Phone :
Grams : NEHU

पूर्वोत्तर पर्वतीय विश्वविद्यालय
पू० प० विवि० परिसर, शिलांग-७९३०२२ (मेघालय)
North-Eastern Hill University
NEHU Campus, Shillong - 793 022 (Meghalaya)

NO:AC:76-3/Conf/2006-286 Dated 2nd December, 2006.

To

All Members
Academic Council
North-Eastern Hill University
Shillong.

Sub: Minutes of the 76th Meeting of the Academic Council.

Sir/Madam,

I am forwarding herewith the Minutes of the 76th meeting of the Academic Council held on 20th November, 2006 for favour of information and comments, if any.

Yours faithfully

IMS Khongwir
Deputy Registrar

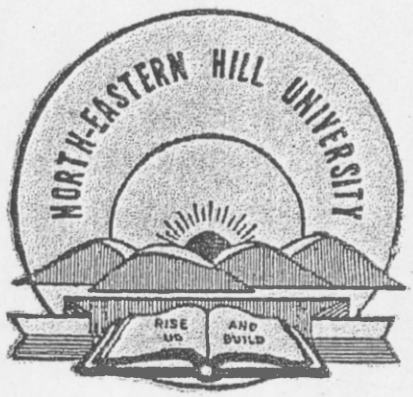
To

_____

_____

_____Member(s)

NORTH EASTERN HILL UNIVERSITY SHILLONG



MINUTES

Seventy Sixth

ACADEMIC COUNCIL MEETING

20th November, 2006

CONTENTS

Contd..2/-

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MINUTES OF THE SEVENTY-SIXTH MEETING OF THE ACADEMIC COUNCIL

The 76th meeting of the Academic Council was held on the 20th of November, 2006 at 1000 Hours in the Science Seminar Hall, Permanent Campus, NEHU, Mawkynroh, Shillong.

MEMBERS PRESENT:

A list of members who attended the 76th meeting of the Council is appended as Appendix-I.

WELCOME:

The Chairman welcomed all the members of the Council especially the new members as per Appendix –II.

APOLOGY:

Apologies were received from Prof. Anil K. Bhatnagar, Prof. A. Henia, Dr. JJ. Mozika and Mr. WS Boney.

ITEM NO.1 **CONFIRMATION OF THE MINUTES**

(i) Confirmation of the Minutes of the 75th meeting of the Academic Council held on 25th May, 2006.

AC:76:2006:1:(i): The Council considered the Minutes of the 75th meeting held on 25th May, 2006 and since no comments were received from the members the Council **RESOLVED** to confirm the same.

ITEM NO.2 **REPORTING ITEMS**

(i) Endowment of Rs.50,000/- of Smti.Chandrakala Sharma and all aspects of other endowments received by the University.

AC:76:2006:2:(i): The Council **considered** the report of the Committee on Endowment of Rs.50,000/- of Smri.Chandrakala Sharma and all aspects of other endowments received by

the University and **RESOLVED** to accept the recommendations of the Committee. The Council, further **RESOLVED** that a Committee be appointed to review all the Ordinances on Endowments and awards.

(ii) Amendment / Clarification on NEHU Ordinance OB-6.

AC:76:2006:2:(ii): The Council **considered** the report of the Committee on amendment / clarification on Ordinance OB-6 and **RESOLVED** to approve the same as per **Annexure– I.** The Council also **RESOLVED** that the same Committee be authorized to make necessary modifications to all the existing relevant proforma on permanent affiliation of colleges and also a regulation on the fee structure and place the matter in the next meeting of the Academic Council. The Council further **RESOLVED** that the Ordinance may be called as the Ordinance on the Affiliation of Colleges and Subjects of Studies.

(iii) Action taken on Report of EC Resolution No.123:2005:7:(ii) based on the resolution adopted in the 74th meeting of the AC vide Resolution No.AC:74:2005:5:8: (v).

AC:76:2006:2:(iii): The Council **considered** the action taken Report on EC Resolution No.123:2005:7:(ii) based on the resolution adopted in the 74th meeting of the AC vide Resolution No.AC:74:2005:5:8:(v).

The Council demanded to know the contents of the confidential letter No.CSE/2006-1113 .012 dated 13th November 2006 sent by Prof. M.M. Singh in order to discuss the matter threadbare.

After going through the said letter and the copy of his earlier letter dated 27th October, 1995 attached with it, the Council **RESOLVED** that the amount along with interest be refunded to Prof. Man Mohan Singh.

The Council further demanded to know whether Prof. Man Mohan Singh had sought the permission of the University to run the Mass Action for National Regeneration, Bharat Jan Gyan Vigyan Jatha as its Executive Secretary, Central Executive Council under the Centre for Science Education.

