KANNUR UNIVERSITY

(Abstract)

B.Sc (Honours) in Mathematics Degree Programme - Revised Regulations Scheme and Syllabus- Implemented with effect from 2016 admissions - Modified Orders Issued.

ACADEMIC C SECTION

No. Acad/C2/6190/2016 **Dated, Civil Station P.O, 14-08-2017**

Read: 1. U.O of Even No. dated 30.08.2016

2. U.O Note No. ESI/5/18344/2016 dated 03.06.2017

3. Minutes of the meeting of the BOS in B.Sc (Honours) in Mathematics held on 12.07.2017.

4. E-mail dated 10.08.2017 from the Chairman, BOS in B.Sc (Honours) in Mathematics

ORDER

1. As per paper read (1) above, the revised regulations , scheme, syllabus and pattern of question papers of B.Sc (Honours) in Mathematics Degree Programme were implemented in the university w.e.f 2016 admission.

2. The examination branch vide paper read (2) above has reported certain discrepancies in the credits and total marks in the course structure of syllabus of B.Sc (Honours) in Mathematics Degree Programme implemented w.e.f 2016 admission.

3. The meeting of the BOS in B.Sc (Honours) in Mathematics held on 12.07.2017 vide paper read (3) above, after detailed discussion has recommended to incorporate certain modifications in the Regulations ,Scheme and Syllabus of B.Sc (Honours) in Mathematics programme, implemented w.e.f 2016 admission, as follows:.

a) The core paper "BHM602 - Integral Equations and Measure Theory" to be chosen as Elective - I paper in 5th semester as BHM505A.

b) The Elective - II paper "BHM605C - Fuzzy Mathematics" of the 6th semester is deleted and the Elective - I paper in 5th semester "BHM505A - Calculus of Variations" to be incorporated in 6th semester Elective -II paper as BHM604C

c) The course codes of the Elective - II papers BHM605A, BHM605B, BHM605D to be changed respectively as BHM604A, BHM604B, BHM604D.

d) To delete comprehensive viva of the 3rd and 6th semester and individual project work of the 6th semester and to incorporate "BHM605 - Project work and Viva-Voce" with 4 credits and 75 marks in the 6th semester.

e) Course code of papers "Topology, Operations Research, Elective - II" of the 6th semester to be modified as BHM602, BHM603 and BHM604

4. The Chairman, BOS in B.Sc (Honours) in Mathematics vide paper read (4) above, has forwarded the modified Regulations ,Scheme and Syllabus of B.Sc (Honours) in Mathematics programme to be implemented w.e.f 2016 admission .

5. The Vice Chancellor, after examining the matter in detail, and in exercise of the powers of the Academic Council as per section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction to implement with effect from 2016 admission, the modifications in B.Sc (Honours) in Mathematics programme incorporating the changes as recommended by the Board of Studies in B.Sc (Honours) in Mathematics , vide para. 3, subject to report to the Academic Council.

6. The modified pages of the regulations, scheme and syllabus are uploaded on the university website for reference.

7. U.O as per the paper read (1) above, stands modified to this extent.

8. Orders, are therefore issued accordingly.

KANNUR UNIVERSITY CIVIL STATION P.O. KANNUR Pin-670 002 THAVAKKARA

Sd/-
JOINT REGISTRAR (ACADEMIC)
FOR REGISTRAR

To

The Examination Branch (through PA to CE)

Copy To:

1. The Chairman, BOS in B.Sc (Honours) in Mathematics
2. PS to VC/PA to PVC/PA to Registrar
3. JR/AR I Academic
4. SF/DF/FC.

Forwarded/By Order

Section Officer

For more details; log on www.kannuruniversity.ac.in

REGULATIONS, SCHEME & SYLLABUS
for
B.Sc. (HONOURS) IN MATHEMATICS
(A Six Semester Degree Programme Spread over 3 years)
(2016 Admission onwards)

1. Introduction:-

A good background in Mathematical Sciences is essential to study various disciplines ranging from economics and business administration to computer applications. The programme is designed for students falling in the following categories:

1. Students who aspire for higher studies in Mathematics/Statistics
2. Students who are aiming at M.Sc.(Economics)
3. Students who opt for MCA or MBA

