic components, selected by the course teacher.

1. Assignments, Quiz (announced or unannounced)
2. Individual viva or group viva
3. Short duration objective types tests/snap tests
4. Short answer type test or problem solving(for assessment of cognitive ability)
5. Seminar (once in a semester is compulsory)
6. Unit test (written or oral)/internal test

(7)

7. Laboratory/field/practical work
8. Group Discussion(Once in a semester to asses originality, creativity, initiative, communication skills, leadership …etc)
9. Class-room attendance/punctuality/sincerity ….etc

❖ **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.

There is no Continuous Internal Assessment for any practical. Also External University Examination for practical is of 50 Marks/practical which including Practical & 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 having with prior permissions of the Head of the Department.

(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 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 Exam, grade points and letter grade.

(8)

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:

(9)

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] $= (GP_1 + GP_2 + \ldots + GP_n) / (C_1 + C_2 + \ldots + C_n)$

$= (GP_1 + GP_2 + \ldots + GP_n) / 24$

(since total credit for each semester=24)

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

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

Note: The candidates who pass the subject at first appearance and within the prescribed semester of the PG Programme 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 as per the university rules instead of the higher numerical grade obtained by the candidate with showing the attempts.

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 / Fail	Knowledge of principles and facts is fragmentary; 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 possesses four units. Every university examination paper consists of FOUR Questions from each unit. For the paper of 70 marks Question – 1 is of 18 marks, Question – 2 is of 17 marks, Question – 3 is of 18 marks, Qquestion – 4 is of 17 marks. For the paper of 35 marks Question – 1 is of 9 marks, Question – 2 is of 9 marks, Question – 3 is of 9 marks, Question – 4 is of 8 marks.

Two examiners, either both internal or one internal and one external can set the question paper. The senior internal examiner of the University Department shall be the chairperson for the respective paper/COURSE if university adopt such policy for all faculties.

(14) Appearance for Improvement:

Once degree allotted to the students there is no provisions for the improvement of marks i,e, presently there is no scheme for the improvement of the degree.

(15) Provisions for the Elective & 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 (of Major Dept selected by the HOD) 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 at least 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 (If university adopt such policy)

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 to be modified, time to time if needed.

(I) Structure for Computer Laboratory/Practical Examination.

Duration: 2 Hours Examination. There is no Continuous Internal Assessment for any practical. University Examination per practical: 50 Marks (Practical & Viva 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 …etc.

(ii) Format for the Cognitive/Project Work.

Title of the Course: Paper Number --------- Year ----- Category -----

Semester ------- Credits ---- Course Code-------Total Instructional Hours per week – etc..

(a) Title page : TITLE OF THE PROJECT

A project report Submitted for the partial fulfilment 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) 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 fulfilment 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 Examiner)

(c) Acknowledgement (d) Content (e) Introduction (f) Chapters

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

DETAILS OF M. Sc. CURRICULUM

M.SC. MATHEMATICS SEMESTER - 1

MSM1101 - 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 Boral 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.

MSM1102 – GENERAL TOPOLOGY

Unit 1: Topological Spaces: Topological spaces, basis and sub-basis for a topology, The order topology, the product space Π Xi (for finitely many topological spaces only), 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.

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.

MSM1103 – THEORY OF ORDINARY 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: Power series solution of linear differential equations - ordinary and singular points of differential equations, Classification into regular and irregular singular points; Series solution about an ordinary point and a regular singular point - Frobenius method, Chebyshev and Gauss Hypergeometric equations and their general solutions.

Unit 4: Generating function, Recurrence relations, Rodrigue's formula Orthogonality properties. Behaviour of solution at irregular singular points and the point at infinity

Reference Books

1. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand & Co.
2. G..F. Simmons: Differential Equations, TMH Edition, New Delhi, 1974
3. E.D. Rainville and P.E. Bedient: Elementary Differential Equations, McGraw Hill, NewYork, 1969.
4. E.A. Coddington and N. Levinson: Theory of ordinary differential equations, McGraw Hill, 1955.
5. A.C. King, J. Billingham& S.R. Otto: Differential equations, Cambridge University Press, 2006.

MSM1104 – 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.

MSM3101 - ELEMENTARY MATLAB PROGRAMMING

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

Practical: Related to above theory part

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

MSM3102 – ADVANCED MATLAB PROGRAMMING

MATLAB 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

Practical related to Plotting , User Defined Functions , Mathematical/Engineering case studies

Main Books:

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

MSM4101 – 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.

Reference Books:

1. The Fourier Transforms and its applications, by Ronald Bracewell
2. Schaum's outline of Fourier analysis with applications to Boundary value problems, by Murray Spiegel
3. The Laplace Transform: Theory and applications, by Joel L. Schiff
4. Schaum's outline of Laplace Transforms, by Murray Spiegel

M.SC. MATHEMATICS SEMESTER - 2

MSM1201 – 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: Imbedding 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.