ITEM NO.3 **RATIFICATION OF ACTION TAKEN BY THE VICE-CHANCELLOR.**

(i) Panel of Examiners for M.Phil/Ph.D. candidates.

AC:75:2006:3:(i): The Council **ratified** the action taken by the Vice-Chancellor in approving the Panel of Examiners for M.Phil/Ph.D. candidates as per list given below.

Sl.No.	Name of candidates	Name of Department	Degree
1.	Shembhalang Kharwanlang	Geography	M.Phil
2.	Roshan Singh	Geography	M.Phil
3.	Periyam Raikham	Geography	M.Phil
4.	Madhuparna Bhattacharjee	Geography	Ph.D.
5.	Prakash Sarma	Geography	Ph.D.
6.	R. Lalmuankima	Geography	Ph.D.
7.	Kamaleswar Kalita	Geography	Ph.D.
8.	Subrata Chakraborty	Geography	Ph.D.
9.	Surajit Barman	Geography	Ph.D.
10.	Mr. L. Robert Verti	Anthropology	Ph.D.
11.	Ms. Chopfoza Cathrine	Anthropology	Ph.D.
12.	Smti. Cornelia Mary Lyngdoh	Chemistry	Ph.D.
13.	Ms. Soma Datta	Physics	Ph.D.

14.	Mr. Pius Varghese	Education	Ph.D.
15.	Biola Shadap	Education	Ph.D.
16.	Ms. Regalia M. Tongper	Education	Ph.D.
17.	Ms. Kelo Leeda R. Marak	Education	Ph.D.
18.	Ms. Baladiangti Nongbri	Education	Ph.D.
19.	Ms. Jova C. Marak	English	Ph.D.
20.	Pauthang Haokip	Linguistics	Ph.D.
21.	Ailynti Nongbri	Khasi	Ph.D.
22.	Mr. Ricky AJ Syngkon	Economics	Ph.D.
23.	Mr. Temzenzulu Jamir	Economics	Ph.D.
24.	Mr. Sumarbin Umdor	Economics	Ph.D.
25.	Mr. Wallamlaibor Lyngkhoi	Economics	Ph.D.
26.	Ms. Shritapa Datta	Zoology	Ph.D.
27.	Mr. Kesham Surjit Singh	Chemistry	Ph.D.
28.	Mr. Iohborlang M. Umlong	Chemistry	Ph.D.
29.	Mr. Wandondor Rynjah	Chemistry	Ph.D.
30	Mahasweta Satpati	Geography	Ph.D.

31.	Synsharlang Kharshiing	Geography	Ph.D.
32.	Amulya Chandra Debneth	Geography	Ph.D.
33.	Bhaben Kalita	Geography	Ph.D.
34.	Benjongtula	Anthropology	Ph.D.
35.	Mr. Sanjay Barbora	Sociology	Ph.D.
36.	Ms. B. Lalrinchhani	History	Ph.D.
37.	Ms. MW Lyngdoh Nongbri	Sociology	Ph.D.
38.	Ms. Rekha M. Shangpliang	Sociology	Ph.D.
39.	Mr. S. Jeeva	Botany	Ph.D.
40.	Ms. KS Nakhuru	Bio-Chemistry	Ph.D.
41.	Ms. Ksh Raseshowri Devi	Botany	Ph.D.
42.	Mr. MG Liangkuwang	Botany	Ph.D.
43.	Ms. Kuheli Beswas	Zoology	Ph.D.

(ii) Panel of Paper Setters/ Examiners.

AC:76:2006:3:(ii): The Council **ratified** the action taken by the Vice-Chancellor in approving Panel of Paper Setters/ Examiners for the following Departments / Semesters.

1. Department of Commerce, M. Com.
   I Semester Examination (New Syllabus)
   for the year 2006.

2. Department of Economics
   I & III Semester Examinations.
   for the year 2006.

3. Department of Library & Information Science
   I & III Semester Examinations.
   for the year 2006.

4. Department of Chemistry, M.Sc.

5. Department of Linguistics, M.A.

(iii) Declaration of Ph.D. / M.Phil. Results.

AC:76:2006:3:(iii): The Council **ratified** the action taken by the Vice-Chancellor in the declaration of Ph.D./M.Phil. results of the following candidates.