This is a three year degree programme (six semesters of equal duration) in which more topics in Mathematical Sciences are covered than in any conventional B.Sc. Mathematics programme. The topics are logically arranged so that for any course, the prerequisite is covered in the earlier semesters. The treatment for all courses is chosen from standard text books which are used in many reputed Universities in India and abroad. *"For the programme to be effective it is mandatory that questions for internal and external examinations must be from the text books mentioned in the syllabus"*

2. OBJECTIVES OF THE PROGRAMME

B.Sc. (Honours) in Mathematics programme envisages the following from successful candidates who pursued it: He/She should

1. Be able to imbibe and develop mathematical ideas, both abstract and concrete and independently able to apply/invent methods to solve problems in certain real life situations.
2. Be able to pursue higher studies in Mathematical Sciences or allied disciplines from some reputed institutions in India and abroad especially in institutions like IITs, IISER, NITs, ISI IISc etc.,
3. Develop a positive attitude towards creative research in Mathematical Sciences or allied disciplines.

3. NOMENCLATURE, FACULTY AND ELIGIBILITY FOR ADMISSION

The name of this programme shall be "**Bachelor of Science (Honours) in Mathematics**"

This undergraduate programme comes under the **Faculty of Science**.

Eligibility for admission: Those who have passed Plus Two or equivalent examinations in science with Mathematics as one of the subjects and secured an aggregate of 70% of marks will be eligible for admission. For those belonging to SC category, an aggregate of 60% marks and for ST, an aggregate of 55% is required.

4. DURATION OF THE PROGRAMME

The duration of the programme shall be three years spread over six semesters of 90 working days each with 5 hours per day and 5 days a week. Maximum duration for successful completion of the programme in the case of failed or discontinued candidates is 6 years. On completion of six years the registration given to the candidate for the programme shall be cancelled and the candidate may re-register for the programme again in order to complete the programme. Such candidates should follow the then existing syllabus.

5. REQUIREMENT OF ATTENDANCE

A minimum of 75% of attendance is required for a candidate to appear for the end-semester examination in each course both in theory and practical. However, if there are genuine reasons, a student shall be permitted to condone the shortage of attendance as per the rules and regulations followed by Kannur University from time to time.

6. EXAMINATION- INTERNAL AND EXTERNAL

There shall be University examination at the end of each semester, written for all the courses except for the elective course BHM 505 B. Programming using Scilab for which there will be external practical examination. During the 6^{th} semester, students have to carry out a project work and based on that work and based on the concepts they have acquired during the programme, a comprehensive viva shall be conducted. For the Individual Project work and Comprehensive viva for 75 marks (Internal 15 marks + End Semester evaluation 60 marks) in 6^{th} semester, it is to be noted that out of the 60 marks meant for the end semester evaluation, 30 marks is earmarked for question on the project work and the remaining 30 marks is to be attributed to the questions pertaining to their knowledge on the topics they have learnt during the programme. For all the courses, the evaluation consists of two parts: End semester examination (ESE) for 60 marks conducted by the University and internal assessment (IA) for 15 marks conducted by the institution concerned.

The end semester examination will be a written/practical examination of 3 hrs duration.

The pattern of question papers, generally, for all courses in Mathematical sciences (except for the course BHM 505 B. Programming using Scilab) will be

No: of Questions	No: of Questions to be answered	Marks for each question	Total
5	4	1	4
9	6	2	12
12	8	4	32
4	2	6	12

TOTAL : 60 marks

The structure for internal evaluation is as follows:

Test Paper : 8 marks (from a minimum of two test papers)
Viva/Seminar/Assignment: 4 marks
Attendance : 3 marks
TOTAL : 15 marks

In the case of attendance, the following table may be used to award marks for the same.

Attendance in percentage	Marks
Greater than or equal to 90	3
>=80 and <90	2
>=75 and <80	1

External practical examination for the course BHM 505 B. Programming in Scilab falling in the fifth semester of three hour duration shall be conducted for 60 marks. Internal evaluation for 15 marks can be done as per the following:

Written Test Paper/Lab Experimental test : 8 marks (from a minimum of two tests)
Viva/Seminar/Assignment: 4 marks
Attendance : 3 marks
TOTAL : 15 marks

For the practical external examination, two questions on computer programmes from a prescribed set of practical programmes given in the syllabus of this course shall be asked and the duration of practical examination shall be 3 hours. Each student should keep a record book of the prescribed practical works done and the same may be valued by external examiner(s) at the time of external practical examination.