The Textbook: "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.

MSM1202 – 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 Textbook: "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), Narossa Pub House, New Delhi.

MSM1203 – THEORY OF PARTIAL DIFFERENTIAL EQUATIONS

Unit 1: Definition, Order and Degree of PDE, Linear and Non Linear PDE, Classification of 1st order PDE, Formulation of PDE, Cauchy's Problem for first order PDE.

Unit 2: Solution of Linear PDE of first order.

Unit 3: Solution of Non linear PDE of first order.

Unit 4: Separation of variables use of Fourier series, D'Alembert's solution of the wave equation, Heat equation.

Course covered by : I. N. SNEDDON, Elements of PDE's , McGraw Hill Inc. 2009

Reference Books:

1. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand & Co.
2. L DEBNATH , Nonlinear PDE's for Scientists and Engineers, Birkhauser , Boston, 2008.

MSM1204 – STATISTICAL METHODS

Unit 1: Descriptive Statistics and Correlation [**Revision:**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 Distribution [**Revision:** Probability: Basic probability concepts, methods for assigning probability, events and their probability, addition rule, conditional probability, multiplication rule & Bayes' theorem (statement only)] 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

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, test of hypothesis about population proportion, Sampling distribution and test of hypothesis about difference between two population means.

Unit 4: Regression- Introduction to Regression; Simple linear Regression Model; least Square Method; Coefficient of Determination; Correlation Coefficient.

Reference Books:

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).
3. Statistical Methods by S.P. Gupta

MSM3201 – ODE MATLAB PROGRAMMING

Practical: Related to First/Second/higher order Ordinary Differential Equations such as Solution of Differential Equation Using:

1. Picard's method 2. Taylor's method 3. Euler's method 4. Modified Euler's method
5. Improved Euler' method 6. Runge-Kutta 2nd order method 7. Runge-Kutta 3rd order method
8. Runge-Kutta 4th order method 9. Adam's Predictor-corrector method

..... Etc.

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MSM3201 – NUMERICAL METHODS WITH MATLAB

Practical: Related to Numerical Solutions of equations such as Finding roots of a polynomial using :

1. Bisection Method 2.Newton-Raphson Method 3. Regula-Falsi Method
4. Inverse of a matrix 5. Gauss Elimination Method 6. Gauss-Seidal Method
7. Simpson's 1/3rd rule and 3/8th rule 8. Trapezoidal Rule 9. Runge-Kutta Method
10. Lagrange's Interpolation

...etc

MSM4201 – RESEARCH METHODOLOGY

Unit 1& 2: Research Methodology: An Introduction Meaning of Research – Objectives of Research – Motivation in Research – Types of Research – Significance of Research – Research and Scientific Methods – Importance of knowing How Research is Done – Research Process – Criteria of Good Research. Defining the Research Problem What is a Research – Selecting the Problems – Necessity of Defining the Problem – Technique involved in Defining a Problem.

Unit 3&4: Research Design Meaning of Research Design – Features of a Good Design – Importance Concepts Relating to Research Design – Different Research Design – Basic Principles of Experimental Designs.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.

Reference Books:

1. Research Methodology Methods and Techniques C.R. Kothari
2. Research Methodology Methods and Statistical Techniques Santosh Gupta
3. How to write and publish a scientific paper by Day, R.A.
4. Guide to write scientific papers by Garson, G.D.

M.SC. MATHEMATICS SEMESTER – 3

MSM1301 – 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:

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

Reference Books:

1. B. V. Limaye: Functional Analysis, 2nd Edition, New Age International Ltd. Publishers.
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 Y.
4. S. K. Berberain: Lectures in Functional Analysis and Operator theory, Springer Verlag.

MSM1302 – 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 – Goursat Theorem.

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 and examples.

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.

Reference Books:

1. John Duncan, The Elements of Complex Analysis, John Wiley & Sons Ltd, London. (1968)
2. L V Ahlfors, Complex Analysis, 3rd edition, McGraw Hill, 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)

MSM1303 – 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.

MSM3301 – PDE MATLAB PROGRAMMING

Matlab Programs for solution of partial differential equations using

1. Laplace equation 2. Poisson equation 3. Schmidt Method 4. Crank-Nicolson method
5. ADI method 6. Explicit method for wave equation 7. Lees ADI method for wave equation

.....etc.

