DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY
MURTHAL (SONEPAT)
ORDINANCE
For
FIVE-YEARS-INTEGRATED MASTER OF SCIENCE IN MATHEMATICS
(w.e.f. from the Academic Session 2012-13)

1 Preliminaries

1.1 This ordinance shall apply to Five-Years-Integrated M. Sc. in Mathematics in the University Teaching Departments.

Normal duration of the Programme	**Extended duration of the Programme**
Five Years (10 semesters)	Eight Years

The eligibility criteria for admission to the programme, fee structure, academic calendar, scheme of studies and examination, examination schedule, sports calendar and cultural activity calendar etc. for the academic year shall be published in the prospectus.

2. ORDINANCE: FIVE-YEARS-INTEGRATED MASTER OF SCIENCE IN MATHEMATICS

Notwithstanding anything contained in any other ordinance with regard to the matter hereunder, the courses of study for the Degrees of Five-Years-Integrated M. Sc. in Mathematics and the conditions for admission thereto shall be as under:

2.1 The Five-Years-Integrated M. Sc. in Mathematics shall extend over a **minimum period of five academic years.** Teaching in each academic year shall be divided into two semesters, each semester extending to 20 weeks including practical, semester examination and semester break. Teaching for odd semesters will normally be from July to December and for even semesters from January to May.

2.2 At the end of the each semester, there shall be an examination wherein candidates shall be examined in the courses studied by them in that semester. Semester examinations shall be designated as First Semester Examination, Second Semester Examination, and Third Semester Examination and so on.

2.3 The Examination of odd semesters will normally be held in **December/January** and that of even semesters will normally be held in **May/ June** except students having reappear in 9^{th} (or 10^{th}) semester may be allowed to appear along with main examination of 10^{th} (or 9^{th}) semester on such dates as may be fixed by the Controller of Examination as per the Schedule provided by the University. The date(s) of commencement of examination as well as the last date(s) for the receipt of examination forms and fees shall also be notified by the controller of Examinations to the concerned University Teaching Departments.

2.4 The courses of the study and the subjects of examinations shall be as approved by the **Academic Council from time to time**. The medium of instructions and Examination shall ordinarily be **English** except otherwise decided by the Academic Council. The question paper will be set in English, except otherwise decided by the Post Graduate Board of Studies concerned and approved by the Academic Council. Every candidate shall be examined in the subjects as laid down in the syllabus approved by the Academic Council from time to time. The credits for each subject as also the contact hours per week will be mentioned in the scheme of studies approved by the Academic Council.

Evaluation Process:

a. Major Test (Theory Examination):

Written question papers for the semester examination shall be set by an **External/ Internal paper setter** appointed by the Vice-Chancellor from a panel of examiners submitted by the chairman of the department duly approved by the PGBOS (Post Graduate Board of Studies) of the concerned department and the answer sheets shall generally be evaluated by the **internal examiners** but, in exceptional cases, can be evaluated from **outside experts** with the permission of the Vice-Chancellor. At the most 50% question papers can be set by the external examiners. In case a question paper is not received in time from an external examiners or he refuses to set the question paper, the paper can be got set from an internal examiner. The evaluation of answer sheets will be done by the examiners as per the procedure laid down by the University for the purpose.

b. Practical Examination:

Examination in practical and viva-voce shall be conducted jointly by the External and Internal Examiners appointed by the Vice-Chancellor from a panel of examiners submitted by the chairman of the department duly approved by the PGBOS of the concerned. If an External Examiner is not able to join, alternate examiner (including those of the same University dept) may be appointed by the Chairperson of the concerned dept. with the intimation to the Controller of Examinations in the following preferential order:

i) From outside ii) from DCRUST Murthal

c. Sesssionals (Internal Assessment) for Theory Subjects, Practical Subjects and Seminars:

Sessional (internal assessment) works shall be evaluated by the teachers of the various subjects based on the work done during semester on the basis of the following weightage:

I. For Theory subjects:

i) Minor Test –I 40%

ii)	Minor Test-II	40%
iii)	Assignment/Performance in the class	20%

II. **For Practicals:**

i) Viva-Voce/ Test 40%
ii) Laboratory Record/ Project Report/Seminar Report/Drawing Sheet 60%

III. For Seminar

i) Presentation 40%
ii) Discussion 20%
iii) Report 40%

Every student has to appear in both the minor tests. **If a student does not take a minor test, he/she shall be awarded zero marks in that test**. The marks obtained in sessional/practical/theory are to be submitted to the Examination Branch duly signed by the Chairperson of the department before the close of semester examination or a date fixed by the COE. The examination branch/course coordinator shall convert the marks in to equivalent grades as per the grading procedure.

The examination shall be open to a candidate who:

- has attended regularly the prescribed courses of studies for the relevant semester examination in the department recognized by the University for the degree of Five-Years-Integrated M. Sc. in Mathematics.

- has his/her name submitted to the Controller of Examinations through the Chairperson of the department.

- has attended **not less than 75% of the total classes held in each theory/ lab/project/seminar etc.** This requirement shall be fulfilled separately for each subject of study. A deficiency up to **10% may be condoned by the Chairman** of the department. A further condoning of **5% in attendance** may be allowed in severe/ Compassionate circumstances by the Vice-Chancellor. **However it may not be treated as a matter of right by the students.** (In case a student fails to fulfill the necessary requirement of the attendance in any subject(s) in any semester , he/ she shall not be promoted to next semester and will have to repeat that academic semester in the next academic session along with regular students.)

- whose result declaration is delayed for no fault of his/her or has applied for revaluation may attend classes of the next higher semester provisionally at his /her own risk and responsibility subject to his/her passing the concerned semester Examination. Such a candidate shall also be governed by the clause 2.6 given below. In case the candidate fails to pass the concerned Semester Examination, his / her attendance and studies in the next higher semester in which he /she was allowed to attend classes provisionally, shall stand cancelled.

2.5 If a candidate, after attending the requisite number of classes for the course of studies in the Department either not appeared or having appeared in any semester examination has failed in one or more paper(s) for that examination, he/she can appear for such paper(s) at subsequent examinations without attending a fresh course of studies for that semester. Such a candidate may, in the meantime, pursue his / her studies for the next semester(s) and appear in the examination(s) for the same along with the examination for the lower semester(s).

2.6 A candidate will be automatically eligible for promotion to the next semester provided he/she fulfils the other essential eligibility criterion for promotion as mentioned in the ordinance.

The amount of Exam/Reappear/ Re-evaluation/ Improvement fee to be paid by the candidates shall be as prescribed by the University from time to time. A candidate who has paid dues for the higher class and is dropped for want of fulfillment of any of the above conditions shall not be required to pay his dues again on re-admission after fulfillment of above conditions.

Re-evaluation is permitted only for major tests (Theory course) as per University Rules for Re-evaluation. **The Re-evaluation is not permitted in an examination which involve more than one examiner i.e. Practicals/Seminar/Project /Dissertation etc.**

A candidate admitted to M.Sc. 5 years integrated course in Mathematics will be awarded with the degree of B.Sc.(Hons) in Mathematics as well as with the degree of M.Sc. in Mathematics as per the clause (i) and (ii) below:

(i) A candidate after 3^{rd} year will be awarded with the degree of B.Sc.(Hons) in Mathematics, provided he/she has passed all the papers of 1^{st} , 2^{nd} , 3^{rd} , 4^{th} , 5^{th} and 6^{th} semesters within 8 years of his/her admission to the course.

(ii) A candidate after 5^{th} year will be awarded with the degree of M.Sc. in Mathematics, provided he/she has passed all the papers of 1^{st}, 2^{nd} , 3^{rd} , 4^{th} , 5^{th} , 6^{th} , 7^{th} , 8^{th} , 9^{th} and 10^{th} semesters within 8 years of his/her admission to the course.

2.7 A candidate who is unable to pass the Five-Years-Integrated M.Sc. in Mathematics within a maximum of **eight consecutive academic years** from the date of his admission shall **lose the right to pursue the degree programme.**

If a candidate wants to discontinue in the 5-year Integrated course after 3^{rd} year(i.e. after 6^{th} semester), he/she will be awarded the degree of B.Sc.(Honours) in Mathematics, provided he/she has passed all the papers of the 1^{st} , 2^{nd} ,3^{rd} ,4^{th} ,5^{th} and 6^{th} semesters within a period of 8 years from the date of his/her admission to the course.

2.8 The minimum passing marks/grade for passing any semester Examination shall be:

i. 40% in each major test (theory paper).
ii. 40% in each Practical Examination/Viva-Voce Examination.
iii. 40% in aggregate of each major test and its sessional.
iv. 40% in aggregate of each practical examination and its sessional.

A candidate, who fails to obtain the requisite marks in aggregate of sessionals and end semester examinations (as described in (iii) and (iv) above) shall be required to reappear in the concerned subject in the subsequent theory(major test)/practical examination(s) subject to clause 2.6, 2.7 and 2.3. Such candidates will not be allowed to repeat the sessional (internal assessment) works.

v. Minimum pass grade in each course is 'D' grade. Grade will be awarded after adding the marks of sessional (internal assessment) and major test/practical examination.
vi. SGPA of 4.0

A candidate who fails to obtain the requisite marks/grade in any course shall **be required to appear** in the concerned course in the subsequent examination(s) as per the clause 2.6, 2.7 and 2.3.