For the external practical examination in the case of BHM 505 B. Programming using Scilab, the marks are distributed as follows:

Practical Record – Maximum 10 marks Writing source code of the programme in the answer sheet for the two given questions– Maximum 20 marks (10 marks each) Practical work done in the computer – Maximum 20 marks (10 marks each) Correct output – Maximum 10 marks (5 marks each)
Total – 60 marks

Attending the external practical examination is **mandatory** and no student shall be declared to have passed in these two courses without appearing for the practical examinations concerned.

Regarding the individual project work, the following directions shall be followed. Each student has to prepare a project report on any mathematical topic of their interest under the guidance of a faculty member of the Mathematics Department of the concerned institute where he/she studies. The topic selected should be the one at par or above the undergraduate level and the content should at large deal with concepts not discussed in the syllabus of any of the courses he /she is being offered under this programme. The report should be neatly typewritten or neatly handwritten and the content should be spread into at least 30 pages in the case of typewritten projects and at least 45 pages in the case of handwritten projects. The project report should adhere to the standard norms in which pages for certificate from the guiding supervisor, declaration by the student, acknowledgment and table of contents are to be essentially included. 15 marks for internal evaluation of the individual project work and comprehensive viva are to be distributed as follows:

A maximum of 3 marks for the attendance, a maximum of 8 marks for short presentations before the guiding supervisor (at least 5 times during the 6 th semester) on the topic of the project work and discussions thereof and a maximum of 4 marks for the project report prepared depending on the quality of its content, over all layout and methodology adopted.

30 marks earmarked for the external evaluation of the individual project are to be distributed as follows:

A maximum of 15 marks for the short presentation of the project work, a maximum of 10 marks for the performance in the associated viva-voce examination and a maximum 5 marks for the project report submitted.

With regard to the remaining 30 marks for that course in relation to the comprehensive viva-voce, Board of Examiners appointed by the University shall decide on the split up of the total 30 marks.

Project evaluation and Viva-Voce shall be conducted by at least two external examiners. 15 minutes time shall be given for the presentation and another 15 minutes for viva voce for each candidates. Maximum number of candidates for evaluation shall not be more than 10 per day.

Comprehensive Viva-Voce will also be conducted by at least two external examiners. 30 minutes shall be given for each candidates. Maximum number of candidates for this also shall not be more than 10 per day.

Submission of the project report and attending the comprehensive viva are mandatory.

7. PASS MINIMUM FOR EACH COURSE

A candidate securing E grade with 40% of aggregate marks and 40% separately for ESA for each course shall be declared to have passed in that course. A student who fails to secure minimum E grade for a pass in a course is permitted to write the examination for reappearance along with the subsequent batch. Marks obtained for IA in the first appearance shall be retained (irrespective of pass or fail). Appearance for the internal assessment and end semester examination for each course is compulsory and no grade will be awarded unless a candidate appears for both ESA and IA.

8. PASS CONDITION FOR THE WHOLE PROGRAMME AND CLASSIFICATION

A minimum CGPA of 2.4 is required to declare a student to have passed in the programme and the remaining classifications like First class with distinction, First class, Second class etc should be made as per Table No. 2 given in Annexure III.

9. POSITION CERTIFICATES: Position certificates shall be issued to I, II and III position holders based on the overall grade points i.e., CGPA acquired by the students.

10. REAPPEARANCE /IMPROVEMENT EXAMINATION

There shall be examination for reappearance/improvement of grades which shall be conducted in the following way. For those courses in odd semesters, the same shall be conducted in the odd semester of the successive batches and for even semesters, such exams shall take place in the even semester of the successive batches. Those failing in any one course need reappear only in that course. Those who appear for these examinations shall pay the examination fee as prescribed by the university from time to time.