MSM3302 – LATEX PROGRAMMING

[Course covers: TYPESETTING IN LATEX , Defining command and environments, table of content, cross-reference, bibliography and citation, making index and glossary, slides, overlays and notes, Design it yourself as document class, page style, title page, customizing the style, line and page breaking, numbering, length, spaces and boxes, formatting with boxes, centring and flushing, list making environments, changing font type size and special symbols, picture, picture environments, picture objects, text, boxes, straight lines, arrow, stacks, circles, oval, framing, curve, grid, repeat patterns and Making presentation slides in beamer class LaTeX]

1. Basic Introduction to LaTeX, Structure of LaTeX document, First document produced using LaTeX.
2. Use of different fonts, size, apply page break and line break, use command for making text bold, italic, emphasis, underline.
5. Document structure using /chapter, /section, /subsection, cross referencing using /label and /ref command, Footnote and use of fancy header package.
3. Equation environment, single equation, multi line single equation, multi equations, mathematical symbols.
6. How to write array and matrix in LaTeX, Writing theorem and lemma using LaTeX.
7. Preparing Tables using LaTeX, Use of Graphicx package in LaTeX.
8. How to write bibliography using LaTeX.
9. Preparing a basic beamer presentation using overlay, color, slide transaction, use of different themes, use of graphics.

TEXT BOOKS / OPEN SOURCE MATERIALS/Suggested Readings:

1. Leslie L. A Document Preparation System: User's Guide and Reference Manual. Addison-Wesley Publishing Company, 2001.

2. Stefan K. LaTeX Beginner's Guide, Packt Publishing Ltd, 2011

3. Tantau, T. User Guide to the Beamer Class, http://latex-beamer.sourceforge.net.

4. Tobias O. The Not So Short Introduction to LATEX2E. https://tobi.oetiker.ch/lshort/lshort.pdf

5. Charles T. Batts : A Beamer Tutorial in Beamer.

6. http://www.ctan.org/tex-archive/macros/latex/contrib/beamer/doc/

DS Elective Group – 1 For Sem-III		DS Elective Group – 2 For Sem-IV	
Course Code	Course	Course Code	Course
MSM2301	Differential Geometry	MSM2401	Algebraic Topology
MSM2302	Functions of several variables	MSM2402	Operations Research
MSM2303	Mathematics of Money	MSM2403	Cryptography
MSM2304	Fuzzy Sets And Their Applications	MSM2404	BIO-MECHANICS
MSM2305	**Classical Mechanics-I**	MSM2405	Classical Mechanics-II
MSM2306	**Theory of Relativity**	MSM2406	**Relativity and Cosmology**
MSM2307	**ODE Modeling-I**	MSM2407	**ODE Modeling-II**

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MSM2301 – 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.

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.

MSM2302 – 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.

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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.

MSM2303 – MATHEMATICS OF MONEY

Unit 1: The Simple Interest Theorem, Consequences of the theorem, Financial Digression, Ambiguities when interest period is measured in days, Number of days calculations, The Compound Interest Theorem, Consequences of the theorem, The annual effective rate, time diagram and cash flows, interest rate of return (IRR), Financial Digression, The IRR uniqueness theorem and its consequences, the rule of 72,Inflation, The purchasing power theorem, consumer price index(CPI), personal taxes, the tax theorem.

Unit 2: An ordinary annuity, the future value of an ordinary annuity theorem(OAT), consequences of OAT, the interest value of an OAT and its applications, 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, credit card load)

Unit 3: Amortization tables, the amortization theorem, periodic payments, the periodic payment theorem(PPT), consequences of PPT, linear interpolations, credit cards payments, the credit card theorem and its applications, credit card numbers.

Unit 4: 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 maintenance level theorem, the short sale maintenance level theorem and its examples.

Note: 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, NY2005, 7th .
5. Options, Futures and Other Derivatives, Hull, Prentice Hall, 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.

MSM2304 – FUZZY SETS AND THEIR APPLICATIONS

Unit 1: Basics of Fuzzy Theory- Fuzzy Set: Definition of Fuzzy set and set theoretic operations, Alpha-set, Normality, Extension Principle, Triangular norms (t-norms) and triangular conorms (t-conorms), 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: Classical relation and fuzzy relation: Crisp relations, fuzzy relations, Tolerance and equivalence relations, fuzzy tolerance and equivalence relation, 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, Development of Membership Functions: Membership value assignments by intuition, inference, rank ordering, inductive reasoning, 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, 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

Reference Books:

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.

MSM2305 – CLASSICAL MECHANICS-I

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

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Unit II : Velocity 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 Cyclic 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.

MSM2306 – 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 2: Space – Time symmetries, displacement of space–time, some properties of killing vectors, homogeneity and isotropy space – time of constant curvature, symmetric subspaces.

Unit 3: Energy Momentum Tensors, the action principle, the electromagnetic theory, Energy momentum tensors (general), conservation laws.

Unit 4: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.

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.

