ORDINANCES AND OUTLINES OF TESTS,

SYLLABI AND COURSE OF READING

FOR

MASTER OF SCIENCE (MATHEMATICS)
PART - I
(SEMESTER I & II)

FOR

2016-17 & 2017-18 SESSIONS

UNDER CREDIT BASED SEMESTER SYSTEM

OF

UNIVERSITY GRANTS COMMISSION

General Shivdev Singh Diwan Gurbachan Singh

KHALSA COLLEGE PATIALA

An Autonomous College
NAAC Accredited 'A' Grade
College with Potential for Excellence Status by UGC
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Preamble:

General Shivdev Singh Diwan Gurbachan Singh Khalsa College Patiala, accredited 'A' grade by NAAC (2015), recognized as "College with Potential for Excellence" status by UGC, New Delhi (2016) and an Autonomous College (2016), is a premier institute of higher education in the state of Punjab since 1960. Being concordant with the need to the creation of a self-sustaining, global knowledge society, the college has undertaken several measures initiated by UGC to bring equity, efficiency and excellence in the Higher Education System of the country.

The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by Higher Educational Institutions towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently, the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So, it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated CBSS guidelines.

DEFINITIONS

a. **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
b. **Course:** Usually referred to, as ‘papers’ is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/tutorials/laboratory work/field work/outreach

activities/ project work/vocational training/viva/seminars/term papers /assignments/ presentations/self study etc. or a combination of some of these.

c. **Credit Based Semester System (CBSS):** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

d. **Credit Point (CP):** The numerical value obtained by multiplying the grade point (GP) by the no. of credits (C) of the respective course i.e. CP= GP X C.

e. **Credit (C):** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week, i.e. a course with assigned L-T-P: 3-0-2 or 3-1-0 will be equivalent to 4 credits weight-age course.

f. **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

g. **Grade Point (GP):** It is a numerical weight allotted to each letter grade on a 10 point scale.

h. **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

i. **Programme:** An educational programme leading to award of a degree, diploma or certificate.

j. **Semester Grade point Average (SGPA):** It is a measure of performance of work done in a semester. It is ratio of total credit points (CPs) secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed upto two decimal places.

k. **Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

l. **Transcript or Grade Card (GC) or Certificate:** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, no. of credits, grades secured) along with SGPA of that semester and CGPA earned till date semester.

m. **Semester Examinations:** The comprehensive examinations conducted for summative evaluation of course. The duration of these examinations shall be 3 hours for both theory and practical courses and the weight shall be as per the ordinance of relevant programme.

n. L-T-P: The prescribed hours/week during a semester for Lecture-Tutorial-Practical to a particular course, in accordance with curriculum prescriptions based on respective nature.

ORDINANCES FOR M.Sc. MATHEMATICS

Applicability of Ordinances for the time being in force.

Notwithstanding the integrated nature of a course spread over more than one academic year, the Ordinances in force at the time a student joins a course shall hold good only for the examination held during or at the end of the academic year. Nothing in these Ordinances shall be deemed to debar the College from amending the ordinances subsequently and the amended ordinances, if any, shall apply to all the students whether old or new.

1. The course for the Degree of Master of MATHEMATICS shall be spread over two academic years to be called M.Sc. (MATHEMATICS) Part-I and M.Sc. (MATHEMATICS) Part-II. Each part shall consist of two semesters. The examination for the first semester and third semester shall be held in the month of November/December and the examination for the second semester and fourth semester shall be held in the month of April/May or such other dates as may be fixed by the Academic Council.
2. The examination in M.Sc (MATHEMATICS) Part-I shall be open to a student who produces the following certificates to the Principal of the college.
   (i) B.A./ B.Sc. /B.Sc. (Honours) with Mathematics from any recognized university with at least 50% marks for general candidates.
   (ii) 5% Relaxation in marks for SC/ST/ Physical Challenged Student.
   Note: Candidate placed under reappear in one or more subjects in B.A./B.Sc. or any other examination, recognized as equivalent thereto shall not be eligible for admission to M.Sc. (MATHEMATICS) Part-I Course.

   (iii) of having good character.