11. IMPROVEMENT OF GRADES

Students who wish to improve the grades in any course after their first successful attempt in that course and secured a complete pass minimum only shall be permitted to reappear for the improvement of grades (for theory examinations only) without cancelling the earlier examination(s). No improvement shall be permitted for practical examinations. Examination for improving the grades may be conducted along with the subsequent batch. Improvement of a particular semester can be done only once. If a candidate fails to appear for the improvement examination after registering or if there is no change in the marks of the improvement examination, then the marks obtained in the first appearance shall be retained.

12. INDIRECT GRADING SYSTEM

Indirect Grading system shall be implemented for this programme, the details of which are given below.

Method of Indirect Grading:
Evaluation (both internal and external) is carried out using Mark system .The grading on the basis of a total internal and external marks will be indicated for each course and for each semester and for the entire programme.

Indirect Grading System in 7 point scale is given in Table No: 1 of Annexure III.

The **Grade Point Average** (G) for each course is calculated using the formula:

G = Actual Marks obtained X 6/ Maximum Marks

In the case of a semester, **Semester Grade Point Average (SGPA)** is calculated as follows:

SGPA = {sum of (GPA x credit) of each course} / (Total credit for that Semester)

While preparing the consolidated grade card at the end of the programme, to calculate the **Cumulative Grade Point Average (CGPA)**, we shall use the formulae:

CGPA for English = {sum of (GPA x credit) of each course in English} / (Total credit of English)

CGPA for Mathematical Sciences (including comprehensive viva and individual project)

= {sum of (GPA x credit) of each course in Mathematics} / (Total credit of Mathematics)

CGPA for the programme = { (CGPA of English x total credit of English) + (CGPA of Mathematics x total credit of Mathematics)} / (Total credit of the Programme)

To classify students on the basis of CGPA, Table No: 2 in Annexure III shall be used.

13. SPECIMEN OF THE GRADE CARD AT THE END-SEMESTER EXAMINATION

An illustrative specimen of the grade card to be issued to the candidates after they complete one semester is given in Table No:3 of Annexure III

In the overleaf of the grade card, interpretation on the grades of each course shown in Table No:1 of Annexure III may be given.

14. SPECIMEN OF THE CONSOLIDATED GRADE CARD AT THE END OF THE PROGRAMME

A consolidated grade card may also be issued to a successful candidate at the end of the programme. A specimen in this regard is given in Table No.4 of Annexure III, where the explanations for the asterisks therein are supplied after the table.

In the overleaf of the consolidated grade card, interpretation on the grades shown in Table No:5 of Annexure III may be given.

15. APPLICATION OF REGULATION FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM FOR UNDER GRADUATE CURRICULUM -2014

The Regulations for undergraduate curriculum under choice based credit and semester system with effect from 2014 will be made applicable to B.Sc. (Honours) in Mathematics programme in relation to the operation of clauses which are not specifically mentioned in this part.