MSM2307 – ODE MODELING – I

Unit – 1 : Mathematical Modelling : Need, Techniques, Classification And Simple Illustration [Simple situations requiring Mathematical Modeling, The technique of Mathematical Modeling, Mathematical Modeling through Geometry, Mathematical Modeling through Algebra, Mathematical Modeling through Trigonometry &Limitations of Mathematical Modeling.

Unit –2: Mathematical Modelling Through Ordinary Differential Equations Of First Order : 2.1 Mathematical Modeling through differential equations. 2.2 Linear Growth and Decay Models.

2.3 Non-linear Growth and Decay Models. 2.4 Compartment Models. 2.5 Mathematical Modeling in Dynamics through Ordinary differential Equations of First Order.

Unit – 3 : Mathematical Modelling Through Systems Of Ordinary Differential Equations Of First Order :3.1 Compartment Models through Systems of Ordinary Differential Equations. 3.2 Mathematical Modeling in Economics through System of Ordinary Differential Equations of First order. 3.3 Mathematical Models in Medicine, Arms Race Battles and Internationals Trades in terms of System of Ordinary Differential Equations.

Unit – 4 : Mathematical Modelling Through Ordinary Differential Equations Of Second Order: 4.1 Mathematical Modeling of Planetary Motions. 4.2 Mathematical Modeling of Circular Motion and Motion of Satellites. 4.3 Mathematical Modeling through Linear Differentials Equations of Second Order. 4.4 Miscellaneous Mathematical Models through Ordinary Differential Equations of the Second Order.

REFERENCE BOOKS

1. Mathematical Modeling, J. N. Kapur, New Age International (P) Ltd., Reprint 2003.
2. Differential Equations and Their Application ,ZafarAhsan ,Prentice Hall of India , Delhi
3. Mathematical Modeling, J.G. Andrews and R. R. Mclone (1976). Butterwerths London.
4. Mathematical Modeling Techniques, R. Aris (1978) , Pitman.
5. Differential Equation Models, Martin Braun, C. S. Coleman, D.A.Drew , Vol. 1.
6. Political and Related Models, Steven J. Drams, Kl. F Lucas, P. D. Straffin (Eds),Vol. 1.
7. Discrete and System Models, W. F. Lucas, F. S. Roberts, R. M. Thrall, Vol. 3.
8. Life Science Models, H. M. Roberts And M. Thompson, Vol. 4.
9. "Thinking with Models" (Mathematical Models in Physical, Biological and Social Sciences), T. Saaty and J.Alexander Pergamon Press, New York.

Generic Elective Group – 3 For Sem-III		**Generic Elective Group – 4 For Sem-IV**	
Course Code	Course	Course Code	Course
MSM4301	Advanced Linear Algebra	MSM4401	Fuzzy Logic and Control System
MSM4302	Computational Biology	MSM4402	Financial Mathematics
MSM4303	Mathematical Hydrology	MSM4403	Mathematical Ecology
MSM4304	Mathematical Population Biology-I	MSM4404	Mathematical Population Biology-Ii
MSM4305	Applications of Mathematics in Insurance	MSM4505	Application Of Mathematics In Environmental Studies

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MSM4301 – 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)

Reference Books:

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)

MSM4302 – COMPUTATIONAL BIOLOGY

Unit 1&2: Basic concepts of Molecular biology, DNA and Proteins, The Central Dogma, Gene and Genome Sequences. Restriction Maps - Graphs, Interval graphs. Measuring Fragment sizes.

Unit 3&4: Algorithms for double digest problem , (DDP) - Algorithms and complexity, Approaches to DDP, Simulated Annealing Sequence. Assembly - Sequencing strategies, Assembly in practices, fragment overlap statistics.

Note: The course is coved by the 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.

MSM4303: Mathematical Hydrology

Unit 1: Introduction about an occurrence of groundwater, Groundwater and its contamination.

Unit 2: Sources of Groundwater Contamination, Geological formations and their Properties, Darcy's Laws.

Unit 3: Solute transport Mechanism, Advective-Dispersive Equation (ADE) and simple problems with Dirichlet type.

Unit 4: Neumann type and Cauchy type boundary conditions, Analytical and Numerical Approaches. Groundwater Resources, Groundwater Resources of India.

MSM4304: MATHEMATICAL POPULATION BIOLOGY-I

Unit 1: Basic Concepts: Dynamical models (deterministic and stochastic), Discrete-time and Continuoustime dynamical models.

Unit 2: Single-Species Populations: Discrete-time models (logistic difference equation, Beverton-Holt, and other difference equation models), Allee effect, Equilibrium analysis, Period doubling, bifurcation and chaos, Liapunov exponent, Cobwebs and bifurcation diagrams, Rabbit problem and Fibonacci sequence.

Unit 3:. Single-Species Populations: Continuous-time models, Malthusian, Logistic, and Gompertz growth, Equilibrium points and stability, Delay models.