2.1 To quality for admission to 3rd semester of the course, the candidate must have passed 50% of total papers of the two semesters of the 1st year. In case, the result of 2nd semester is not declared at the time of admission to 3rd semester, the student may be admitted provisionally and will be allowed to take examination if 3rd semester if he/she has passed in 50% of the total papers of first year (i.e. 1st and 2nd semester). A candidate must complete and pass the whole course of two years within a maximum of four years from the date of admission in M.Sc. (MATHEMATICS) First semester. If the candidate does not clear the lower examination within stipulated period, the higher result of the candidate will stand automatically cancelled.

3. Semester examinations will be open to regular candidates who have been on the rolls of the college and meet the attendance and other requirements as prescribed in the ordinances of the course.

4. Examination Rules

I. Paper Setting/Evaluation will be done by an External Examiner or as decided by the Examination Cell.

II. The supplementary examination will be held along with the routine End Semester Tests. The supplementary paper would be from the syllabi prescribed for that session in which the candidate is appearing. The student can appear only in the theory paper on the payment of the required fee. The candidate will have consecutive two attempts to clear the Supplementry Examination, marks of practical and internal assessment will be carry forward as original.

III. Re-evaluation of answer sheet in two subjects is allowed after paying the requisite fee. The application for Re-evaluation should be submitted within 15 days of the declaration of the results. In case there is a difference of more than 10 % between the marking of the First evaluator and the Second evaluator, then the paper would be sent to a Third Evaluator. The mean of the marks of the Second and Third evaluators is then considered as the final marks. The re-evaluated marks will be considered final irrespective of the increase or decrease in marks.

IV. The students who have reappear in the IIIrd semester only in Two Year Degree Course at the Postgraduate Level will be allowed to appear in their Reappear examination along with the Final Semester Examinations of their respective courses.

V. The Principal can provide Golden Chance (with special chance fee) to students who have been unable to clear their exams even after two attempts.

5 IMPROVEMENT EXAMINATIONS:

I. A student who has been declared 'pass' in the postgraduate course he/she was admitted to, may apply for improvement within a year from the declaration of the result of the final semester and he/she can take maximum of 50% of the total papers for that course for improvement.

II. A student shall have to appear in End semester examination of the paper chosen for improvement along with the regular students. No special exam shall be held for him/her.

III. If a student fails to improve upon the original marks obtained in the paper chosen for improvement, his/her original marks shall be retained and he/she shall not get a second chance for improvement.

IV. Improvement examination in practical paper shall not be allowed.

V. A student taking improvement examination shall have to pay a fee decided by the college.

5.1 Grading System:

The grades and their description, along with equivalent numerical grade points are listed in the Grading Assignment Table as follows:

Grade Assignment Table

Range of Marks	Description	Grade	Grade Point
85-100	Outstanding	O	10
75-84	Excellent	A+	9
65-74	Very Good	A	8
55-64	Good	B+	7
50-54	Above Average	B	6
45-49	Average	C	5
35-44	Pass	P	4
0-34	Fail	F	0
Otherwise	Absent/Detained	Ab./D	0

a. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

b. For non credit courses **'Satisfactory' or 'Unsatisfactory'** shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

5.2 Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

a. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = ∑(Earned Credits Ci x Grade Point Gi)/∑Earned Credits Ci;

Where Ci is the number of credits of the ith course and Gi is the Grade Point Scored by the student in the ith course.

b. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA (Ci) = ∑(Earned Credits Ci x SGPA Si)/∑Ci);

Where Si is the SGPA of the ith semesters and Ci is the total number of credits in that semester.

c. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration of the computation of SGPA and CGPA and Format for Transcripts

i. Computation of SGPA and CGPA

Illustration for SGPA

Course	Credits	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 X 8 = 24
Course 2	4	B+	7	4 X 7 = 28
Course 3	3	B	6	3 X 6 = 18
Course 4	3	O	10	3 X 10 = 30
Course 5	3	C	5	3 X 5 = 15
Course 6	4	B	6	4 X 6 = 24
	20			139

Thus, **SGPA = 139/20 = 6.95**

Illustration for CGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 20 SGPA : 6.9	Credit : 22 SGPA : 7.8	Credit : 25 SGPA : 5.6	Credit : 26 SGPA : 60
Semester 5	**Semester 6**		
Credit : 26 SGPA : 6.3	Credit : 25 SGPA : 8.0		