16. Course Structure:-

Semester	Code	Course	Credits	Contact Hours	Max. Marks (Int+Ext)	Min marks for pass
Semester 1	BHM101	Communicative English	4 credits	5 Hrs/week	15+60=75	30
	BHM 102	Foundations of Mathematics	4 credits	5 Hrs/week	15+60=75	30
	BHM 103	Differential Calculus	4 credits	5 Hrs/week	15+60=75	30
	BHM 104	Matrices and Probability Theory	4 credits	5 Hrs/week	15+60=75	30
	BHM 105	Two Dimensional Geometry	4 credits	5 Hrs/week	15+60=75	30
Semester 2	BHM 201	Language through Literature	4 credits	5 Hrs/week	15+60=75	30
	BHM 202	Abstract Algebra and Linear Algebra	4 credits	5 Hrs/week	15+60=75	30
	BHM 203	Integral Calculus	4 credits	5 Hrs/week	15+60=75	30
	BHM 204	Theory of Numbers and Equations	4 credits	5 Hrs/week	15+60=75	30
	BHM 205	Graph Theory and Distribution Functions	4 credits	5 Hrs/week	15+60=75	30
Semester 3	BHM 301	Real Analysis	4 credits	5 Hrs/week	15+60=75	30
	BHM 302	Vector Calculus	4 credits	5 Hrs/week	15+60=75	30
	BHM 303	Ordinary Differential Equations	4 credits	5 Hrs/week	15+60=75	30
	BHM 304	Theory of Sampling and Estimation	4 credits	5 Hrs/week	15+60=75	30
	BHM 305	Advanced Linear Algebra	4 credits	5 Hrs/week	15+60=75	30
Semester 4	BHM 401	Advanced Real Analysis and Metric Spaces	4 credits	5 Hrs/week	15+60=75	30
	BHM 402	Advanced Abstract Algebra	4 credits	5 Hrs/week	15+60=75	30
	BHM 403	Complex Analysis, Fourier Series and Partial Differential Equations	4 credits	5 Hrs/week	15+60=75	30
	BHM 404	Advanced Statistical Techniques	4 credits	5 Hrs/week	15+60=75	30
	BHM 405	Numerical Analysis	4 credits	5 Hrs/week	15+60=75	30
Semester 5	BHM 501	Special Functions	4 credits	5 Hrs/week	15+60=75	30
	BHM 502	Advanced Complex Analysis	4 credits	5 Hrs/week	15+60=75	30
	BHM 503	Advanced Discrete Mathematics	4 credits	5 Hrs/week	15+60=75	30
	BHM 504	Differential Geometry	4 credits	5 Hrs/week	15+60=75	30
	BHM 505	Elective –I	4 credits	5 Hrs/week	15+60=75	30
Semester 6	BHM 601	Mathematical Transforms	4 credits	5 Hrs/week	15+60=75	30
	BHM 602	Topology	4 credits	5 Hrs/week	15+60=75	30
	BHM 603	Operations Research	4 credits	5 Hrs/week	15+60=75	30
	BHM 604	Elective-II	4 credits	5 Hrs/week	15+60=75	30
	BHM 605	Project Work and Viva-Voce	4 credits	5 Hrs/week	15+60=75	30
		Total	**120** credits		2250	900

Elective-I is to be chosen as one of the following courses:

BHM 505 A. Integral Equations and Measure Theory

BHM 505 B. Programming using Scilab

BHM 505 C. Classical Mechanics

BHM 505 D. Mathematical Economics

Elective-II is to be chosen as one of the following courses:

BHM 604 A. Discrete Fourier Analysis

BHM 604 B. Mathematical Finance

BHM 604 C. Calculus of Variations

BHM 604 D. Automata Theory

17. WORKLOAD PER WEEK

Subject	**1and II Sem**	**III and IV Sem**	**V and VI Sem**
English	5 hrs	--	--
Mathematical Sciences	20 hrs	25 hrs	25 hrs
Total	**25 Hrs**	**25 Hrs**	**25 Hrs**

ANNEXURE-III: Tables

Calculation of grades in the case of a course

Table No: 1

% of marks obtained	Grade	Interpretation
90 and above	**A+**	Outstanding
80 to below 90	**A**	Excellent
70 to below 80	**B**	Very good
60 to below 70	**C**	Good
50 to below 60	**D**	Satisfactory
40 to below 50	**E**	Pass
Below 40	**F**	Fail

Table No: 2

CGPA	Grade	Interpretation	Class
5.4 to 6	**A+**	Outstanding	First class with distinction
4.8 to below 5.4	**A**	Excellent	First class with distinction
4.2 to below 4.8	**B**	Very good	First Class
3.6 to below 4.2	**C**	Good	First Class
3 to below 3.6	**D**	Satisfactory	Second Class
2.4 to below 3	**E**	Pass	Pass
Below 2.4	**F**	Fail	Fail

Course Code	Course	Course Credit	Marks obtained							Grade Point Average (G)	Grade
			Internal *	External				Total			
				Theory	Max	Practical	Maximum marks		Max		
BHM XXX	XXX	4	10	50	60	-	-	60	75	4.80	A
BHM XXX	XXX	4	12	-	-	40	60	52	75	4.16	C
BHM XXX	XXX	4	11	42	60	-	-	53	75	4.24	B
BHM XXX	XXX	4	13	50	60	-	-	63	75	5.04	A
BHM XXX	XXX	4	15	56	60	-	-	71	75	5.68	A+
TOTAL		20	61	238				299	375	-	-
SGPA = 4.784 (B)											

Table No: 3

For each course, **GPA(G) = (Marks obtained) x 6 / (Maximum Marks)**

For each Semester, **SGPA = {sum of (GPA x credit) of each course} / (Total credit)**