Unit 4: Interacting Populations: Lotka-Volterra predator-prey model and its modification, Linear stability theory, Periodic solutions and Limit cycle. Poincar´e-Bendixson theorem, Global stability. Competition models, Mutualism models, Cooperative Systems, Kolmogorov models, Food chain models, Hopf bifurcation theorem and its applications.

Recommended Texts (i) Elements of Mathematical Biology, Mark Kot, CUP 2001. (ii) Evolutionary games and population dynamics, Joseph Hofbauer and Karl Sigmund, CUP 2002. (iii) Mathematical Biology, J.D. Murray, Springer-Verlag Biomathematics Texts, 1989. (iv) A Primer in Ecology, N.J. Gotelli, Sinaur Associates Inc.

MSM4305: APPLICATIONS OF MATHEMATICS IN INSURANCE

Unit – 1 :Insurance Fundamentals. 1.1 Insurance defined. 1.2 Meaning of loss. Chances of loss, peril, hazard and proximate cause in insurance. 1.3 Costs and benefits of insurance to the society and branches of insurance-life insurance and various types of general insurance.

Unit – 2 :Life Insurance Mathematics. 2.0 1.4 Insurable loss exposures features of a loss that is ideal for insurance. 2.1 Construction of Mortality Tables. 2.2 Computation of Premium of Life Insurance for a fixed duration and for the whole life.

Unit – 3:Determination Of Claims For General Insurance. 3.1 Determination of claims for general insurance using Poisson distribution. 3.2 Determination of claims for general insurance using and Negative Binomial Distribution. 3.2.1 The Polya Case.

Unit – 4 :Determination Of The Amount Of Claims In General Insurance 4.1 Compound Aggregate claim model and its properties and claims of reinsurance. 4.2 Calculation of a compound claim density function. 4.3 F-recursive and approximate formulae for F.

REFERENCE BOOKS

1. Corporate Finance -Theory and Practice, AswathDamodaran, John Wiley & Sons.Inc.
2. Options, Futures, and Other Derivatives, John C. Hull, Prentice - Hall of India Limited.
3. An Introduction to Mathematical Finanace, Sheldon M . Ross, Cambridge University Press.
4. Introduction to Risk Management and Insurance, Mark S. Dorfman, Prentice Hall, Englwood Cliffs, New Jersey

M.SC. MATHEMATICS SEMESTER – 4

MSM1401 – 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 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.

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

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

Reference Books:

1. B. V. Limaye: Functional Analysis, 2nd Edition, New Age International Limited, 2nd edition.
2. R Larson : Banach Algebra, Marcell Dekker,1973.
3. H G Dales : Automatic Continuity, Cambridge, 2000
4. S. K. Berberain: Lectures in Functional Analysis and Operator theory, Springer Verlag.

5. Goffman and George Padre: First course in Functional Analysis, Prentice Hall of India.
6. Martin Schechter: Principles of Functional Analysis (stud. ed.) Academic Press, New York.

MSM1402 – FILED 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 covered by chapter 5 (all articles) and chapter 7 (7.1 and 7.2 only) of the book, "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.

MSM1403 – GRAPH THEORY

Unit 1: Definition, Degree of a vertex, Path, Circuit, Connected and disconnected graphs, Components.

Unit 2: Euler trail, Euler tour, Euler Graph, Characterizations of Eulerian graph, Hamiltonian Paths and Cycles.

Unit 3: Trees and their properties, Bridges, Spanning trees, Kruskal's algorithm, Prime's algorithm.

Unit 4: Planar Graphs, Kuratowski's two graphs, Different representation of planarity, Detection of Planarity.

Note: This course is roughly covered by the book: A first Look at Graph Theory by Clerk and Holton- World Scientific.

Reference Books:-

1. Graph theory by F. Harary – Addision – Wesley 1969
2. Graph Theory with Applications to Engineering and Computer Science by Narsingh Deo, Prentice-Hall of India, 2004
3. R. J. Willson & J. J. Walkms: Graphs: An introductory approach wiley, 1990.

MSM3401 – COMPUTER GRAPHICS PROGRAMMING

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, Intern. Edition, 1988.
2 "Computer Graphics" by Plastock and Kelley, McGraw-Hill, 1986.

MSM3402 – C LANGUAGE PROGRAMMING

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. 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.

DS Elective Group – 1 For Sem-III		DS Elective Group – 2 For Sem-IV	
Course Code	Course	Course Code	Course
MSM2301	Differential Geometry	MSM2401	Algebraic Topology
MSM2302	Functions of several variables	MSM2402	Operations Research
MSM2303	Mathematics of Money	MSM2403	Cryptography
MSM2304	Fuzzy Sets And Their Applications	MSM2404	BIO-MECHANICS
MSM2305	**Classical Mechanics-I**	MSM2405	Classical Mechanics-II
MSM2306	**Theory of Relativity**	MSM2406	**Relativity and Cosmology**
Msm2307	**ODE Modeling-II**	MSM2407	**ODE Modeling-II**

MSM2401 – ALGEBRAIC TOPOLOGY

Unit 1: Homotopy theory: Homotopy of paths and loops , Product of two loops, Fundamental group, homomorphism induced by homotopy, retraction.