Thus, **CGPA** = $\frac{20 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0}{144}$ = 6 . 7 3

ii. Transcripts (Format):

Based on the above recommendations on Letter grades, grade points, SGPA and CGPA, the College may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

5.3 Division and Position:

Division shall be awarded in the following manner, to the candidates on the basis of their respective CGPA:

CGPA 7.5 or more	1st Division with Distinction
CGPA 6.0 or more but less than 7.5	1st Division
CGPA 5.0 or more but less than 6.0	2nd Division
CGPA 3.5 or more but less than 5.0	3rd Division
Otherwise	Fail

However, First, Second or Third position shall be awarded to the candidates, provided they meet the following conditions:

a) Rank shall be solely decided on the final CGPA, on completion of degree credit requirement.

b) The candidate has completed all the prescribed requirements, in the prescribed programme duration.

c) The candidate has passed / secured valid grades in all the prescribed courses, in the first attempt.

d) No disciplinary action is pending or has ever been lodged against him/her.

e) In case of an exceptional tie, both candidates shall be awarded the same rank.

5.4 Grade Card:

At the end of each semester, a student will be given a 'Grade Card' which will contain Course Code, Title, Credits, Grades Awarded, Earned Credits and Earned Point secured by him/her in each course, together with his/her SGPA in that semester. On the completion of the programme, a Final Grade Card will be issued to the student, giving full semester-wise details about the absolute marks and grades obtained by him/her in each course together with his/her SGPA and also the CGPA and Division awarded to him/her.

5.5 Equivalence:

Percentage (P) equivalent to CGPA earned by a candidate may be calculated using the following formula:

P= CGPA X 10

5.6 MALPRACTICES/UNFAIR MEANS

5.6.1 The following shall be deemed to be unfair means:

I. Leaving the Examination Hall without submitting the answer book to the invigilator or taking away, tearing off or otherwise disposing off the same or any part thereof.

II. Using abusive language in the examination hall or writing the same in the answer sheet.

III. Making an appeal to the evaluator through answer sheet.

IV. Possession by examinee or having access to books, notes, papers, mobile or any other electronic material which can prove to be helpful in the exam.

V. Any action on the part of candidate at an examination trying to get undue advantage in the performance at examinations or trying to help another, or derive the same.

VI. Impersonating for a candidate in the examination.

VII. Intimidating, threatening, manhandling, using violence, show of force in any form against any invigilator or any person on duty, creating disturbance to the smooth conduct of the examination.

VIII. Any other action which the Controller Examination / Chief Controller deem fit to be a case of UMC.

5.6.2 In case the student is found to have used any of the above Unfair means:

I. His/her answer book shall be seized and He/She will be given a new answer sheet.

II. Invigilator shall submit a detailed report along with the answer book of the student and the related material, if any, to the Centre Superintendent who will subsequently hand it over to Controller Examination.

III. Written statement to this effect shall be obtained from the student by the Centre Superintendent. In case the student refuses to do the same, the fact of refusal must be recorded.

IV. The student reported to have used unfair means shall be allowed to appear in the subsequent papers. However, no marks would be awarded for the paper in which unfair means were used.

V. The Principal shall refer the cases of malpractices in Mid Semester tests, House Tests and End Semester Examinations, to an Unfair Means Committee, constituted by him/her for the purpose. Such committee shall follow the approved scales of punishment. The Principal shall take necessary action, against the erring students based on the recommendations of the committee.

5.6.3 The involvement of the Staff, who are in charge of conducting examinations, evaluating examination papers and preparing/keeping records of documents relating to the examinations if involved in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and recommended for award of appropriate punishment after enquiry.

6. Attendance Regulations & Condonation:

6.1 A student shall be eligible to appear for end semester examinations, if he/she acquires a minimum of 75% of attendance in each subject.

6.2 Request to the Principal for Condonation of shortage of attendance after the recommendation of the HOD will be forwarded to Lecture Shortage Condonation Committee. The committee can finally condone the shortage in aggregate up to 15% on medical grounds in each semester.