2.9 If a candidate has completed his/her degree of M.Sc. with a **CGPA≤ 6.5 and he/she wants to improve his/her grade,** he/she may be allowed to improve by depositing the requisite fee as per the University Rules. He/she is allowed to appear in **at the most half of the theory papers only** of one semester along with the regular candidates of that semester and the sessional (internal assessment) part will be retained. **Such opportunity may be given only twice in succession, subject to the condition that the candidate has to complete the degree, within 8 consecutive years of his/her registration to the course.** If the improved CGPA is less than the original, then the original will be retained. **Here note that the candidate will not be allowed to avail the chance of improvement after 8th year of his/her admission to the course in any case.**
Further, If a candidate gets his/her CGPA improved, then his/her claim for a position in the class/university, if any, will be ceased.

2.10 The result of a student at the end of each semester Examination and after completion of course shall be declared on the basis of the **SGPA & CGPA (cumulative grade point average)** obtained by the student.

2.11 At the end of each semester examination, the COE shall publish the result, provided that in a case where candidate who was permitted to take examination for higher semester but has not cleared the lower semester examination his result for the higher semester examination will be declared provisionally. Each successful candidate shall be issued a copy of the result card on having passed the semester examination.

2.12 Notwithstanding the integrated nature of the course wherever it is spread over more than one academic year, the Ordinance in force at the time a student joins the course shall hold good only for the examination held during or at the end of the semester and nothing in this Ordinance shall be deemed to debar the University from amending the Ordinance and the amended Ordinance, if any, shall apply to all students whether old or new.

3. SCHOLARSHIP:

Scholarship may be awarded to students as per the terms and conditions stipulated by the funding agencies. However, it should be mentioned in the prospectus.

4. THE CREDIT SYSTEM:

The University has introduced credit system of study for all the Under Graduate and Post Graduate programs for all the students admitted from the **Academic Year 2008-09.** The prominent features of the credit system are the process of continuous evaluation of a student's performance, and a flexibility to allow the student to progress at an optimum pace.

Each Academic Program has a certain number of **credits** which describe its weightage. A student's performance is measured by the number of credits that he/she has completed satisfactorily. A minimum grade point average is required to be maintained for satisfactory progress.

Each subject (component) has a certain number of credits which reflect its weightage and is normally decided on the basis of effective contact hours. It is mentioned in the scheme of studies and examinations.

4.1 The semester examination for the odd semesters shall ordinarily be held in the month of **December/January** and for the even semesters in the month of **May/June**, on such dates as may be fixed by University authority. The concerned teacher/ course coordinator should ensure that 100% syllabus is covered in each subject before the Semester Examination.

4.2 A faculty member shall be appointed as a **semester-coordinator** by the **Chairperson** of the department who shall have the full responsibility for conducting the minor tests, coordinating the work of evaluation with other faculty members involved in the course and awarding of grades. A common paper will be set for the minor tests of the common courses.

In case of perceptible deviation in the awards given by different teachers of the same course, the **course co-ordinator will moderate the awards by calling meeting** of the teachers associated. However, where a single teacher is associated with the course, moderation of awards will be done in consultation with the chairperson of the department.

4.3 For the time being the existing system of centralized examination will be followed for conducting the Semester Examination. However the system may be reviewed as the University grows and more and more number of departments/courses/students are added to it.

4.4 The marks/grade awarded to a student in any particular subject will be based on the performance of the student evaluated throughout the semester. **The syllabus of the minor tests will be what is covered in that particular term.** The Semester Examination will be based on the entire syllabus.

4.5 The marks/grades will be displayed on the notice board of the department by the Chairperson before forwarding it to the Examination Branch.

4.6 The Chairperson of the department shall forward the awards/grades to the Examination Branch within a week after the semester ends and examination process starts. The evaluated answer sheets of minor tests are to be kept by the course coordinator for at least one year. The Examination Branch will keep the evaluated answer sheets of the semester examination for **at least one year**.

5. GRADING SYSTEM:

For the award of grades in a subject, all component-wise evaluation shall be done in marks. The marks would be converted to grades as per the guidelines given below:

5.1 Award of Grades Based on Absolute Marks

The University will follow system of grading for all (irrespective of no. of students) based on absolute marks (**after applying moderation if any**) as given below:

Range of Marks (%)			**Grade**
90	to	100	A+
80	to	89	A
70	to	79	B+
62	to	69	B
55	to	61	C+
46	to	54	C
40	to	45	D
Less than		40	F

Note:

(i) The awards/grades shall be submitted by the teacher concerned through course coordinator to the Chairperson of the department. **The awards/grades should be finalized within 7 days** of the semester examination.

(ii) The procedure for evaluation and award of grades for professional training shall be decided by the respective Chairman/Chairperson of the department. The candidate shall be required to **submit a comprehensive report within one month of completion the training**. Training Report will be completed under the supervision of the officer of the company/institution under whose guidance and supervision the training was completed by the candidate in that company/institute. The candidate will add supervisor's certificate in the beginning of the report stating that the report is an out-come of work done by the candidate during his/her training.

(iii) While calculating percentage of marks to award grades, 0.5 or higher fraction may be raised to the next higher whole number.

5.2 GRADE POINTS:

The grading point of academic performance will be as under:-

Academic Performance	**Grades**	**Grade Points**
Outstanding	A+	10
Excellent	A	9
Very Good	B+	8
Good	B	7
Average	C+	6
Below Average	C	5
Marginal	D	4
Very Poor	F	0
Absent	G	-
Audit Pass	AP	-
Audit Fail	AF	-
Incomplete Dissertation	X	-

Note:

1. Pass Grade is Grade D and higher grades
2. Grade F is Fail grade.

'F' Grade

The F grade denotes poor performance, i.e. failing in a subject (or subject component). A student has to reappear in the semester examination only, in which he/she obtains 'F' grades, until a passing grade is obtained, within the stipulated time of completion of that programme.

'G' Grade

If any student, who is otherwise eligible for appearing in the semester examination as per the ordinance, but he/she is unable to appear in the semester examination then he /she will be awarded 'G' grade. The candidate will be

allowed to take up the examination next time along with regular students and he /she will be awarded the grade as per grade system explained above.

AP/AF Grade

These grades are awarded to qualifying/Non-Credit subject(s) (as per scheme supplied by concerned departments). The candidate **will not be eligible for award of degree** without qualifying these courses.

Continuous Absence

If a student is continuously absent from the Department for **more than four weeks** without intimation to the Chairperson of Department, his/her name will be struck off from the roll of department. The re-admission shall not be allowed to the candidate during the same academic session.

'X' Grade

This grade is awarded for incomplete Project work as per guidelines given below and will be converted to a regular grade on the completion of the Project work and its evaluation.

A student who is unable to complete his/her Project may be awarded an 'X' grade by the Chairman/Chairperson/chairperson on the recommendation of his/her supervisor.

A student who has been awarded 'X' grade shall be required to formally register for the next semester and pay the requisite fee.

'X' grade will be awarded in exceptional circumstances beyond student's/supervisor's control. Normally, the following grounds may be considered for the award of 'X' grade:

(a) Technical reasons/grounds such as Supervisor/equipment not being available.
(b) Any other reason to the satisfaction of supervisor.

5.3 Evaluation of Performance

The performance of a student will be evaluated in terms of Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point of time.

The CGPA is calculated on the basis of all pass grades, except audit courses, obtained in all completed semesters.

- Regarding evaluation of performance.

The formula for calculating SGPA is as mentioned below:

$$SGPA \equiv \frac{\sum_{SEM} (\text{Total credits earned in a subject x Grade points out of total marks in a concerned subject}) \text{ except audit courses}}{\sum_{SEM} (\text{Total credits earned in a subject}) \text{ except audit courses}}$$

Illustration for calculating SGPA/CGPA:

Ist Semester

Course No. (1)	Course Credits (2)	Grade Awarded (3)	Earned Credits (4)	Grade Points (5)	Point Secured (6)
MALXXX	5	C+	5	6	30
CSLXXX	4	C	4	5	20
PHLXXX	4	A+	4	10	40
PHPXXX	1.5	B+	1.5	8	12
MELXXX	4	F	0	0	00
AMLXXX	4	B	4	7	28

Credits registered in the semester (total of column 2) = 22.5
Earned Credits in the semester = 18.5
Total of column 4 (total of column 2 excluding F grade)
Point secured in this semester in passed courses = 130

$$\text{SGPA} = \frac{Points \text{ secured in passed courses}}{Credits \text{ earned}} = \frac{130}{18.5} = 7.027$$

IInd Semester

Course No. (1)	Course Credits (2)	Grade Awarded (3)	Earned Credits (4)	Grade Points (5)	Point Secured (6)
MALXXX	5	D	5	4	20
EELXXX	5	F	0	0	00
CYLXXX	4	B	4	7	28
CYPXXX	1.5	C+	1.5	6	09
MELXXX	4	A	4	9	36
HULXXX	2	AP	2	N.A.	00

Credits registered in the semester (total of column 2) = 21.5
Earned Credits in the semester =14.5
Total of column 4 (total of column 2 excluding F&AP grades)
Cumulative Earned Credits (earned credits in previous semesters and current semester) =
18.5+14.5=33.0
Points Secured in this semester in passed courses = 93
Cumulative points secured (total of point secured in previous semesters and current semester) = 130 + 93 = 223

CGPA = $\dfrac{\text{Cumulative points secured in all passed courses}}{\text{Cumulative earned credits, excluding audit courses}} = \dfrac{130+93}{18.5+14.5} = 6.757$

Each successful candidate shall be issued a copy of the result card on having passed the semester examination.

- **Regarding Conversion of CGPA into Marks**

The CGPA if multiplied by 9.5 will give the equivalent marks in %age.