Unit 2: 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 3: 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 4: 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 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", 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.

MSM2402 – OPERATIONS RESEARCH

[Revision: Linear Programming, Graphical method, Simplex method, Duality, Two – Phase Simplex method, Transportation problems, Assignment problems]

Unit I Sequencing and Networks :Sequencing –Problem with N jobs and 2 machines - 3 machines and 'M' machines, Network models – Basic Concepts – Construction of Networks – Project Network – CPM and PERT - Critical Path`Scheduling – Crashing of Network.

Unit II Inventory Models: Inventory models – Various Costs and Concepts–EOQ–Deterministic inventory models – Production models – Stochastic Inventory models – Buffer stock.

Unit III Queuing Models: Queuing models – Poisson arrivals and Exponential service times – Single channel models and Multi channel models. Simulation – Basic concepts – Advantages and Disadvantages – Random number generation – Monte-Carlo Simulation – Simulation models.

Unit IV Decision Models: Decision models – Game theory – Two person zero sum game – Graphic solution - Property of dominance – Algebraic solution. Replacement models – Items that deteriorate with time - When money value changes – Items that fail completely – Individual replacement and Group replacement.

Text Books: Kanti Swarup, Gupta P.K., and Manmohan, (2001), Operations Research, S.Chand & sons.

References:

1. Hamdy Taha, (1999), Operations Research, PHI.
2. Hira and Gupta, (2001), Operations Research, S. Chand & Sons.
3. Panneerselvan. R. (2006), Operation Research, Prentice Hall of India Pvt Ltd
4. J. K. Sharma, "Operations Research – Theory and Application", 4th Edition, Macmillan Publishers India Ltd.

MSM2403 – CRYPTOGRAPHY

UNIT 1:Fundamental concepts: Elements of number theory: Greatest Common Divisor, divisibility and Euclidean algorithm, Congruences, Semi-Groups, Groups, Residue Class Rings, Fields, Analysis of Operation in the Residue Class Rings, Fermat's Little Theorem, Fast Exponentiation, The Chinese Remainder Theorem ,Time estimates for doing arithmetic, Polynomial time. Factoring concept.

Unit 2 – Encryption process : Encryption, decryption and key generation. Symmetric and Asymmetric Crypto systems, Cryptanalysis, Alphabets and Words, Permutations, Block Ciphers, Multiple Encryption, Use of Block Ciphers, Stream Ciphers, Affine Ciphers, Matrices and Linear Maps, Affine Linear Block Ciphers, Vigenere, Hill and Permutation Ciphers, Cryptanalysis of Affine Linear Block Ciphers

Unit 3- Public key cryptosystems : Probability and perfect secure, Various One Time Rabin System, ElGamal System, Enciphering matrices, the idea of public key cryptography, design of RSA, some important properties of RSA, Discrete logarithm problem, public key cryptosystem based on Knapsack problem , the concept of zero knowledge transfer.

Unit 4- Primality and factoring: Trial Division, Carmichael number, Millor-Rabin Test, p-1 Method, pseudo primes, the rho methods, Fermat factorization and factor basis, the continued fraction method, the quadratic sieve method.

Books recommended :

1.A course in number theory and cryptography by N. Koblitz. Springer 2002.

2.An introduction to cryptography by J. A. Buchmman. Springer.2001.

3.Introduction to Cryptography by Hans Delfs and H.Knebl. Springer 2001.

4. Modern cryptography by O.Goldrich. Springer. 1999 5. Modern cryptography: theory and practice by Wenbo Mao. HP. 2004

MSM2404 – 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.

MSM2405 – CLASSICAL MECHANICS-II

Unit 1: Derivation of Hamilton's canonical equations of motion from both differential and integral principles; canonical transformations and the four types of generating functions.

Unit 2: 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 3: 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 4: 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.

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.

MSM2406 –RELATIVITY AND COSMOLOGY

Unit 1:The Schwarzschild Solution: The spherically symmetric space–time, field equations, the Schwarzschild solution, particle orbits in Schwarzschild space–time, photon orbits.

Unit 2: 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 3: Strong Gravitational Fields (II): The external Schwarzschild solution, The Kruskal – Szekers diagram, The Kerz – Newman solution.

Unit 4: 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.

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.