6.3 Any student representing the Institute/ University/ State/ Nation in any Academic/ Sports/ Cultural/Extra Co curricular/ NSS/NCC or any other event shall be considered on duty. His/ Her shortage of lectures shall be condoned, provided that the student is permitted in writing by the Principal/HOD concerned and a certificate to this effect signed by the competent authority where the student attended the event is taken.

6.4 A Student will not be promoted to the next semester unless he/she satisfies the attendance requirement of the present semester as applicable.

6.5 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end semester examination of that particular semester and their registration for examination shall stand cancelled and no fee shall be refunded.

7. Late college students: A candidate, who has completed the prescribed course of instructions for a semester but has not appeared in the examination or having appeared, has failed in the examination, may appear as a late college student within the prescribed period.

8. Applications for admission to the examination shall be made on the prescribed form attested by the competent authority as per the college rules.

9. Amount of examination fee to be paid by a candidate for each semester shall be as fixed by the College from time to time.

10. The last date by which examination forms and fees must reach the college office shall be as follows.

Semester	**Without late fee**	**With late fee of Rs. 800/-**	**With late fee of Rs.1200/-**	**With late fee of Rs.5000/-**	**With late Fee of Rs. 10,000**
Nov./Dec. (Odd)	Sept. 30	Oct.15	Oct. 21	Oct. 31	Nov. 10*
April/May(Even)	Feb. 28	March 15	March 21	March 31	April 15*

***Note: No Examination Form will be accepted after the prescribed date.**

11. College medal will be awarded to a candidate who secures first position in the College on the basis of the marks of all the six semesters taken together. The general rules and conditions of the College/University for the Award of medal/prizes etc. will be applicable in the award of College medal to the topper of this examination.

12. All the question papers should be in English and candidates will be required to answer the questions in English only.

13. Viva Voce/ Practical examination shall be conducted by a Committee consisting of the following:

(i) One external examiner

(ii) One internal examiner

14. The minimum number of marks required to pass each semester examination will be 35% in each paper and 35% in the aggregate of the semester examination. Provided, that in papers with practicals, the percentage shall be required separately in written and practical/lab work. The candidate shall also be entitled to grace marks as admissible under the general ordinance relating to the 'Award of Grace Marks'.

15. Assessment:

15.1 M.Sc (MATHEMATICS) Course will be run on Credit Based Semester System (CBSS) as described in the Introduction.

15.2 The Assessment in each semester of M.Sc. (MATHEMATICS) Course will be 30% internal and 70% external for each Theory paper. The result of the Internal Assessment shall be conveyed to the students/examination branch by the Head of the Department according to prescribed schedule.

15.3 There shall be Two Mid Semester tests in each Semester.

15.4 Internal Assesment of 30% will be based on Continuos Comprehensive Assessment (CCA) pattern and the break up of 30% will be as under:

(i)	Average of Two Mid Semester Tests	:	40%
(ii)	Assignment/Seminar/Class Test/Tutorial/Quiz etc.	:	40%
(iii)	Attendace	:	20%

Papers having practical/viva, the marks of theory and practical/viva will be reduced equally percentage wise to make room for 30% internal assessment.

Note: If a case comes to notice of Controller of Examinations where the marks awarded by the Teacher are on a very Higher/Lower side, the award will be got moderated by the following committee.

I. Paper Evaluator
II. Head of the Department
III. Dean of Faculty concerned
IV. Controller of Examination

15.5 The marks for attendance in internal assessment would be awarded according to the student's attendance percentage as follows:

91-100% attendance	100% marks of the allotted Internal Assessment marks for attendance
81-90% attendance	80% marks of the allotted Internal Assessment marks for attendance
75-80% attendance	70% marks of the allotted Internal Assessment marks for attendance
Below 75%	Zero marks

15.6 A candidate is required to secure at least 35% marks both in external examination (Theory and Practical/ Project work) and in internal assessment separately in each paper in order to qualify in an examination.

15.7 Students should be shown the internal assessment before submission. In case the student is dissatisfied with the marks awarded to him/her in internal assessment; he/she can approach the concerned teacher. If the student is still not satisfied he/she may approach the head of department and the Principal subsequently.

16. End-Semester Examination:

End-semester examination(s) of each theory course shall be of three hours duration and will be conducted as per norms and schedule notified by the Controller of Examination.