Candidates who pass all the prescribed subjects for all the semesters, but obtained:-

(i)	Less than CGPA of 5.26	Pass class
(ii)	5.26≤ CGPA<6.32	2nd Division
(iii)	6.32≤ CGPA<7.9	1st Division
(iv)	CGPA of 7.9 or more	1st Division with Honours provided that they have passed all the semester examinations in single sitting within the normal period of course and without re-appear in any paper throughout the programme.

will be awarded aforesaid division.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5-Year Integrated M.Sc. in Mathematics

Semester I

MAT 211H	Algebra	4 credits	4-1-0
MAT 213H	Calculus	4 credits	4-1-0
MAT 215H	Solid Geometry	4 credits	4-1-0
MAT 217H	Discrete Mathematics-I	4 credits	4-1-0
MAT 219H	Descriptive Statistics	4 credits	4-1-0
MAT 221H	Computer Fundamentals and MS-OFFICE	4 credits	4-1-0
MAT 223H	Practical/ Computational work based on papers MAT 219H and MAT 221H	2 credits	0-0-4
MAT 225H	English-I	-	3-0-0
Total Credits		26 Credits	

Semester II

MAT 212H	Number Theory and Trigonometry	4 credits	4-1-0
MAT 214H	Ordinary Differential Equations	4 credits	4-1-0
MAT 216H	Vectors Calculus	4 credits	4-1-0
MAT 218H	Discrete Mathematics-II	4 credits	4-1-0
MAT 220H	Regression Analysis and Probability	4 credits	4-1-0
MAT 222H	Programming in Visual Basis	4 credits	4-1-0
MAT 224H	Practical/ Computational work based on papers MAT 220H and MAT 222H	2 credits	0-0-4
MAT 226H	English-II	-	3-0-0
	Total Credits	26Credits	

Semester III

MAT 311H	Advanced Calculus	4 credits	4-1-0
MAT 313H	Partial Differential Equations	4 credits	4-1-0
MAT 315H	Statics	4 credits	4-1-0
MAT 317H	Differential Geometry	4 credits	4-1-0
MAT 319H	Programming in C	4 credits	4-1-0
MAT 321H	Database Management and Oracle	4 credits	4-1-0
MAT 323H	Practical/ Computational work based on papers MAT 319H and MAT 321H	2 credits	0-0-4
	Total Credits	26 Credits	
	Environmental science		

Semester IV

MAT 312H	Sequence and Series	4 credits	4-1-0
MAT 314H	Special Functions and Integral Transforms	4 credits	4-1-0
MAT 316H	Probability Distributions and Numerical Methods	4 credits	4-1-0
MAT 318H	Hydrostatics	4 credits	4-1-0
MAT 320H	Elementary Inference	4 credits	4-1-0
MAT 322H	Data Structures using C	4 credits	4-1-0
MAT 324H	Practical/ Computational work based on papers MAT 320H and MAT 322H	2 credits	0-0-4
	Total Credits	26 Credits	

Semester V

MAT 411H	Real Analysis	4 credits	4-1-0
MAT 413H	Groups and Rings	4 credits	4-1-0
MAT 415H	Numerical Analysis	4 credits	4-1-0
MAT 417H	Integral Equations	4 credits	4-1-0
MAT 419H	Methods of Applied Mathematics	4 credits	4-1-0
MAT 421H	Operations Research-I	4 credits	4-1-0
MAT 423H	Practical/ Computational work to be performed on computing using EXCEL/SPSS	2 credits	0-0-4
	Total Credits	26 Credits	

Semester VI

MAT 412H	Real and Complex Analysis	4 credits	4-1-0
MAT 414H	Linear Algebra	4 credits	4-1-0
MAT 416H	Dynamics	4 credits	4-1-0
MAT 418H	Elementary Topology	4 credits	4-1-0
MAT 420H	Fluid Dynamics	4 credits	4-1-0
MAT 422H	Operations Research-II	4 credits	4-1-0
MAT 424H	Practical/ Computational work to be performed on computing using MATLAB/TORA	2 credits	0-0-4
	Total Credits	26 Credits	

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5 -Years Integrated M.Sc. in Mathematics, Semester-I
(w.e.f. 2012-2013)

Paper No.	Paper title	Teaching Scheme			Examination Scheme			Duration of Exam.	Credit
		L	T	P	Internal Marks	External Marks	Total		
MAT 211H	Algebra	4	1	0	25	75	100	3 Hours	4
MAT 213H	Calculus	4	1	0	25	75	100	3 Hours	4
MAT 215H	Solid Geometry	4	1	0	25	75	100	3 Hours	4
MAT 217H	Discrete Mathematics-I	4	1	0	25	75	100	3 Hours	4
MAT 219H	Descriptive Statistics	4	1	0	25	75	100	3 Hours	4
MAT 221H	Computer Fundamentals and MS-OFFICE	4	1	0	25	75	100	3 Hours	4
MAT 223H	Practical/ Computational work based on Papers MAT 219H and MAT 221H	0	0	4	25	25	50	3 Hours	2
MAT 225H	English - I	3	0	0		60		3 Hours	Qualifying
Total		27	6	4	175	475	650		26

Note:

1. Paper MAT 225H will be the qualifying paper and its marks will not be included in the total marks obtained by the student for the course.
2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Algebra

Code: MAT 211H

Max. Marks: 100
External Exam: 75
Internal Exam: 25
Time: 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit– I

Symmetric, Skew-symmetric, Hermitian and Skew Hermitian matrices. Elementary Operations on matrices. Rank of a matrix. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Eigenvalues, Eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Unit – II

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations., Unitary and Orthogonal Matrices, Bilinear and Quadratic forms.

Unit – III

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.

Unit – IV

Nature of the roots of an equation Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.

Books Recommended :

1. H.S. Hall and S.R. Knight, Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan and P.K.Mittal, A Text Book of Matrices, S.Chand Publication.

Calculus

Code: MAT 213H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Definition of the limit of a function. Basic properties of limits, Indeterminate forms, Continuous functions and various types of discontinuities. Differentiability. Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions.

Unit – II

Tangents and normals, sub-tangents and sub-normals, Asymptotes in Cartesian coordinates and polar coordinates. Curvature, radius of curvature for Cartesian, parametric, pedal and polar forms. Newton's method, Centre of curvature. Circle of curvature. Chord of curvature, Evolutes.

Unit – III

Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points. Type of cusps, Tracing of curves in Cartesian, parametric and polar co-ordinates. Reduction formulae.

Unit – IV

Rectification.,Quadrature, Area bounded by closed curves. Volumes and surfaces of solids of revolution. Theorems of Pappu's and Guilden.

Books Recommended :

1. Shanti Narayan: Differential and Integral Calculus.
2. Murray R. Spiegel: Theory and Problems of Advanced Calculus. Schaun's Outline series. Schaum Publishing Co., New York.
3. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
4. M.J.Strauss, G.L. Bradley, K.J.Smith: Calculus (3^{rd} edition), Darling Kindasley (INDIA) Pvt. Limited (Pearson Education) Delhi, 2007.

Solid Geometry

Code: MAT 215H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

General equation of second degree. Tracing of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic. System of conics. Confocal conics. Polar equation of a conic, tangent and normal to the conic.

Unit – II

Spheres: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres. Co-axial system of spheres. Cones: Right circular cone, enveloping cone and reciprocal cone. Cylinders: Right circular cylinder and enveloping cylinder.

Unit – III

Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Enveloping cone of a coincoid. Enveloping cylinder of a coincoid.

Unit – IV

Paraboloids: Circular section, Plane sections of conicoids. Generating lines. Confocal conicoid. Reduction of second degree equations.

Books Recommended:

1. R.J.T. Bill, Elementary Treatise on Coordinary Geometry of Three Dimensions, MacMillan India Ltd. 1994.
2. P.K. Jain and Khalil Ahmad : A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999.
3. Bansi Lal, Solid Geometry,

Discrete Mathematics-I

Code: MAT 217H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

Sets, principle of inclusion and exclusion, relations, equivalence relations and partition, denumerable sets, Cardinality of sets, Posets and their properties, Pigeon Hole Principle and its applications.

Unit – II

Propositions, logical operations, logical equivalence, conditional propositions, Tautologies and contradictions. Quantifier, Predicates and Validity. Types of proof: Direct proof , indirect proof, proof by mathematical induction.

Unit – III

Permutations and combinations, Functions: injective, surjective, bijective, many to one, Range, domain, Invertible and composite. Examples of functions including hash function, floor function, ceiling function, characteristic function.

Unit -IV

Discrete numeric functions, Generating functions, recurrence relations with constant coefficients. Complementary function, particular solution, total solution, Solution of recurrence relation by the method of generating functions.

Books Recommended :

1. Johnsonbaugh: Discrete mathematics, Pearson Education
2. Kolman, Busby and Rose: Discrete mathematics, Pearson Education.
3. C.L. Liu: Elements of Discrete Mathematics, McGraw-Hilll Book Co
4. Babu Ram: Discrete Mathematics, Pearson's Publishers, 2009.

Descriptive Statistics

Code: MAT 219H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

Introduction of Statistics, Basic knowledge of various types of data, Collection, classification and tabulation of data. Presentation of data: histograms, frequency polygon, frequency curve and ogives. Stem- and- Leaf and Box plots.

Unit – II

Measures of Central Tendency and Location: Mean, median, mode, geometric mean, harmonic mean, partition values.
Measures of Dispersion: Absolute and relative measures of range, quartile deviation, mean deviation, standard deviation (σ), coefficient of variation.

Unit – III

Moments, Skewness and Kurtosis: Moments about mean and about any point and derivation of their relationships, effect of change of origin and scale on moments, Sheppard's correction for moments (without derivation), Charlier's checks, Concepts of Skewness and Kurtosis.