MSM2407 – ODE MODELING-II

Unit–1 : Mathematical Modelling Through Difference Equations: 1.1 The need for Mathematical Modeling through Difference Equations: Some Simple Models. 1.2 Basic Theory of Linear Difference Equations with constant coefficients. 1.3 Mathematical Modeling through Difference Equation in Economics. 1.4 Mathematical Modeling through Difference Equations in Population Dynamics.

Unit–2: Mathematical Modellig Through Graphs: 2.1 Situation that can be modelled through Graphs. 2.2 Mathematical Models in terms of Directed Graphs. 2.3 Mathematical Models in terms of Signed Graphs. 2.4 Mathematical Models in terms of Weighted Diagraphs.

Unit – 3 & Unit–4: Mathematical Modelling Through Decay – Differential Difference Equations: Multispecies Model, A Model for Growth of Population inhibited by Cumulative Effects of Pollution, Prey- Predator Model in terms of Integro – Differential Equations, Stability of the Prey – Predator Model, Differential – Differences Equations Models in Relation to other Models.

REFERENCE BOOKS:

1. Mathematical Modelling, J. N. Kapur, New Age International (P) Ltd., Reprint 2003.
2. Differential Equations and Their Application ,ZafarAhsan ,Prentice Hall of India , Delhi
3. Mathematical Modelling, J.G. Andrews and R. R. Mclone (1976). Butterwerths London.
4. Mathematical Modelling Techniques, R. Aris (1978) , Pitman.
5. Differential Equation Models, Martin Braun, C. S. Coleman, D.A.Drew , Vol. 1.
6. Political and Related Models, Steven J. Drams, Kl. F Lucas, P. D. Straffin (Eds),Vol. 1.
7. Discrete and System Models, W. F. Lucas, F. S. Roberts, R. M. Thrall, Vol. 3.
8. Life Science Models, H. M. Roberts And M. Thompson, Vol. 4.
9. " Thinking with Models " (Mathematical Models in Physical, Biological and Social Sciences), T. Saaty and J.AlexanderPergamon Press, New York

Generic Elective Group – 3 For Sem-III		Generic Elective Group – 4 For Sem-IV	
Course Code	Course	Course Code	Course
MSM4301	Advanced Linear Algebra	MSM4401	Fuzzy Logic and Control System
MSM4302	Computational Biology	MSM4402	Financial Mathematics
MSM4303	Mathematical Hydrology	MSM4403	Mathematical Ecology
MSM4304	Mathematical Population Biology-I	MSM4404	Mathematical Population Biology-Ii
MSM4305	Applications of Mathematics in Insurance	MSM4505	Application Of Mathematics In Environmental Studies

MSM4401: FUZZY LOGIC AND 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.

MSM4402 –FINANCIAL MATHEMATICS

Unit 1:Some Preliminary Notions and Facts from Probability theory, The Theory of Interest and Calculus.

Unit 2: Conditional expectation, Comparison of Random variables, Random Processes I : Counting and Compound Processes, Markov chains, Modelling Claim and Cash Flows.

Unit 3: Random Processes II : Brownian Motion and Martingales, The Itô Integral , The Itô formula, Survival Distributions, Life Insurance Models.

Unit 4: Annuity Models, Bonds, forward contracts and future, Asian, European and American options, Preferences of Individuals, An individual Risk model for short period.

MSM4403: MATHEMATICAL ECOLOGY

Unit 1: Single species models, Exponential, logistic, Gompertz growth Harvest model.

Unit 2: Discrete-time and Delay model, Interacting population model, chemostate model.

Unit 3: Prey-predator, competition & mutualism models, Dynamics of exploited populations, spatially structured models.

Unit 4: Age-structured models, sex-structured models, models of spread, two sex models, Leslie matrix.

Recommended Texts (i) Elements of Mathematical Biology, Mark Kot, CUP 2001. (ii) Evolutionary games and population dynamics, Joseph Hofbauer and Karl Sigmund, CUP 2002. (iii) Mathematical Biology, J.D.

Murray, Springer-Verlag Biomathematics Texts, 1989. (iv) A Primer in Ecology, N.J. Gotelli, Sinaur Associates Inc. Reference Books:

Essential Mathematical Biology by Nicholas, F. Britton.

A Course in Mathematical Biology: Quantitative Modeling with Mathematical & Computational Methods

by Gerda de Vries, Thomas Hillen, Mark Lewis, Johannes M□ller, and Birgitt Sch□nfisch.

Mathematical Models in Biology by Leah Edelstein-Keshet.

Mathematical Models in Biology: An Introduction by Elizabeth S. Allman, John A. Rhodes.

A Biologist's Guide to Mathematical Modeling in Ecology and Evolution Sarah P. Otto and Troy Day.

Dynamic Models in Biology by Stephen P. Ellner and John Guckenheimer.