The end semester examinations of laboratory/practical courses and other courses such as seminar, colloquium, field work, project, dissertation etc. shall be conducted as notified by the HOD.

17. Degree Requirement:

17.1 The result of all the examinations will be declared through the College website.

17.2 The grace marks shall be allowed according to the general ordinances relating to 'Award of Grace Marks'. These ordinances will apply to all examinations.

(i) Up to 1% of the total marks of Part-I and II examination shall be added to the aggregate of both Part-I and Part-II examinations to award a higher division/55%marks, to a candidate.

(ii) Grace marks to be given shall be calculated on the basis of 1% of total aggregate marks of all the written and practical papers of the examination concerned. Marks for viva-voice/internal assessment/sessional work/skill in teaching/any additional /optional subject shall not be taken into account for this purpose. If a fraction works out to half or more, it shall count as one mark and fractional less than half shall be ignored

(iii) To pass in one or more written papers or subjects, and/or to make up the aggregate to pass the examination but not in sessional work, internal assessment, viva-voice and skill in teaching.

17.3 The College may from time to time revise, amend and change the regulations or the curriculum, if formed necessary.

17.4 The students will be given the facilities of transfer of Credits earned in different recognized/approved Institutions of Higher Education in India and Abroad.

17.5 A student who earns total specified credits according to the curriculum and fulfulls such other conditions as may be mentioned in the curriculum of the programme, shall be issued the DMC and shall be awarded degree by Punjabi University Patiala. He/she must also pay all College dues as per rules. Moreover, there should be no case of indiscipline pending against him/her.

18. If any student gets admission after concealing any fact or his/her certificates are found fake after verification or he/she misleads the institution as any front or because of any other reason, his/her admission will stand cancelled/ his/her result cancelled though he/she may have been declared pass.

19. In case the ordinance is silent about any issue, it will be decided by the College Principal in consultation with the Academic Advisory Committee of the college in the anticipation of approval of the same by Academic Counsil of the College.

M.Sc. (MATHEMATICS) –I
(SEMESTER I & II)

Semester	Course No.	Course Title	Hours			Total Credits
			L	T	P	
1.	MM 1.1	Real Analysis	4	1	0	5
	MM 1.2	Topology	4	1	0	5
	MM 1.3	Algebra	4	1	0	5
	MM1.4	Complex Analysis	4	1	0	5
	MM 1.5	Ordinary Differential Equations	4	1	0	5
2.	MM 2.1	Functional Analysis	4	1	0	5
	MM 2.2	Rings & Modules	4	1	0	5
	MM 2.3	Advanced Topology	4	1	0	5
	MM 2.4	Differential Geometry	4	1	0	5
	MM 2.5	Special Functions	4	1	0	5

PAPER MM 1.1: REAL ANALYSIS

Duration: 3 Hrs. **Max. Marks: 100**
Internal Assessment: 30
Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

UNIT-I

Functions of several variables, Linear transformations, Derivatives in an open subset of R^n, Chain Rule, Partial derivatives, Interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem. Rectifiable Curves, Uniform convergence and continuity, Uniform convergence and Differentiation, Stone-Weierstrass Theorem.

UNIT-II

Sequences of functions: convergence and continuity in metric spaces, Pointwise and uniform convergence of sequences of functions, Continuous maps, sequences. Completeness: Cauchy sequences, complete spaces, dense sets and nowhere dense sets, Contraction Mapping Theorem.

UNIT-III

Rearrangement of terms of a series, Riemann's Theorem. Power series, uniqueness theorem for power series, Abel's theorem and Tauber's theorem, Exponential and Logarithmic functions, Trigonometric functions, Fourier series.

UNIT-IV

Riemann- Stieljes Integration: Definition and Existence of Riemann-Stieljes Integral, Properties of Integral, Integration and Differentiation, The Fundamental Theorem of Calculus, Change of Variables, Integration of vector valued functions.