Table No. 4

Subject	Credit	CGPA	Grade
English	8	*	*(1)
Mathematical Sciences	112	**	**(1)
TOTAL	120	***	***(1)
CGPA for the Programme		***	***(1)
Overall Grade	****	Class	*****

Explanation for the asterisks in Table No. 4:

* This entry is calculated using the formula

CGPA for English = {sum of (GPA x credit) of each course in English} / (Total credit of English)

*(1) Here grade should be assigned based on the calculations given in Table No. 5

** This entry is computed using the formula

CGPA for Mathematical Sciences (including comprehensive viva and individual project) =

{sum of (GPA x credit) of each course in Mathematics} / (Total credit of Mathematics)

**(1) Here grade should be assigned based on the calculations given in Table No. 5

*** To calculate this, we shall use the formula:

CGPA for the Programme = { (CGPA of English x total credit of English) + (CGPA of Mathematics x total credit of Mathematics)} / (Total credit of the Programme)

***(1) Here grade should be assigned based on the calculations given in Table No. 5

**** Here grade should be assigned based on the calculations given in Table No. 2

***** The class here should be recorded as per the last column in Table No. 2

Details regarding the grades and computations shall be given in the overleaf of the grade sheet.

Table No. 5

GPA for the course	Grade	Interpretation
5.4 to 6	**A+**	Outstanding
4.8 to below 5.4	**A**	Excellent
4.2 to below 4.8	**B**	Very good
3.6 to below 4.2	**C**	Good
3 to below 3.6	**D**	Satisfactory
2.4 to below 3	**E**	Pass

BHM 504. DIFFERENTIAL GEOMETRY

Module I(30 Hours)

Chapter 1 Graphs and Level Sets
Chapter 2 Vector Fields
Chapter 3 The Tangent Space

Module II(30 Hours)

Chapter 4 Surfaces
Chapter 5 Vector Fields on Surfaces; Orientation
Chapter 7 Geodesics

Module III(30 Hours)

Chapter 8 Parallel Transport
Chapter 9 The Weingarten Map
Chapter 10 Curvature of Plane Curves

Text Book :John A. Thorpe, Elementary Topics in Differential Geometry, Springer, 1979.

BHM 505. ELECTIVE-I

Elective-I is to be chosen as one of the following courses:

BHM 505 A. Integral Equations and Measure Theory
BHM 505 B. Programming using Scilab
BHM 505 C. Classical Mechanics
BHM 505 D. Mathematical Economics

(See the syllabi of these courses in Annexure-I)

BHM602.TOPOLOGY

MODULE 1 (25 HOURS)

(A quick review of metric spaces)

4.1 Definition of a Topological Space

4.2 Examples of Topological Spaces

4.3 Bases and Sub-bases

4.4 Subspaces

MODULE 2 (25 Hours)

5.1 Closed sets and Closure

5.2 Neighbourhoods, Interior and Accumulation Points

5.3 Continuity and Related Concepts

MODULE 3(20 Hours)

6.1 Smallness conditions on a Space (Excluding the proof of Theorem 1.16)

6.2 Connectedness

MODULE 4 (20 Hours)

7.1 Hierarchy of Separation Axioms

7.2 Compactness and Separation Axioms (Up to Corollary 2.10)

7.3 The Urysohn Characterisation of Normality (statement only)

7.4 Tietze Characterisation of Normality (Statement only)

Text Book: James R. Munkres – *Topology A First Course*, 2nd edition – Prentice Hall of India.

Reference Books:

1. C. Wayne Patty, *Foundations of Topology*, Second Edition – Jones &BartlettIndiaPvt. Ltd., New Delhi, 2012.
2. K. D. Joshi, *Introduction to General Topology*, New Age International (P) Ltd.Publishers.
3. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill.
4. S. Willard, *General Topology* , Addison Wesley Publishing Company.