Sl.No.	Name of the candidate	Departments	Degree
1.	Ms. Yodida Bhuta	Education	Ph.D.
2.	Mr. Rimanbor J. Cunville	Education	Ph.D.
3.	Ms. Ridalin Paswet	Education	Ph.D.
4.	Mr. Lalmigliana	Education	Ph.D.
5.	Ms. Sunepsungla	Philosophy	Ph.D.
6.	Mr. Prasen Daimari	Economics	Ph.D.
7.	Ms. Bonnie M. Nicol	Zoology	Ph.D.
8.	Mr. Pradip Thakuria	Zoology	Ph.D.
9.	Mr. Dibyendu Adhikari	Botany	Ph.D.

10.	Mr. Anil.Kumar	Botany	Ph.D.
11.	Mr. JC Dang	Zoology	Ph.D.
12.	Mr. Sanjib Ray	Zoology	Ph.D.
13.	Mr. Jag Mohan Singh Tomar	Botany	Ph.D.
14.	Ms. Mainu Goswami	Geography	Ph.D.
15.	Ms. Koseno	Sociology	Ph.D.
16.	Mr. Paochon Tuboi	Sociology	Ph.D.
17.	Ms. Amena Passah	History	Ph.D.
18.	Ms. Alicia Gatphoh	History	Ph.D.
19.	C. Ramhnehzauva	Geography	M. Phil
20.	H. Laldinmawia	Geography	M. Phil

ITEM NO.5 **ACADEMIC MATTERS**

5:1- Statutes, Ordinances, Regulations & Rules

(i) Constitution of Board of Studies for Professional Courses in Law.

AC:76:2006:5:1:(i): The Council **RESOLVED** to amend Ordinance OA-13 by inserting "as well as outside the school" in Clause 2 (iv).

(ii) Convening of Local School Board meeting: Provisions in NEHU Ordinance.

AC:76:2006:5:1:(ii): The Council considered the Convening of local School Board meetings and **RESOLVED** to constitute a Committee to go into the relevant Ordinances and Regulations.

5:2- Syllabus

(i) M.Ed.Syllabus of Education Department.

AC:76:2006:5:2:(i): The Council considered the M.Ed. Syllabus of Education Department and **RESOLVED** to approve the same as per **Annexure- II,** subject to the dissertation made compulsory as per the Ordinance (OC-6). **RESOLVED** that a Committee would go into the Ordinance OC-6 to review its provisions and recommend amendments if felt necessary.

(ii) MA Syllabus of Philosophy.

AC:76:2006:5:2:(ii): The Council considered the MA Syllabus of Philosophy and **RESOLVED** to approve the same as per **Annexure-III** . Repeaters who have already appeared in the examinations should be taken care of.

(iii) Revised Syllabus for M.Sc. Mathematics.

AC:76:2006:5:2:(iii): The Council considered the revised Syllabus for M.Sc. Mathematics and **RESOLVED** to approve the same as per **Annexure-IV**. However, objective type questions are to be specified in the Syllabus paper-wise. The proposal on Choice-Based Credit System of Mathematics Department was not considered. It would be considered later together with the University as a whole.

(iv) Syllabus of the integrated Course /M.Sc. in Environmental Sciences.

AC:76:2006:5:2:(iv): The syllabus could not be approved in the absence of relevant ordinance. The Council **RESOLVED** to constitute a committee to frame an ordinance on 5-year integrated courses.

(v) Course on Law : Course No.4:2 History II (Legal and Constitutional History).

AC:76:2006:5:2:(v): The Council considered the Course on Law : Course No.4:2 History II (Legal and Constitutional History) and **RESOLVED** to approve the same as per **Annexure-V.**

(vi) Draft Syllabus for B.Sc.(Honours) Microbiology.

AC:76:2006:5:2:(vi): The Council considered the draft Syllabus and for B.Sc. (Honours) in Microbiology and **RESOLVED** to approve the same as per **Annexure-VI.** However, the text books for the subject be properly identified.

(vii) Revised Syllabus for B. Tech.
&
(viii) Syllabus for Electronics and Communication Engineering.

AC:76:2006:5:2:(vii)& (viii): The Council considered the revised Syllabi for B. Tech in Information Technology; Electronics and Communication Engineering and **RESOLVED** that a Committee be constituted with the following members to examine the Syllabi.

1. Prof. HK Mukherjee
2. Prof. Kamal Kumar
3. Prof. YS Jain
4. Prof. A. Chaterjee
5. Prof. BK Tiwari
6. Prof. NM Panda
7. Dr. L. Joyprakash Singh
8. Mr. Somnath Tripathi
9. Dr. AK Das
10. Prof. K. Ismail - Convener

Council further **RESOLVED** that the recommendations of the Committee be made available before the winter vacation and the Chairman was authorized to approve the syllabi after necessary corrections have been made.