Reference Books:

1. Walter Rudin Principles of Mathematical Analysis, 3rd edition, McGraw Hill, Kogakusha, 1976, International student edition.
2. T. Apostol, Mathematical Analysis, 2nd ed., Narosa Publishers, 2002.
3. K. Ross, Elementary Analysis: The Theory of Calculus, Springer Int. Edition, 2004.
4. E.T. Copson Metric Spaces, Cambridge University Press, Cambridge, NewYork, 1968.
5. W. Fleming, Functions of Several Variables, 2nd Ed., Springer-Verlag, 1977

PAPER MM 1.2: TOPOLOGY

Duration: 3 Hrs. **Max. Marks: 100**
Internal Assessment: 30
Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

Unit I

Metric spaces: Definitions and examples, Open ball, Closed ball, Euclidean metric, discrete metric, distance between sets and diameter of a set, Open sets, closed sets, interior, exterior, boundary and closure, Denseness, Countable and uncountable sets.

Unitn II

Topological spaces, Different types of topological spaces, Base and local base for a topology, the subspace topology, Open and Closed sets, limit points, interior, exterior, boundary and closure in topological spaces,

Unit II

First and second countable spaces, Continuous functions and properties, Homeomorphism, Topological property, Open and closed maps, Restriction and extension maps, Isometry, Separable space and Separated sets.

Unit IV

Connected and disconnected sets, relation of connectedness, totally connected sets, Connected subspaces of the Real line, Components and local connectedness.

Reference Books:

1. James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)
2. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
3. George F. Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
4. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York S.Willard, General Topology, Addison - Wesley, Mass., 1970

PAPER MM 1.3: ALGEBRA

Duration: 3 Hrs. **Max. Marks: 100**
Internal Assessment: 30
Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

Unit I

Review of groups, subgroups, cosets, normal subgroups, quotient groups, homomorphisms and isomorphism theorems.

Normal and subnormal series, Solvable groups, Nilpotent groups, Composition Series, Jordan-Holder theorem for groups.

Unit II

Group action, Stabilizer, orbit, Review of class equation, permutation groups, cyclic decomposition, Alternating group A_n, Simplicity of A_w.

Unit-III

Structure theory of groups, Fundamental theorem of finitely generated abelian groups, Invariants of a finite abelian group, Sylow's theorems, Groups of order p^2, pq.

Unit IV

Review of rings and homorphism of rings, Ideals, Algebra of Ideals, Maximal and prime ideals, ideal in Quotient rings, Field of Quotients of integral Domain.

Reference Books:

1. Bhattacharya, Jain & Nagpaul: Basic Abstract Algebra, Second Edition (Ch. 6, 7, 8, 10).
2. Surjeet Singh, Qzai Zimeeruddin : Modern Algebra, Vikas Publishing House, 1972.
3. I.N. Herstein : Topics in Algebra, Second Edition.

PAPER MM 1.4: COMPLEX ANALYSIS

Duration: 3 hrs **Max. Marks: 100**
Theory: 70
Internal Assessment: 30

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

UNIT-I

Function of complex variable, Analytic function, Cauchy-Riemann equations, Harmonic function and Harmonic conjugates, Branches of multivalued functions with reference to arg z, logz and z^c.

UNIT -II

Complex Integration, Cauchy's theorem, Cauchy Goursat theorem Cauchy integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of Algebra, Maximum Modulus Principle. Schwarz lemma.

UNIT -III

Taylor's theorem. Laurent series in an annulus. Singularities, Meromorphic function. Cauchy's theorem on residues. Application to evaluation of definite integrals.

UNIT -IV

Principle of analytic continuation, General definition of an analytic function. Analytic continuation by power series method, Natural boundary, Harmonic functions on a disc, Schwarz Reflection principle.

Refecence Books:

1. L.V.Ahlfors, Complex Analysis, 3rd Edition.
2. E.T.Copson, An introduction to Theory of Functions of a Complex Variable
3. H.S. Kasana, Complex Variables, Prentice Hall of India

PAPER MM 1.5: ORDINARY DIFFERENTIAL EQUATIONS

Duration: 3 Hrs. **Max. Marks: 100**
Internal Assessment: 30
Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

Unit I

Existence of solution of ODE of first order, initial value problem, Ascoli's Lemma, Gronwall's inequality, Cauchy Peano Existence Theorem, Uniqueness of Solutions. Method of successive approximations, Existence and Uniqueness Theorem.