BHM 603. OPERATIONS RESEARCH

MODULE I (25Hours) – The Simplex Method and Sensitivity Analysis
3.1 LP Model in Equation Form
3.2 Transition from Graphical to Algebraic Solution
3.3 The Simplex Method
3.4 Artificial Starting Solution
3.5 Special Cases in the Simplex Method.
MODULE II (20 Hours) – Duality and Post Optimal Analysis
4.1 Definition of the Dual Problem
4.2 Primal-Dual Relationship
4.3 Economic Interpretation of Duality
4.4 Additional Simplex Algorithms
4.5 Post Optimal Analysis.
MODULE III (20 Hours) – Transportation Model and Its Variants
5.1 Definition of the Transportation Model
5.2 Non Traditional transportation Models
5.3 The transportation Algorithm
5.4 The Assignment Model
5.5 The Transportation Model.
MODULE IV (25Hours)- Network Models
6.1 Scope and Definition of Network Models
6.2 Minimal Spanning Tree Algorithms
6.3 Shortest Route Problem
6.4 Maximal Flow Model
6.5 CPM and PERT
Text:
HAMDY A THAHA OPERATIONS RESEARCH, AN INTRODUCTION, 8TH EDITION, PEARSON PRNTICE HALL
References
1. **J.K.Sharma**(2001).Operations Research Theory and Applications.McMillan New Delhi.
2. **Hadley,G.**(1964).Linear Programming,Oxford&IBH Publishing Company,New Delhi.
3. **KantiSwaroop,P.K. Gupta** et.al**,**(1985),Operation Research,Sultan Chand & Sons.

BHM 604. ELECTIVE-II

Elective-II is to be chosen as one of the following courses:

BHM 604 A. Discrete Fourier Analysis

BHM 604 B. Mathematical Finance

BHM 604 C. Calculus of Variations

BHM 604 D. Automata Theory

(See the syllabi of these Elective courses in Annexure II)

BHM 605. PROJECT WORK AND VIVA-VOCE

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ANNEXURE-I: Electives for the fifth semester

BHM 505 A. INTEGRAL EQUATIONS AND MEASURE THEORY

MODULE I (30 Hours) – INTEGRAL EQUATIONS

Introduction,Relation Between differential and Integral Equation, The Green's Function, Frdholm Equation With Separable Kernels, Illustrative Examples, Hilbert Schmidt Theory, Iterative Methods for Solving Equations of the Second Kind.

(Sections 3.1 – 3.3, 3.6 – 3.11 from the Text 1)

Module – II (20 Hours)

Introduction:Reasons for the development of the Lebesgue integral,comparison with the Riemann integral, the extended realnumber system

Measurable Functions: Introduction – Measurable sets and functions, Combinations – Complex valued functions, functions between measurable spaces.

(Chapter 1, 2 from Text 2)

Module – III(25 Hours)

Measures – Measure Almost everywhere – Charges

The Integral: Simple Functions and their Integrals – The integral of a non-negative extended real-valued measurable function – the Monotone Convergence Theorem – Fatou's Lemma – Properties of the integral

(Chapter3 4 from Text 2)

Module – IV (15 Hours)

Integrable Functions: Integrable real-valued functions – Positivity and linearity of theintegral – The Lebesgue Dominated Convergence Theorem

(Chapter 5 from TextDependence of parameter omitted)

Texts:

1) Francis B. Hildebrand, Methods of Applied Mathematics, Second Edn., PHI

2) Bartle R G : The Elements of Integration and Lebesgue Measure : John Wilwy& sons Inc. 1995

References:

1. Walter Rudin : Principles of Mathematical Analysis : Mc Grow Hill International.
2. Royden : Real Analysis : Pearson
3. T. Apostol: Mathematical Analysis,

ANNEXURE-II: Electives for the sixth semester

BHM 604 A. DISCRETE FOURIER ANALYSIS

MODULE I (20 Hours)

1. Definition and basic properties of Discrete Fourier Transform.
2. Translation invariant linear transformations.

(Chapter 2, Sections 1 and 2 of the text.)

MODULE II (25 Hours)

1. Construction of First Stage Wavelets on Z_N.
2. The iteration step for Wavelets on Z_N.
3. Daubechies's D6 Wavelets on Z_N.

(Chapter 3, Sections 1 and 2 and example 3.35 of the text.)

MODULE III (25 Hours)

1. Spaces $l^2(Z)$ and L^2 ($[-\pi, \pi]$) and Fourier Series.
2. The Fourier Transform and Convolution on $l^2(Z)$.

(Chapter 4, Sections 1 ,3 and 4 of the text.)