Unit – IV

Theory of Attributes: Symbolic notation, dichotomy of data, class frequencies, order of class frequencies, consistency of data, independence and association of attributes, Yule's coefficient of association and coefficient of colligation.
Correlation for Bivariate Data: Concept and types of correlation, Scatter diagram, Karl Pearson Coefficient (r) of correlation and rank correlation coefficient.

Books Suggested

1. A.M. Goon, M.K. Gupta, and B. Das Gupta: Fundamentals of Statistics, Vol-I.
2. S. Bernstein and R. Bernstein, Elements of Statistics, Schaum's outline series, McGraw-Hill.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.

Computer Fundamentals and MS-OFFICE

Code: MAT 221H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit -I

Fundamentals of Computer: Model of a digital computer, Functioning of a digital computer, Historical evolution of computers, classification of computers, Human being vs computer, Input / Output devices, Storage devices, Memory and mass storage devices, characteristics of memory systems, types of memory, RAM, ROM, concepts of Virtual and Cache memory, Types of software, Application and system software and its functions, time sharing, multiprocessing, Applications of Computer.

Unit -II

Introduction to Windows: Types of windows, windows as an operating system, windows explorer, using clipboard, using paintbrush, control panel, installing a printer.
MS Power Point: Introduction, Power point slide creation, Slide-show, Adding graphics, Formatting Customizing and Printing.

Unit -III

MS-Word: Introduction to MS-Word, Standard Toolbar, Word Wrap, Text formatting, Indents, Tabs, Formatting paragraphs, Applying Effects to text, Applying animation to text.

Unit -IV

MS Excel: Introduction to MS Excel, Working with Toolbars, Formatting, Formulas, Data management, Graphs and Charts, Macros and other additional functions.

Books Recommended:

1. Donald Sanders, Computers Today, McGraw-Hill Publishers.
2. Davis, Introduction to Computers, McGraw-Hill Publishers.
3. V. Rajaraman, Fundamental of Computers, Prentice-Hall India Ltd., New Delhi.

Practical/ Computational Work

Code: MAT 223H

(Based on papers MAT 219H and MAT 221H)

Max. Marks: 50

i) External Exam : 25 Marks

ii) Internal Exam : 25 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned units). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each unit.

Unit – I

Practicals based on Paper MAT 115.

Unit – II

Practicals based on Paper MAT 116.

English - I

Code: MAT 225H

Max. Marks : 60
Time : 3 Hours

Part –A Poetry

The following poems from The Chronicles of Time edited by Asha Kadyan (Oxford University Press)

a) "Let Me Not to the Marriage of True Minds" by William Shakespeare
b) "Death Be Not Proud" by John Donne
c) "On His Blindness" by John Donne
d) "Shadwell" by John Donne
e) "Know Then Thyself" by Alexander Pope
f) "The Little Black Boy" by William Blake
g) "Three Years She Grew in Sun and Shower" by William Wordsworth

Part – B Phonetics and Grammar

i) **Phonetics:** Introduction to the Sound System of English: Phonetics Symbols, Organs of Speech, Transcription of Words (Oxford Advance Learners' Disctionary by Hornby to be folowed).

ii) **Grammar:** Parts of Speech, Types of Sentences, Common Errors, Technical Writing (application writing, business letter).

Instructions for the paper-setter and the students

Q. No. 1 Explanation with reference to the context. The students will be required to attempt two passages out of the given four from the book of poems. 6x2=12

Q. No. 2 Two questions (with internal choice) will be asked based on theme, central idea, message and narrative technique of the poem 6x2=12

Q. No. 3 The question will be based on the Sound System of English language having internal choice 12

Q. No. 4 The question will be based on grammar. There will be internal choice with sixteen sentences out of twenty two to be attempted. 12

Q. No. 5 The question will be based on technical writing. There will be internal choice. 12

Suggested Reading:

High School Grammar by Wren and Martin.
Remedial English Grammar for Foreign Students by F.T. Wood.
Essentials of Communication by D.G. Saxena

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5- Years Integrated M.Sc. in Mathematics, Semester-II
(w.e.f. 2012-2013)

Paper No.	Paper title	Teaching Scheme			Examination Scheme			Duration of Exam.	Credit
		L	T	P	Internal Marks	External Marks	Total		
MAT 212H	Number Theory and Trigonometry	4	1	0	25	75	100	3 Hours	4
MAT 214H	Ordinary Differential Equations	4	1	0	25	75	100	3 Hours	4
MAT 216H	Vector Calculus	4	1	0	25	75	100	3 Hours	4
MAT 218H	Discrete Mathematics-II	4	1	0	25	75	100	3 Hours	4
MAT 220H	Regression Analysis and Probability	4	1	0	25	75	100	3 Hours	4
MAT 222H	Programming in Visual Basic	4	1	0	25	75	100	3 Hours	4
MAT 224H	Practical / Computational work based on Papers MAT220H and MAT222H	0	0	4	25	25	50	3 Hours	2
MAT 226H	English-II	3	0	0		60		3Hours	Qualifying
Total		27	6	4	175	475	650		26

Note:

1. Paper MAT 226H will be the qualifying paper and its marks will not be included in the total marks obtained by the student for the course.
2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Number Theory and Trigonometry

Code: MAT 212H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Divisibility, G.C.D.(greatest common divisors), L.C.M.(least common multiple)
Primes, well ordering property, Division algorithm, Fundamental Theorem of Arithemetic. Linear Congruences, Fermat's theorem. Wilson's theorem and its converse. Linear Diophanatine equations in two variables

Unit – II

Complete residue system and reduced residue system modulo m. Euler's ø function Euler's generalization of Fermat's theorem. Chinese Remainder Theorem. Quadratic residues. Legendre symbols. Lemma of Gauss; Gauss reciprocity law. Greatest integer function. The number of divisors and the sum of divisors of a natural number n (The functions d(n) and $\sigma(n)$). Mobius function and Mobius inversion formula.

Unit - III

De Moivre's Theorem and its Applications. Expansion of trigonometrical functions. Direct circular and hyperbolic functions and their properties.

Unit – IV

Inverse circular and hyperbolic functions and their properties. Logarithm of a complex quantity. Gregory's series. Summation of Trigonometry series.

Books Recommended :

1. S.L. Loney, Plane Trigonometry Part – II, Macmillan and Company, London.
2. Ivan Ninen and H.S. Zuckerman, An Introduction to the Theory of Numbers.
3. Joseph A. Gallen: Contemporary Abstract Algebra (4^{th} edition), Narosa Publication House New Delhi.

Ordinary Differential Equations

Code: MAT 214H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Geometrical meaning of a differential equation. Exact differential equations, integrating factors. First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form. Singular solutions.

Unit – II

Orthogonal trajectories: in Cartesian coordinates and polar coordinates. Self orthogonal family of curves.. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous form.

Unit – III

Linear differential equations of second order: Reduction to normal form. Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations. Reduction of order of a differential equation. Method of variations of parameters. Method of undetermined coefficients.

Unit – IV

Ordinary simultaneous differential equations. Solution of simultaneous differential equations. Simultaneous equation of the form $dx/P = dy/Q = dz/R$. Total differential equations. Condition for $Pdx + Qdy + Rdz = 0$ to be exact. General method of solving $Pdx + Qdy + Rdz = 0$ by taking one variable constant. Method of auxiliary equations.

Books Recommended :

1. E.A. Codington, Introduction to Differential Equations.
2. S.L.Ross, Differential Equations, John Wiley & Sons
3. B.Rai & D.P. Chaudhary, Ordinary Differential Equations, Narosa Publishing House Pvt. Ltd.
4. Spiegal, Differential Equations, Schaum Outline Series.

Vector Calculus

Code: MAT 216H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Scalar and vector product of three vectors, product of four vectors. Reciprocal vectors. Vector differentiation. Scalar Valued point functions, vector valued point functions, derivative along a curve, directional derivatives

Unit – II

Gradient of a scalar point function, geometrical interpretation of grad Φ , characteristics of gradient as a point function. Divergence and curl of vector point function, characteristics of Div $\vec{f}$ and Curl $\vec{f}$ as point function, geometrical interpretation of Div and Curl. Gradient, divergence and curl of sums and product and their related vector identities. Laplacian operator.

Unit – III

Orthogonal curvilinear coordinates Conditions for orthogonality fundamental triad of mutually orthogonal unit vectors. Gradient, Divergence, Curl and Laplacian operators in terms of orthogonal curvilinear coordinates, Cylindrical co-ordinates and Spherical co-ordinates.

Unit – IV

Vector integration; Line integral, Surface integral, Volume integral.
Theorems of Gauss, Green & Stokes and problems based on these theorms.

Books Recommended:

1. Murrary R. Spiegal, Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York.
2. Murrary R. Spiegal, Vector Analysis, Schaum Publisghing Company, New York.
3. Shanti Narayan, A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Discrete Mathematics-II

Code: MAT 218H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit -I

Lattices and their properties, lattice as algebraic system, Bounded, Complement and distributive lattices.

Unit -II

Boolean algebra, definition and examples, properties, duality, distributive and complemented Calculus. Design and implementation of digital networks, switching circuits, simplification of Boolean expression using Algebraic methods and Karnaugh map.

Unit -III

Graphs: Definition, Types of graphs, paths and circuits, Koingsberg seven brige problem, Eulerian and Hamiltonion paths and circuits. Seven bridges problem, shortest path traveling salesman problems. Planar graph and Euler's formula. Non-planarity of K_5 and $K_{3,3.}$ Matrix of a graph.

Unit -IV

Directed Graphs, Trees, Isomorphism of Trees, Representation of Algebraic Expressions by Binary Trees, Spanning Tree of a Graph, Shortest Path Problem, Minimal spanning Trees: Prim's and Kruskal's Algorithms. Shortest Route Problems: Dijkastra's Algorithm. Cut Sets, Tree Searching.