Unit II

System of differential equations, nth order differential equation, Existence and Uniqueness of solutions, dependence of solutions on initial conditions and parameters.

Unit III

Linear system of equations (homogeneous & non homogeneous). Superposition principle, Fundamental set of solutions, Fundamental Matrix, Wronskian, Abel Liouville formula, Reduction of order, Adjoint systems and self adjoint systems of second order, Floquet Theory.

Unit IV

Linear 2^{nd} order equations, preliminaries, Sturm's separation theorem, Sturm's fundamental comparison theorem, Sturm Liouville boundary value problem, Characteristic values & Characteristic functions, Orthogonality of Characteristic functions, Expansion of a function in a series of orthonormal functions.

Refecence Books:

1. E. Coddington & N. Levinson, Theory of Ordinary Differential Equations, Tata Mc-Graw Hill, India
2. S.L. Ross, Differential Equations, 3^{rd} edition, John Wiley & sons (Asia).
3. D.A. Sanchez, Ordinary Differential Equations & Stability Theory, Freeman & company.
4. A.C. King, J. Billingham, S.R. Otto, Differential Equations, Linear, Nonlinear, Ordinary, Partial, Cambridge University Press.

PAPER MM 2.1: FUNCTIONAL ANALYSIS

Duration: 3 hrs **Max. Marks: 100**

Theory: 70

Internal Assessment: 30

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

UNIT-I

Normal Linear spaces, Banach spaces, Examples of Banach spaces, Subspaces and Quotient spaces, Continuity of Linear maps, Equivalent norms, Normed spaces of bounded linear maps, Bounded Linear functional, Hahn-Banach theorem in Linear Spaces and its applications.

UNIT -II

Natural Imbedding of N into N^{**}, Open mapping theorem, Projections on Banach spaces, Closed graph theorem, Uniform boundedness principle.

UNIT –III

Inner Product Spaces, Hilbert spaces, examples, Schwarz’s Inequality, Orthogonality, Orthonormal sets, Bessel's inequality, Parseval's theorem, Gram Schmidt Orthogonalization Process, The conjugate space of a Hilbert spaces.

UNIT -IV

Adjoint operators, Self-adjoint operators, Normal and Unitary operators, Projection operators, Invariants and Reducibility.

Reference Books:

1. G.F.Simmons: Introduction to Toplogy and modern Analysis, Chapters IX, X , XII and XIII.
2. George Bachman & Lawrence Narici: Functional Analysis,Courier Coorporation,1966.
3. S.Ponnusamy: Foundations of Functional Analysis, Narosa Publishing House.

PAPER MM 2.2: Rings & Modules

Duration: 3 hrs **Max. Marks: 100**

Theory: 70

Internal Assessment: 30

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

UNIT-I

Homorphism of rings, Unique Factorization Domains, Principal Ideal Domains, Euclidean Domains, Polynomial Rings over UFD, Rings of Fractions (RB1: Ch. 11 and Section 1 of Chapter 12).

UNIT -II

Modules: Definition and Examples, Submodules, Direct sum of submodules, Free modules, Difference between modules and vector spaces, Quotient modules, Homomorphism, Simple modules, Modules over PID (RB2: Chapter 5)

UNIT –III

Modules with chain conditions: Artinian Modules, Noetherian Modules, composition series of a module, Length of a module, Hilbert Basis Theorem (RB2: Chapter 6).

UNIT -IV

Cohen Theorem, Radical Ideal, Nil Radical, Jacobson Radical, Radical of Artinian ring.(RB2:Chapter 6).

Reference Books:

1. Bhattacharya, Jain and Nagpaul: Basic Abstract Algebra, Second Edition, Cambridge University Press.
2. Musili C, Introduction to Rings and Modules, Second Revised Edition, Narosa Publishing House, 1994.

PAPER MM 2.3: ADVANCED TOPOLOGY

Duration: 3 Hrs. **Max. Marks: 100**
Internal Assessment: 30
Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

Unit I

Compact spaces, Compact subspaces of the Real line, Local Compactness, Bolzano-Weirstrass property, Heine- Borel theorem, Sequential compactness, countable compactness, Lindeloff spaces, Lindeloff theorem, one point compactification.