MODULE IV (20 Hours)

1. First Stage Wavelets on Z.
2. The iteration step for Wavelets on Z.

(Chapter 4, Sections 5 and 6 of the text.)

Text: An Introduction to Wavelets through Linear Algebra: Michael W. Frazier. (Springer 1999)

Reference: Discrete Fourier Analysis: M.W.Wong. (Birkhauser 2010)

BHM 604 B. MATHEMATICAL FINANCE

MODULE I- (25 Hours)

2.3 Finance (2.3.1-2.3.5 of Text 1)

5.6 Some Applications of Integration (5.6.1-5.6.3 of Text 1)

MODULE II – (20 Hours)

12.4 Linear difference equations (12.4.1- 12.4.3 of Text 1)

10 Consumer Mathematics (10.1 -10.4 of Text 2)

MODULE III – (20 Hours)

6 The Arbitrage Theorem (6.1-6.3 of Text 3)

7 The Black–Scholes Formula (7.1-7.3 of Text 3)

MODULE IV – (25 Hours)

10 Stochastic Order Relations (10.1-10.5 of Text 3)

Texts: 1) Frank Verner and Yuri N Sotskov, Mathematics of Economics and Business, Routledge Publications, 2006.

2) Timothy J Biehler, The Mathematics of Money, The McGraw Hill Company, 2008.

3) SHELDON M. ROSS. An elementary introduction to mathematical finance, Cambridge University Press 2011

BHM 604 C. CALCULUS OF VARIATIONS

MODULE I- The Method of Variations in Problems with Fixed Boundaries.

1. Variation and its properties.
2. Euler's Equation.
3. Functionals Dependent on Several Dependent Variables.
4. Functionals Dependent on Higher Order Derivatives.
5. Functionals Dependent on Several Independent Variables.
6. Variational Problems in Parametric Form.
7. Some Applications.

(Chapter 6, Sections 1 to 7 of the text. **25 Hours**)

MODULE II- Variational Problems with Moving Boundaries.

1. An Elementary Problem with Moving Boundaries.
2. The Moving Boundary Problem for Functionals with Integrand of the form $F(x,y,z,y',z')$.
3. Extremals with Corners.
4. One Sided Variations.

(Chapter 7, Sections 1 to 4 of the text. **25 Hours**)

MODULE III-Sufficient Conditions for an Extremum.

1. Field of Extremals.
2. The Function $E(x,y,p,y')$.
3. Transforming the Euler Equations to the Canonical Form.

(Chapter 8, Sections 1 to 3 of the text. **20 Hours**)

MODULE IV- Variational Problems Involving Conditional Extremum.

1. Constraints of the Form $\varphi(x,y_1,y_2,\ldots,y_n) = 0$.
2. Constraints of the Form $\varphi(x,y_1,y_2,\ldots,y_n, y_1',y_2',\ldots,y_n') = 0$.
3. Isoperimetric Problems.

(Chapter 9, Sections 1 to 3 of the text. **20 Hours**)

Text :**Differential Equations and Calculus of Variations** : L. Elsgolts, MIR Publishers 1970

Reference: Calculus of Variations : I.M.Gelfand and S.V.Fomin

BHM 604 D AUTOMATA THEORY

MODULE –I (25 Hours)

Grammars and Languages: Language basics, Regular expressions, Regular grammars, Context free grammars, context-sensitive grammars, unrestricted grammars, Chomsky hierarchy.

MODULE –II (20 Hours)

Automata: Finite automata, pushdown automata, Pumping Lemmas and Closure properties, Turing machines and recursively enumerable languages.

MODULE –III (25 Hours)

Computability: Computable functions, non-recursively enumerable languages, Undecidability, Rice's theorem, Post's correspondence problem, Undecidability of validity problem of First Order Logic.

MODULE –IV (20 Hours)

Complexity: Asymptotic order symbol, Space and Time complexity, Classes P and NP, NP-completeness, Cook-Levin tehorem, Other NP-complete problems.

Text Books:

1. K. Krithivasan and R.Rama, Introduction to Formal Languages, Automata and Computation, Pearson Education, 2009.
2. A. Singh, Elements of Computation Theory, Springer (In: Texts in Computer Science Series),2009.