Books Recommended:

1. Johnsonbaugh: Discrete mathematics, Pearson Education.
2. Kolman, Busby and Rose: Discrete mathematics, Pearson Education.
3. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hilll Book Co.
4. Babu Ram, Discrete Mathematics, Pearson Publications, 2009.

Regression Analysis and Probability

Code: MAT 220H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit -I

Linear Regression: Concept of regression, principle of least squares and fitting of straight line, derivation of two lines of regression, properties of regression coefficients, standard error of estimate obtained from regression line, correlation coefficient between observed and estimated values. Angle between two lines of regression. Difference between correlation and regression.

Curvilinear Regression: Fitting of second degree parabola, power curve of the type $Y=ax^b$, exponential curves of the types $Y=ab^x$ and $Y=ae^{bx}$.

Unit –II

Concepts in Probability: Random experiment, trial, sample point, sample space, operation of events, exhaustive, equally likely and independent events, Definition of probability—classical, relative frequency, statistical and axiomatic approach, Addition and multiplication laws of probability, Boole's inequality.

Unit -III

Bayes' theorem and its applications.

Random Variable and Probability Functions: Definition and properties of random variables, discrete and continuous random variable, probability mass and density functions, distribution function.

Unit –IV

Concepts of bivariate random variable: joint, marginal and conditional distributions.

Mathematical Expectation: Definition and Properties: moments, measures of dispersion, skewness and kurtosis.

Books Suggested:

1. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
2. Baisnab and M. Jas, Element of Probability and statistics, Tata McGraw Hill.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
4 P.L.Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.

Programming in Visual Basic
Code: MAT 222H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each section will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit -I

Visual Basic: Introduction, Analyzing, Controls and Properties, Coding, Control structures: Decision & Loops, Control Array, Arrays

Unit -II

Text Boxes, Command Buttons, Additional Controls – List Box, Option Buttons, Frames, Check Boxes, Scroll Bars, Timer Control,

Unit -III

Menus: Menu Editor, Menu controls, Dialog Boxes, Procedures and Functions, Using Debugging Windows, Database Programming.

Unit -IV

Crystal Reports, Simple Active X controls. Library Functions: String, Numeric, Time-related & Misc. Functions

Books Recommended

1. Reselman & Other, Using Visual Basic 6, Prentice Hall of India.
2. Donald & Oancea, Visual Basic 6 from Scratch, Prentice- Hall of India.
3. Noel Jerke, Visual Basic 6, Tata Mc-Graw Hill
4. Days Maver, Teach Yourself More VB in 21 days, Techmedia.

Practical/ Computational Work

Code: MAT 224H

(Based on papers MAT220H and MAT222H)

Max. Marks : 50

i) External Exam : 25 Marks

ii) Internal Exam : 25 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned units). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each unit.

Unit – I

Practicals based on Paper MAT 220H.

Unit – II

Practicals based on Paper MAT 222H

English - II

Code: MAT 226H

Max. Marks : 60
Time : 3 Hours

Part –A Short Stories

The following Stories from **The Pointed Vision: An Anthology of Short Stories** by Usha Bande and Krishan Gopal (Oxford University Press, New Delhi)

1. 'The Bet' by Anton Chekhov
2. 'Gift of the Magi' by O Henry
3. 'The Postmaster' by Rabindranath Tagore
4. 'Three Questions' by Arthur Conan Doyle.
5. 'Under the Banyan Tree' by R.K. Narayan.

Part – B (i) Grammar and Writing Skills

a) Synonyms and Antonyms
b) Prefix-Suffix
c) Homophones and Homonyms
d) One word substitution

(ii) a) Developing writing skills through theme based paragraphs
b) Technical writing: E-mail writing, Reporting, Resume writing, Re-viewing T.V. Programmes

Instructions for the paper-setter and the students

Q. No. 1 Explanation with reference to the context. The students will be required to attempt two passages (with internal choice) from the book of Stories. 6x2=12
Q. No. 2 Two essay type questions (with internal choice) will be asked from the book of stories. 6x2=12
Q. No. 3 This question will be based on grammar. Students will be required to attempt sixteen sentences out of the given twenty four. 12
Q. No. 4&5 Question No. 4 & 5 will be based on writing skills and technical writing. 24

Suggested Reading:

High School Grammar by Wren and Martin.
Remedial English Grammar for Foreign Students by F.T. Wood.
Essentials of Communication by D.G. Saxena

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5-Years Integrated M.Sc. in Mathematics, Semester-III
(w.e.f. 2013-2014)

Paper No.	Paper title	Teaching Scheme			Examination Scheme			Duration of Exam.	Credit
		L	T	P	Internal Marks	External Marks	Total		
MAT 311H	Advanced Calculus	4	1	0	25	75	100	3 Hours	4
MAT 313H	Partial Differential Equations	4	1	0	25	75	100	3 Hours	4
MAT 315H	Statics	4	1	0	25	75	100	3 Hours	4
MAT 317H	Differential Geometry	4	1	0	25	75	100	3 Hours	4
MAT 319H	Programming in C	4	1	0	25	75	100	3 Hours	4
MAT 321H	Database Management and Oracle	4	1	0	25	75	100	3 Hours	4
MAT 323H	Practical/ Computational work (based on Papers MAT 319H and MAT 321H)	0	0	4	25	25	50	3 Hours	2
	Environmental Science	Qualifying							
Total		24	6	4	175	475	650		26

Note:

1. The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.
2. The syllabus of environment science will be same as in B. Tech. classes.

Advanced Calculus

Code: MAT 311H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Section – I

Continuity, Sequential Continuity, properties of continuous functions, Uniform continuity. Mean value theorems; Rolle's Theorem and Lagrange's mean value theorem and their geometrical interpretations. Taylor's Theorem with various forms of remainders, Darboux intermediate value theorem for derivatives.

Section – II

Limit and continuity of real valued functions of two variables. Partial differentiation. Total Differentials; Composite functions & implicit functions. Change of variables. Jacobians and its properties, Homogenous functions & Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables.

Section – III

Differentiability of real valued functions of two variables. Schwarz and Young's theorem. Implicit function theorem. Maxima and Minima functions of two variables. Lagrange's method of undetermined multipliers.

Section – IV

Curves: Tangents, Principal normals, Binormals, Serret-Frenet formulae. Locus of the centre of curvature, Spherical curvature, Locus of centre of Spherical curvature, Involutes, evolutes, Bertrand Curves. Surfaces: Tangent planes, one parameter family of surfaces, Envelopes.

Books Recommended:

1. C.E. Weatherburn , Differential Geometry of three dimensions, Radhe Publishing House, Calcutta
2. S.C. Malik , Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
3. Shanti Narayan, A Course in Mathemtical Analysis, S.Chand and company, New Delhi.
4. Murray, R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing co., New York.

Partial Differential Equations

Code: MAT 313H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Partial differential equations: Formation, Linear and Non-Linear Partial differential equations of the first order: Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Compatible systems of first order equations, Charpit's general method of solution. Jacobi's method.

Unit – II

Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Unit – III

Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method for partial differential equations of second order.

Unit – IV

Cauchy's problem for second order partial differential equations, Characteristic equations and characteristic curves of second order partial differential equation, Method of separation of variables: Solution of Laplace's equation, Wave equation (one and two dimensions), Diffusion (Heat) equation (one and two dimension) in Cartesian Co-ordinate system.

Books Recommended:

1. Erwin Kreyszing, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999
2. Ian N.Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, 1988
3. J.N. Sharma and Kehar Singh, Partial Differential Equations

Statics

Code: MAT 315H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Composition and resolution of forces. Parallel forces. Moments and Couples.

Unit – II

Analytical conditions of equilibrium of coplanar forces. Friction. Centre of Gravity.

Unit – III

Virtual work. Forces in three dimensions. Poinsots central axis.

Unit – IV

Wrenches. Null lines and planes. Stable and unstable equilibrium.

Books Recommended:

1. S.L. Loney, Statics, Macmillan Company, London
2. R.S. Verma, A Text Book on Statics, Pothishala Pvt. Ltd., Allahabad

Differential Geometry

Code: MAT 317H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

One Parameter family of Surfaces: Envelope, Characteristics, edge of regression, Developable surfaces.

Developables Associated with a Curve: Osculating developable, Polar developable, Rectifying developable.

Unit – II

Two- parameter Family of Surfaces: Envelope, Characteristics points,

Curvilinear coordinates, First order magnitudes, Directions on a surface, The normal, Second order magnitudes, Derivatives of **n**.

Unit- III

Curves on a Surface: Principal directions and curvatures, First and second curvatures, Euler's theorems, Dupin's indicatrix, The surfaces z = f(x,y), Surface of revolution. Conjugate directions, Conjugate systems. Asymptotic lines, Curvature and torsion, Isometric parameters, Null lines, or minimal curves.

Unit- IV

Geodesics and Geodesic Parallels: Geodesics: Geodesic property, Equation of Geodesics, Surface of revolution, Torsion of Geodesic.

Curves in Relation to Geodesics: Bonnet's theorem, Joachimsthal's theorems, Vector curvature, Geodesic curvature κ_g, Other formulae for κ_g, Bonnet's formula.

Books Recommended:.

1. C.E. Weatherburn, Differential Geometry of Three Dimensions, Radhe Publishing House.
2. Erwin Kreyszig, Differential Geometry.
3. A.K. Singh and P.K. Mittal , A Textbook of Differential Geometry, Har-Anand Publications

Programming in C
Code: MAT 319H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Programmer's model of a computer, Algorithms, Flow charts, Data types, Operators and expressions, Input / Output functions.