Unit II

The separation Axioms, T_0, T_1, Hausdorff, Regular, Normal, Completely regular, Completely normal spaces and their properties, The Urysohn Lemma and its general form, The Tietz extension theorem.

Unit III

Product of topological spaces, projection mapping, Box topology, Product invariant property, Short and finitely short families, Hausdorff maximal principle, Quotient topology and Quotient mapping, Theorems relating to Quotient space.

Unit IV

Nets, Subnets, Convergence of Nets, Cluster point of a net, Theorems related to continuity, compactness and convergence of a net, Filters, Comparison of Filters, Base, sub-base, sup and inf of a Filter, Filter base and examples, Ultrafilters, Convergence of Filters.

Reference Books:

1. James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)
2. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
3. George F. Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
4. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
5. S.Willard, General Topology, Addison - Wesley, Mass., 1970

PAPER MM 2.4: DIFFERENTIAL GEOMETRY

Duration: 3 Hrs. **Max. Marks: 100**
Internal Assessment: 30
Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

UNIT-I

A simple arc, Curves and their parametric representation, are length and natural parameter, contact of curves, Tangent to a curve, osculating plane, Frenet trihedron, Curvature and Torsion, Serret Frenet formulae, fundamental theorem for spaces curves, helices, contact between curves and surfaces.

UNIT-II

Evolutes and involutes, Bertrand Curves, spherical indicatrix, implicit equation of the surface, Tangent plane, length of tangent vector and angle between two tangent vectors, area of a surface.

UNIT-III

The first fundamental form of a surface, The second fundamental form, Gaussian map and Gaussian curvature, curvature of a curve on a surface, Normal Curvature, principal curvature, Mean Curvature, principal directions, lines of curvature.

UNIT-IV

Rodrigue formula, asymptotic Lines, conjugate directions, envelopes, and developable surfaces associated with spaces curves, minimal surfaces, ruled surfaces, Gauss and Weingarten formulae, Codazzi equation and Gauss theorem.

Reference Books:

1. A. Goetz: Introduction to differential geometry, Addison-Wesley Publishing Company, 1968.
2. T.J. Willmore: An introduction to differential geometry, Dover Publications, Inc., Mineola, NewYork.

PAPER MM 2.5: SPECIAL FUNCTIONS

Duration: 3 Hrs. **Max. Marks: 100**

Internal Assessment: 30

Theory: 70

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into five parts: A, B, C, D & E.

Section-A

It will consist of 10 short answer questions from the entire syllabus. The candidates are required to attempt all the questions. Each question will carry 3 marks.

Section B, C, D & E

These will consist of 2 questions each from unit-I, II, III and IV of the syllabus and the candidates are required to attempt 1 question each from all the sections. Each question will carry 10 marks.

UNIT-I

Gamma and Beta Functions : The Euler Constant γ, Gamma Function, A series for $\Gamma'(z) / \Gamma(z)$, Difference equation $\Gamma(z+1) = z\Gamma(z)$, Euler's integral for $\Gamma(z)$, Beta function, value of $\Gamma(z)\,\Gamma(1-z)$, Factorial Function, Legendre's duplication formula, Gauss multiplication theorem.

UNIT-II

Bessel function and Legendre polynomials : Definition of $J_n(z)$, Bessel's differential equation, Generating function, Bessel's integral with index half and an odd integer, Generating function for Legendre polynomials Rodrigues formula, Generating functions, Special properties of P_n(x), Some more generating functions, Laplace's first integral form, Orthogonality.

UNIT-III

Hermite polynomial: Definition of Hermite polynomials $H_n(x)$, Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Othogonality, Expansion of polynomials, more generating functions.

UNIT-IV

Laguerre Polynomials :The Laguerre Polynomials $L_n(x)$, Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigue's formula, Orthogonal, Expansion of polynomials, Special properties, Other generating functions.

Reference Books:

1. Rainville, E.D, ; Special Functions, The Macmillan co., New york 1971.
2. Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
3. Saran, N., Sharma S.D. and Trivedi, Special Functions with application, Pragati prakashan, 1986.
4. Lebdev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
5. Whittaker, E.T. and Watson, G.N., A Course of Modern Analysis Cambridge University Press, London, 1963.