Modeling Differential Equations in Biology by Clifford Henry Taubes

A Primer of Ecology by Nicholas J. Gotelli

An Introduction to Mathematical Biology by Linda J. S. Allen

MSM4404:MATHEMATICAL POPULATION BIOLOGY-II

Unit 1: Exploited Populations: Harvest models, Pontryagin's maximum principle and optimal harvest policies.

Unit 2: Chemostat Models: Modeling of bacterial growth, chemostat and its basic mathematical properties.

Unit 3: Epidemic models: Kermack and McKendrick model and its various extensions.

Unit 4: Stochastic Models: Stochastic differential equation. Connection with Fokker-Planck equation. White noise, Wiener process, Coloured noise, Ornstein-Uhlenbeck process. Stochastic stability, Stochastic population models.

Recommended Texts (i) Elements of Mathematical Biology, Mark Kot, CUP 2001. (ii) Evolutionary games and population dynamics, Joseph Hofbauer and Karl Sigmund, CUP 2002. (iii) Mathematical Biology, J.D. Murray, Springer-Verlag Biomathematics Texts, 1989. (iv) A Primer in Ecology, N.J. Gotelli, Sinaur Associates Inc.

MSM4405: APPLICATION OF MATHEMATICS IN ENVIRONMENTAL STUDIES

UNIT 1&2: Linear Equations, matrix form, row reduction; row rank and column rank, row equivalence, row reduced echelon matrices, various methods to find solutions of a system of linear equations, linear inequalities.

UNIT 3&4: Introduction to ecology and environment; linear programming problem – introduction, graphical solution method, some exceptional cases; general linear 8 programming problem, duality, simplex method; problems related to ecology and environment.

Textbook:

1. Linear Algebra (2nd edition) – K. Hoffman and R. Kunze, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

2. Introduction to Matrices and Linear Transformations (3rd edition) – D. T. Finkbeiner, D.B. Taraporevala, Bombay, 1990.

3. Operations Research (for Group B) – K. Swarup, P. K. Gupt and Man Mohan, Sultan Chand & Sons, New Delhi, 2000. Reference books:

4. Applied Operation Research: A Survey (for Group B) – G. E. Whitehouse and B. L. Wechsler, John Wiley & Sons, 1975.

5. Ecology: The Experimental Analysis of Distribution and Abundance (2nd edition) (for Group B) – C. J. Krebs, Harper and Row Publishers, 1978.

MSM4402 – 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 12 credits in at least 14 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 following list.

1. *BOOK REVIEW*
2. *PROJECT WORK/FIELD WORK*
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 Head of the University Department)*
8. *Any Special Topics to be selected by the University Departmental 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 TWO Examiners: HOD of the University Department 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: 45 marks for Internal & 205 marks for External Examination.

205 marks of External Examination separated as;

105 marks for both the project work reports + 100 marks for Presentation & Viva-voce Exam.

N.B.: More Elective/Soft Skill based courses can be added from time to time, as and when needed, subject to the special available faculty (foreign or eminent one from India) in the university department, government's or University's policy matter & also demand and requirements of the students.

CHOICE BASED CREDIT SYSTEM (CBCS): The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed. Outline of Choice Based Credit System: 1. Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. 2. Elective Course: Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course. 2.1 Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study). 2.2 Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. 2.3 Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective. 3. Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course: The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc. 3.1 AE Compulsory Course (AECC): Environmental Science, English Communication/MIL Communication. 3.2 AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction. Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

(42)

Illner, R., Bohun, C., McCollum, S. & van Roode, T. (2005). *Mathematical modelling: A case studies approach*. Providence RI: American Mathematical Society.

Maki, D. & Thompson,M. (2006). *Mathematical modeling and computer simulation*. New York: Thomson, Brooks/Cole.

Extra

GF07 (Interest Rates and Credit Modelling) Year: 2017–2018 Code: MATHGF07 Value: 15 UCL credits (= 7.5 ECTS) Term: 2 Structure: 3 hour lectures per week Assessment: 100% examination. Student must achieve at least 50% to pass this course. Normal Pre-requisites: Knowledge of probability theory and stochastic processes, an introductory course in Financial Mathematics. Lecturer: Prof C Marinelli Course Description and Objectives This is a 30-hour introductory course on interest rate modelling and the pricing of fixed-income assets. The first part of the course focusses on the modelling of the term structure of interest rates. During the second part of the course, the concept of credit risk and some standard credit risk models are introduced. Recommended Texts Damir Filipovic, Term-Structure Models: A graduate Course, Springer, 2009.

Detailed Syllabus Basic notions on interest rates and bond markets.

Short-rate models. Heath-Jarrow-Morton models. Structural models of default: Black-Scholes-Merton model, first-passage models of default. Hazard function approach: hazard function and hazard rate, bond pricing with recovery at maturity or at the default-time. Pricing of simple defaultable claims.