Unit – II

Decisions control structure: Decision statements, Logical and conditional statements, Implementation of Loops, Switch Statement & Case control structures.

Unit – III

Functions, Preprocessors and Arrays. Strings: Character Data Type, Standard String handling Functions, Arithmetic Operations on Characters.

Unit - IV

Structures: Definition, use of Structures in Arrays and Arrays in Structures. Pointers: Pointers Data type, Pointers and Arrays, Pointers and Functions.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie, The C Programming Language, 2nd Edition
2. V. Rajaraman, Programming in C, Prentice Hall of India, 1994
3. Byron S. Gottfried, Theory and Problems of Programming with C, Tata McGraw-Hill Publishing Co. Ltd., 1998
4. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill Publishing Co. Ltd.

Database Management System and Oracle

Code: MAT 321H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Basic Concepts: File systems versus DBMS, advantages and disadvantages of DBMS, objectives of a database. Database systems concepts and architecture.
Data Modeling for a database: records and files, abstraction and data integration.
Database Management System: Relational, Network, and Hierarchical.
Relational Data Manipulations: Relational Algebra, Relational Calculus, SQL.

Unit – II

Relational Database Design: Functional dependencies, Finding keys; 1^{st} to 3^{rd} NFs, CNF, Lossess Join and Dependency preserving decomposition.
Query Processing: General strategies for query processing, query optimization, query processor.
Database security issues and recovery techniques.

Unit – III

Introduction to Oracle: Modules of Oracle, Invoking SQLPLUS, Data types, Data Constraints, Operators, Data manipulation: Create, Modify, Insert, Delete and Update; Searching, Matching and Oracle Functions.
SQL*Forms: Form Construction, user-defined form, multiple-record form, Master-detail form. PL/SQL Blocks in SQL*Forms, PL/SQL syntax, Data types, PL/SQL functions, Error handling in PL/SQL, package functions, package procedures, Oracle transactions.

Unit – IV

SQL*ReportWriter: Selective dump report, Master-detail Report, Control-break Report, Test report.
Database Triggers: Use & type of database Triggers, Database Triggers Vs SQL*Forms, Database Triggers Vs. Declarative Integrity Constraints, BEFORE vs AFTER Trigger Combinations, Creating a Trigger, Dropping a Trigger.

Books Suggested:

1. Austin, Using Oracle-8, Prentice-Hall of India
2. Ivan Bayross, Oracle 8, BPB Publication
3. Jr. Page, Special Edition Using Oracle 8/8i, Prentice-Hall of India
4. Days Maver, Teach Yourself More VB in 21 days, Techmedia

Practical/ Computational Work

Code: MAT 323H

(Based on papers MAT 319H and MAT 321H)

Max. Marks : 50

i) External Exam : 25 Marks

ii)Internal Exam : 25 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned units). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each unit.

Unit – I

Practicals based on Paper MAT 319H.

Unit – II

Practicals based on Paper MAT 321H.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5-Years Integrated M.Sc. in Mathematics Semester-IV
(w.e.f. 2013-2014)

Paper No.	Paper title	Teaching Scheme			Examination Scheme			Duration of Exam.	Credit
		L	T	P	Internal Marks	External Marks	Total		
MAT 312H	Sequences and Series	4	1	0	25	75	100	3 Hours	4
MAT 314H	Special Functions and Integral transforms	4	1	0	25	75	100	3 Hours	4
MAT 316H	Probability Distributions and Numerical Methods	4	1	0	25	75	100	3 Hours	4
MAT 318H	Hydrostatics	4	1	0	25	75	100	3 Hours	4
MAT 320H	Elementary Inference	4	1	0	25	75	100	3 Hours	4
MAT 322H	Data Structures using C	4	1	0	25	75	100	3 Hours	4
MAT 324H	Practical/ Computational Work (Based on papers MAT 320H and MAT 322H)	0	0	4	25	25	50	3 Hours	2
Total		24	6	4	175	475	650		26

Note: The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Sequences and Series

Code: MAT 312H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Boundedness of the set of real numbers: least upper bound, greatest lower bound of a set, neighborhoods, interior points, isolated points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weiestrass theorem, Open covers, Compact sets and Heine-Borel Theorem.

Unit – II

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence, Cauchy general principle of convergence, Subsequences, Subsequential limits.

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, Cauchy's general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or p-series.

Unit – III

Infinite series: D-Alembert's ratio test, Raabe's test, Logarithmic test, de Morgan and Bertrand's test, Cauchy's nth root test, Gauss Test, Cauchy's integral test, Cauchy's condensation test.

Unit – IV

Alternating series, Leibnitz's test, absolute and conditional convergence, Arbitrary series: abel's lemma, Abel's test, Dirichlet's test, Insertion and removal of parenthesis, re-arrangement of terms in a series, Dirichlet's theorem, Riemann's Re-arrangement theorem, Pringsheim's theorem (statement only), Multiplication of series, Cauchy product of series, (definitions and examples only) Convergence and absolute convergence of infinite products.

Books Recommended:

1. S.C. Malik, Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
2. Shanti Narayan, A Course in Mathematical Analysis, S.Chand and Company, New Delhi
3. Murray, R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing Co., New York
4. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
5. Earl D. Rainville, Infinite Series, The Macmillan Co., New York

Special Functions and Integral Transforms

Code: MAT 314H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Series solution of differential equations – Power series method, Definitions of Beta and Gamma functions. Bessel equation and its solution: Bessel functions and their properties-Convergence, recurrence, Relations and generating functions, Orthogonality of Bessel functions.

Unit – II

Legendre and Hermite differentials equations and their solutions: Legendre and Hermite functions and their properties-Recurrence Relations and generating functions. Orhogonality of Legendre and Hermite polynomials. Rodrigues' Formula for Legendre & Hermite Polynomials, Laplace Integral Representation of Legendre polynomial.

Unit – III

Laplace Transforms – Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Convolution theorem, Inverse Laplace transforms, convolution theorem, Inverse Laplace transforms of derivatives and integrals, solution of ordinary differential equations using Laplace transform.

Unit – IV

Fourier transforms: Linearity property, Shifting, Modulation, Convolution Theorem, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms, solution of differential Equations using Fourier Transforms.

Books Recommended:

1. Erwin Kreyszing, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999
2. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd.
3. I.N. Sneddon, Special Functions on mathematics, Physics & Chemistry.
4. W.W. Bell, Special Functions for Scientists and Engineers.
5. I.N. Sneddon, The use of integral transform, McGraw Hill, 1972

Probability Distributions and Numerical Methods

Code: MAT 316H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

Generating Functions: Moment generating function, Cumulants and cumulant generating function along with their properties and uses. Bernoulli and Binomial distributions with their properties.

Unit – II

Poisson and Normal distributions with its properties. Central Limit Theorem (Statement only) and its applications.

Unit – III

Solution of Algebraic and Transcendental equations: Bisection method, Regula-Falsi method, Secant method, Newton-Raphson's method. Newton's iterative method for finding pth root of a number, Order of convergence of above methods.

Unit – IV

Simultaneous linear algebraic equations: Gauss-elimination method, Gauss-Jordan method, Triangularization method (LU decomposition method). Crout's method, Cholesky Decomposition method. Iterative method, Jacobi's method, Gauss-Seidal's method, Relaxation method.

Uniform, gamma, beta (first and second kinds) and exponential distributions with their properties.

Books Suggested:

1. Baisnab and M. Jas, Element of Probability and Statistics, Tata McGraw Hill.
2. P.L.Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
4. M.K. Jain, S.R.K. lyengar, R.K. Jain, Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
5. M.K. Jain, S.R.K. lyengar, R.K. Jain, Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999

Hydrostatics

Code: MAT 318H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

Pressure equation. Condition of equilibrium. Lines of force. Homogeneous and heterogeneous fluids. Elastic fluids. Surface of equal pressure. Fluid at rest under action of gravity. Rotating fluids.

Unit – II

Fluid pressure on plane surfaces. Centre of pressure. Resultant pressure on curved surfaces. Equilibrium of floating bodies. Curves of buoyancy. Surface of buoyancy.

Unit – III

Stability of equilibrium of floating bodies. Metacentre. Work done in producing a displacement. Vessels containing liquid.

Unit – IV

Gas laws. Mixture of gases. Internal energy. Adiabatic expansion. Work done in compressing a gas. Isothermal atmosphere. Connective equilibrium.

Books Recommended

1. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Cambridge University Press, 1956.
2. A.S. Ramsey, Dynamics, Part I, Cambridge University Press, 1973.
3. W.H. Basant and A.S. Ramsey, A Treatise on Hydromechanics, Part I Hydrostatics, ELBS and G. Bell and Sons Ltd., London.

Elementary Inference

Code: MAT 320H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

Parameter and statistic, sampling distribution and standard error of estimate. Point and interval estimation, Unbiasedness, Efficiency, Consistency and Sufficiency.

Unit – II

Method of maximum likelihood estimation.
Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Types of errors, Neyman- Pearson Lemma.

Unit – III

Testing and interval estimation of a single mean, single proportion, difference between two means and two proportions. Fisher's Z transformation.

Unit – IV

Definition of Chi-square statistic, Chi-square tests for goodness of fit and independence of attributes.
Definition of Student's 't' and Snedcor's F-statistics. Testing for the mean and variance of univariate normal distributions, Testing of equality of two means and two variances of two univariate normal distributions. Related confidence intervals. Analysis of variance(ANOVA) for one-way and two-way classified data.

Books Suggested:

1. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
2. A.M. Goon, M.K. Gupta, and B. Das Gupta, Fundamentals of Statistics, Vol-II.
3. R.V. Hogg and A.T. Craig, Introduction to Mathematical Statistics.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.

Data Structures Using C
Code: MAT 322H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit – I

Data structure and its essence, Data structure types.
Linear and list structures: Arrays, stacks, queues and lists; Sequential and linked structures; Simple lists, circular lists, doubly linked lists.
Inverted lists, threaded lists, Operations on all these structures and applications.

Unit – II

Arrays, Multidimensional arrays, sequential allocation, address calculations, sparse arrays. Tree structures: Trees, binary trees and binary search trees. Implementing binary trees, Tree traversal algorithms, threaded trees, trees in search algorithms, AVL Trees.

Unit – III

Graph data structure and their applications. Graph traversals, shortest paths, spanning trees and related algorithms.
Family of B-Trees: B-tree, B*-Trees, B+ Trees.

Unit – IV

Sorting: Internal and External sorting. Various sorting algorithms, Time and Space complexity of algorithms.
Searching techniques and Merging algorithms. Applications of sorting and searching in computer science.

Suggested Readings:

1. Lipschutz, Data Structures (Schaum's Outline Series), Tata McGraw-Hill.
2.Adam Drozdek, Data Structures and Algorithms in C++, Vikas Pub. House (Thompson), New Delhi.
3. 4. S. Sofat, Data Structures With C and C++, Khanna Book Pub. Co.(P) Ltd, N. Delhi.
5. R.G Dromey, How to Solve it by Computer ?, Prentice Hall India.
6. Loomis, Data Structure and File Management, Prentice-Hall India Ltd.
7. Tannenbaum, Data Structure Using C, Tata McGraw-Hill.

Practical/ Computational Work

Code: MAT 324H

(Based on papers MAT 320H and MAT 322H)

Max. Marks : 50

i)External Exam : 25 Marks

ii)Internal Exam : 25 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned units). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each unit.

Unit – I

Practicals based ***Unit*** on Paper MAT 320H.

Unit – II

Practicals based on Paper MAT 322H.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5-Years Integrated M.Sc. in Mathematics Semester-V
(w.e.f. 2014-2015)

Paper No.	Paper title	Teaching Scheme			Examination Scheme			Duration of Exam.	Credit
		L	T	P	Internal Marks	External Marks	Total		
MAT 411H	Real Analysis	4	1	0	25	75	100	3 Hours	4
MAT 413H	Groups and Rings	4	1	0	25	75	100	3 Hours	4
MAT 415H	Numerical Analysis	4	1	0	25	75	100	3 Hours	4
MAT 417H	Integral Equations	4	1	0	25	75	100	3 Hours	4
MAT 419H	Methods of Applied Mathematics	4	1	0	25	75	100	3 Hours	4
MAT 421H	Operations Research-I	4	1	0	25	75	100	3 Hours	4
MAT 423H	Practical/ Computational work to be performed on computers using EXCEL/SPSS)	0	0	4	25	25	50	3 Hours	2
Total		24	6	4	175	475	650		26

Note : The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Real Analysis

Code: MAT 411H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Riemann integral, Integrabililty of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

Unit – II

Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter. Continuity, Differentiability and integrability of an integral of a function of a parameter.

Unit – III

Definition and examples of metric spaces, neighborhoods, limit points, interior points, open and closed sets, closure and interior, boundary points, subspace of a metric space, equivalent metrics, Cauchy sequences, completeness, Cantor sets,Cantor's intersection theorem, Baire's category theorem, contraction Principle

Unit – IV

Continuous functions, uniform continuity, compactness for metric spaces, sequential compactness, Bolzano-Weierstrass property, total boundedness, finite intersection property, continuity in relation with compactness, connectedness , components, continuity in relation with connectedness.

Book s Recommended:

1. P.K. Jain and Khalil Ahmad, Metric Spaces, 2nd Ed., Narosa, 2004
2. R.R. Goldberg, Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
4. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. E.T. Copson, Metric Spaces, Cambridge University Press, 1968.

Groups and Rings

Code: MAT 413H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, cyclic groups, Cosets, Left and right cosets, Index of a sub-group Coset decomposition, Largrage's theorem and its consequences, Normal subgroups, Quotient groups, Dihedral groups.

Unit – II

Homoomorphisms, isomophisms, automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group.

Unit – III

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphisms, ideals (principle, prime and Maximal) and Quotient rings,Imbending of Rings and Field. Field of quotients of an integral domain.

Unit – IV

Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain, $R[X_1, X_2, \ldots X_n]$

Books Recommended:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 19150
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2^{nd} edition).
3. I.S. Luther and I.B.S. Passi, Algebra, Vol.-II, Narosa Publishing House.
4. Joseph A. Gallian: Contemporary Abstract Algebra(4^{th} edition). Narosha Publishing house, New Delhi,1999.

Numerical Analysis
Code: MAT 415H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Finite Differences operators and their relations. Finding the missing terms and effect of error in a difference tabular values, Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Interpolation with unequal intervals: Newton's divided difference, Lagrange's Interpolation formulae, Hermite Formula.

Unit – II

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula.

Probability distribution of random variables, Binomial distribution, Poisson's distribution, Normal distribution: Mean, Variance and Fitting.

Unit – III

Numerical Differentiation: Derivative of a function using interpolation formulae as studied in Sections –I & II.

Eigen Value Problems: Power method, Jacobi's method, Given's method, House-Holder's method, QR method, Lanczos method.

Unit – IV

Numerical Integration: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one- third and three-eighth rule, Chebychev formula, Gauss Quadrature formula.

Numerical solution of ordinary differential equations: Single step methods-Picard's method. Taylor's series method, Euler's method, Runge-Kutta Methods. Multiple step methods; Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.

Books Recommended:

1. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999
4. C. E. Froberg, Introduction to Numerical Analysis (2nd Edition).

Integral Equations

Code: MAT 417H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

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Unit- I

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

Unit -II

Boundary value problems reduced to Fredholm integral equations, method of successive approximations to solve Fredholm equation of second kind, Iterated kernels and Neumann series for Fredholm equations, Resolvent kernel as a sum of series, Fredholm resolvent kernel as a ratio of two series. Fredholm equations with degenerate kernel, approximation of a kernel by a degenerate kernel, Fredholm Alternative.

Unit- III

Green's function. Use of method of variation of parameters to construction the Green's function for a nonhomogeneous linear second degree BVP, Basic four properties of the Green's function, Alternate procedure for construction of the Green's function by using its basic four properties. Method of series representation of the Green's function in terms of the solutions of the associated homogeneous BVP. Reduction of a BVP to a Fredholm integral equation with kernel as Green's function.

Unit- IV

Homogeneous Fredholm equations with symmetric kernels, Solution of Fredholm equations of the second kind with symmetric kernel, Method of Fredholm Resolvent Kernel, Method of Iterated Kernels, Fredholm Equations of the First Kind with Symmetric Kernels.

Books Recommended:

1. A.J. Jerri, Introduction to Integral Equations with Applications.
2. A.D. Polyanin and A.V. Manzhirov, Handbook of Integral Equations, CRC Press.
3. J. Kondo, Integral Equations, Oxford Applied mathematics and Computing Science Series.

Methods of Applied Mathematics

Code: MAT 419H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit - I

Solution of 3D Laplace, wave and heat equations in spherical polar co-ordinates and cylindrical polar co-ordinates by the method of separation of variables. Fourier series solution of the wave equation, transformation of boundary value problems.

Unit - II

Fourier series solution of the heat equation, steady-state temperature in plates, The heat and wave equations in unbounded domains, Fourier transform solution of boundary value problems. The heat equation in an infinite cylinder and in a solid sphere.

Unit - III

Hankel transform of elementary functions. Operational properties of the Hankel transform. Applications of Hankel transforms to PDE.
Definition and basic properties of finite Fourier sine and cosine transforms, its applications to the solutions of BVP's and IVP's.

Unit - IV

Moments and products of inertia, Angular momentum of a rigid body, principal axes and principal moment of inertia of a rigid body, kinetic energy of a rigid body rotating about a fixed point, Momental ellipsoid and equimomental systems, coplanar mass distributions, general motion of a rigid body.

Books Recommended :

1. Lokenath Debnath, Integral Transforms and their Applications, CRC Press, Inc., 1995.
2. Peter V. O'Neil, Advanced Engineering Mathematics, 4th Edition, An International Thomson Publishing Company.
3. I.N. Sneddon, Elements of Partial Differential Equations, Prentice Hall, McGraw Hill.
5. I.N. Sneddon, Special Functions of Mathematical Physics and Chemistry.
6. F. Chorlton, Dynamics, CBS publishers and Distributors.

Operations Research-I

Code: MAT 421H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit - I

Definition, scope, methodology and applications of OR. Types of OR models.
Concept of optimization, Linear Programming: Introduction, Formulation of a Linear Programming Problem (LPP), Requirements for an LPP, Advantages and limitations of LP. Graphical solution: Multiple, unbounded and infeasible solutions.

Unit -II

Principle of simplex method: standard form, basic solution, basic feasible solution.
Computational Aspect of Simplex Method: Cases of unique feasible solution, no feasible solution, multiple solution and unbounded solution and degeneracy. Two Phase and Big-M methods.

Unit -III

Duality in LPP, primal-dual relationship. Dual Simplex Method.
Transportation Problem: Methods for finding basic feasible solution of a transportation problem, Modified distribution method for finding the optimum solution, Unbalanced and degenerate transportation problems, transshipment problem, maximization in a transportation problem.

Unit -IV

Assignment Problem: Solution by Hungarian method, Unbalanced assignment problem, maximization in an assignment problem, Crew assignment and Travelling salesman problem.
Game Theory: Two person zero sum game, Game with saddle points, the rule of dominance; Algebraic, graphical and linear programming methods for solving mixed strategy games.

Books Recommended

1. J.K. Sharma, Mathematical Model in Operations Research, Tata McGraw Hill.
2. H.A. Taha, Operations Research – An Introduction.
3. Kanti Swarup, P.K. Gupta, and Manmohan, Operations Research, S.Chand Publishers.
4. P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.

Practical/ Computational Work
Code: MAT 423H

Max. Marks : 50
i)External Exam : 25 Marks
ii)Internal Exam : 25 Marks
Time:3 Hours

Note: The examiner is requested to set **4** experiments. The candidate is required to attempt **2** of the allotted experiments.

This paper covers the practical/computational work to be performed on computer using EXCEL/SPSS.

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
DEPARTMENT OF MATHEMATICS
Scheme of Study and Examination of
5-Years Integrated M.Sc. in Mathematics Semester-VI
(w.e.f. 2014-2015)

Paper No.	Paper title	Teaching Scheme			Examination Scheme			Duration of Exam.	Credit
		L	T	P	Internal Marks	External Marks	Total		
MAT 412H	Real and Complex Analysis	4	1	0	25	75	100	3 Hours	4
MAT 414H	Linear Algebra	4	1	0	25	75	100	3 Hours	4
MAT 416H	Dynamics	4	1	0		75	100	3 Hours	4
MAT 418H	Elementary Topology	4	1	0	25	75	100	3 Hours	4
MAT 420H	Fluid Dynamics	4	1	0	25	75	100	3 Hours	4
MAT 422H	Operations Research-II	4	1	0	25	75	100	3 Hours	4
MAT 424H	Practical/ Computational work to be performed on computers using MATLAB/TORA)	0	0	4	25	25	50	3 Hours	2
Total		24	6	4	175	475	650		26

Note : The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Real and Complex Analysis

Code: MAT 412H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Functions of complex variables: Trigonometric functions, Periodicity

Unit – II

Fourier's series: Fourier expansion of piecewise monotonic functions, Properties of Fourier Co-efficients, Dirichlet's conditions, Parseval's identity for Fourier series, Fourier series for even and odd functions, Half range series, Change of Intervals.

Unit – III

Extended Complex Plane, Stereographic projection of complex numbers, continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations. Harmonic functions.

Unit – IV

Mappings by elementary functions: Translation, rotation, Magnification and Inversion. Conformal Mappings, Mobius transformations. Fixed pints, Cross ratio, Inverse Points and critical mappings.

Books Recommended:

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
2. R.R. Goldberg, Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary, A First Course in Mathematical, Analysis, Narosa Publishing House, New Delhi, 1997
4. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. R.V. Churchill and J.W. Brown, Complex Variables and Applications, 5th Edition, McGraw-Hill, New York, 1990
6. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.

Linear Algebra

Code: MAT 414H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vector space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension.

Unit – II

Homomorphism and isomorphism of vector spaces, Linear transformations and linear forms on vector spaces, Vector space of all the linear transformations Dual Spaces, Bidual spaces, annihilator of subspaces of finite dimentional vector spaces, Null Space, Range space of a linear transformation, Rank and Nullity Theorem,

Unit – III

Algebra of Linear Transformation, Minimal Polynomial of a linear transformation, Singular and non-singular linear transformations, Matrix of a linear Transformation, Change of basis, Eigen values and Eigen vectors of linear transformations.

Unit – IV

Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthogonal complements, Orthogonal sets and Basis, Bessel's inequality for finite dimensional vector spaces, Gram-Schmidt, Orthogonalization process, Adjoint of a linear transformation and its properties, Unitary linear transformations.

Books Recommended:

1. I.N. Herstein,: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 19150
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2^{nd} edition).
3. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House.
4. I.S. Luther and I.B.S. Passi, Algebra, Vol.-II, Narosa Publishing House.

Dynamics

Code: MAT 416H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit – I

Velocity and acceleration along radial, transverse, tangential and normal directions. Relative velocity and acceleration. Simple harmonic motion. Elastic strings.

Unit – II

Mass, Momentum and Force. Newton's laws of motion. Work, Power and Energy. Definitions of Conservative forces and Impulsive forces.

Unit – III

Motion on smooth and rough plane curves. Projectile motion of a particle in a plane. Vector angular velocity.

Unit – IV

General motion of a rigid body. Central Orbits, Kepler laws of motion. Motion of a particle in three dimensions. Acceleration in terms of different co-ordinate systems.

Books Recommended:

1. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press, 1956
2. F. Chorlton, Dynamics, CBS Publishers, New Delhi
3. A.S. Ramsey, Dynamics Part-1&2, CBS Publisher & Distributors.

Elementary Topology

Code: MAT 418H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit - I

Statements only of (Axiom of choice, Zorn's lemma, Well ordering theorem and Continnum hypothesis).

Definition and examples of topological spaces, Neighborhoods, Interior point and interior of a set , Closed set as a complement of an open set , Adherent point and limit point of a set, Closure of a set, Derived set, Properties of Closure operator, Boundary of a set , Dense subsets, Interior, Exterior and boundary operators.

Base and sub base for a topology, Neighborhood system of a point and its properties, Base for Neighborhood system.

Relative(Induced) topology, Alternative methods of defining a topology in terms of neighborhood system and Kuratowski closure operator.

Comparison of topologies on a set, Intersection and union of topologies on a set.

Unit - II

Continuous functions, Open and closed functions , Homeomorphism.

Connectedness and its characterization, Connected subsets and their properties, Continuity and connectedness, Components, Locally connected spaces,

Unit - III

Compact spaces and subsets, Compactness in terms of finite intersection property,Continuity and compact sets, Basic properties of compactness, Closedness of compactsubset and a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and countably compact sets, Local compactness and one point compatification.

Unit - IV

First countable, second countable and separable spaces, hereditary and topological property, Countability of a collection of disjoint open sets in separable and second countable spaces, Lindelof theorem. T_0, T_1, T_2 (Hausdorff) separation axioms,their characterization and basic properties.

Books Recommended :

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.
3. J. L. Kelly, General Topology, Affiliated East West Press Pvt. Ltd., New Delhi.
4. J. R. Munkres, Toplogy, Pearson Education Asia, 2002.
5. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.

Fluid Dynamics

Code: MAT 420H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

*Unit - **I***

Kinematics - Eulerian and Lagrangian methods. Stream lines, path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vortex lines. Equation of continuity. Boundary surfaces.

*Unit - **II***

Acceleration at a point of a fluid. Components of acceleration in cylindrical and spherical polar co-ordiantes, Pressure at a point of a moving fluid. Euler's and Lagrange's equations of motion. Bernoulli's equation. Impulsive motion. Stream function.

*Unit - **III***

Acyclic and cyclic irrotation motions. Kinetic energy of irrotational flow. Kelvin's minimum energy theorem. Axially symmetric flows. Liquid streaming past a fixed sphere. Motion of a sphere through a liquid at rest at infinity. Equation of motion of a sphere. Three-dimensional sources, sinks, doublets and their images. Stoke's stream function.

Unit - IV

Irrotational motion in two-dimensions. Complex velocity potential. Milne-Thomson circle theorem. Two-dimensional sources, sinks, doublets and their images. Blasius theorem. Two- dimensional irrotation motion produced by motion of circular and co-axial cylinders in an infinite mass of liquid.

Books Recommended:

1. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
2. M.E. O'Neill and F. Chorlton, Ideal and Incompressible Fluid Dynamics, Ellis Horwood Limited, 1986.
3. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
4. W.H. Besant and A.S. Ramsay, A Treatise on Hydromechanics Part I and II, CBS Publishers, New Delhi.
5. Bansi Lal, Theoretical Fluid Dynamics, Skylark Pub., New Delhi.

Operations Research-II

Code: MAT 422H

Max. Marks : 100
External Exam: 75
Internal Exam: 25
Time : 3 Hours

Note: The question paper will consist of **four** units. Each unit will contain two questions and the students shall be asked to attempt a total **five**, selecting at **least one** question from each unit.

Unit - I

Inventory Control: introduction of inventory, factors affecting inventory, Inventory models, Deterministic models: Economic order quantity model when shortages are allowed/not allowed, price discounts model, multi-item inventory models.

Unit -II

Queuing Theory : Basic characteristics of queuing system, Birth-death equations, Steady state solution of Markovian queuing models with single and multiple servers (M/M/1 and M/M/c), with limited capacity (M/M/1/K and M/M/c/K).

Unit -III

Sequencing problems: Processing of n jobs through 2 machines, n jobs through 3 machines, 2 jobs through m machines, n jobs through m machines.
Replacement problems: Replacement of items whose running cost increases with time, Replacement policies for the items that fail completely - Individual and the group replacement policies.

Unit -IV

PERT and CPM: Introduction of PERT and CPM, Earliest and latest times, Determination of critical path and various types of floats, Probablistic and cost considerations in project scheduling

Books Recommended:

1. J.K. Sharma, Mathematical Model in Operations Research, Tata McGraw Hill.
2. H.A. Taha, Operations Research – An Introduction.
3. Kanti Swarup, Gupta, P.K. and Manmohan. Operations Research.
4. P.K. Gupta and D.S Hira, Operations Research, S. Chand & Co.

Practical/ Computational Work
Code: MAT 424H

Max. Marks : 50
i) External Exam : 25 Marks
ii) Internal Exam : 25 Marks
Time:3 Hours

Note: The examiner is requested to set **4** experiments. The candidate is required to attempt **2** of the allotted experiments.

This paper covers the practical/Computational work to be performed on computer using MATLAB/TORA.