5:5- Examination Matters

(i) Re-admission to PG Programmes.

AC:76:2006:5:5:(i): The Council considered the re-admission to PG Programmes of Maibam Chitrasen, a student of M.Sc. in Mathematics of 2003-05 batch and **RESOLVED** that his admission be cancelled as there is no provision in rules.

2: - **REPORTING ITEM:**

(ii) Amendment/Clarification on NEHU Ordinance OB-6.

A Committee was constituted vide resolution No:AC:74:2005:5:7:(ii) under the Chairmanship of Prof. K.Ismail, to look into the Amendment/ Clarification of NEHU, Ordinance OB-6.

The Committee met on 19.5.2006, 10.10.2006 and 16.11.2006, the minutes and report of the Committee is placed at Annexure 'A' & 'B' respectively for consideration of the Council.

Annexure 'A'

Minutes of the meetings of the Committee constituted to look into the Amendment/Clarification on NEHU Ordinance OB-6

The committee first met on May 19, 2006 and identified the difficulties faced during the processes of inspection and affiliation of colleges. The lack of clarity in some of the clauses of the Ordinance OB-6 was also identified. The committee carefully examined each clause of the Ordinance and drafted various modifications.

The committee met again on October 10, 2006 and continued examining the Ordinance and proposing modifications. The committee authorized Prof. K. Ismail and Prof. Nikhilesh Kumar to work out further details.

Prof. K. Ismail and Prof. Nikhilesh Kumar after a number of sittings brought out the details for consideration of the committee.

The committee met once again on November 16, 2006 and decided to recommend to the Academic Council the draft amendments to the Ordinance OB-6 for its consideration and approval. The committee further decided to make the following recommendations:

(i) In the modified Ordinance OB-6 the matters related to permanent affiliation are incorporated in the Ordinance itself by shifting them from Regulation RB-7. Therefore, the Regulation RB-7 on Permanent Affiliation be dispensed with.

(ii) The particulars regarding fees are proposed to be shifted from the existing Ordinance as Regulation under the title, "Regulation on Affiliation and Other Related Fees". It is proposed that these matters related to fees be put as Regulation RB-7. Such a step would facilitate the working of the Ordinance OB-6 as any future revisions in such matters related to fees could easily be incorporated in the Regulation without amending the Ordinance itself.

(iii) The various prescribed proforma that are referred in the Ordinance require corresponding modifications. This committee may be authorized to bring in necessary modifications in the existing proforma and introduce new proforma, if necessary, and to submit it to the Chairman, Academic Council.

16/11/06

(Prof. K. Ismail)	(Prof. Nikhilesh Kumar)	(Prof. N. K. Chungoo)	Dy. Registrar (Conf)
Chairman	Member 16/11/06	Member	Convener

Annexure 'B'

NORTH – EASTERN HILL UNIVERSITY ORDINANCES

ON THE AFFILIATION OF COLLEGES OB – 6

(Under Section 26 (1) (q) of the NEHU ACT, 1973
read with Clause (1) through Clause (6) of Statute 33)

Existing				Proposed			
Affiliation Committee	1.	(1)	The Academic Council shall constitute an Affiliation Committee for Colleges / Institutions under the University. The composition of the Committee shall be as follows: (i) Vice-Chancellor or Pro- Vice-Chancellor - Chairman (ii) Director of Public Instruction/Higher Education or his nominee of the State(s) concerned - Member(s) (iii) Two nominees of the Academic Council - Members (iv) Controller of Examinations - Member (v) Director. CDC - Member-Secretary	**Affiliation Committee**	1.	(1)	The Academic Council shall constitute an Affiliation Committee for colleges / institutions/subjects/ courses of study under the University. The composition of the Committee shall be as follows: (i) Vice-Chancellor or Pro- Vice-Chancellor - Chairman (ii) Director of Public Instruction/Higher Education or her / his nominee of the State(s) concerned - Member (iii) Two nominees of the Academic Council - Members (iv) Controller of Examinations - Member (v) Director. College Development Council (CDC) - Member-Secretary

Existing				Proposed			
Powers and Functions		(2)	The Affiliation Committee shall be the main body to scrutinize the applications for affiliation and recommend to the Academic Council affiliation of Colleges/ Institutions. Withdrawal of affiliation if any, of Colleges/ Institutions, shall also be recommended by the Affiliation Committee.	**Powers and Functions** ~~Meetings~~ ~~Quorum~~		(2) (3)	The Affiliation Committee shall be the main body to scrutinise the applications for affiliation and recommend to the Academic Council affiliation of colleges / institutions / subjects/ courses of study. Withdrawal of affiliation, if any, of colleges / institutions/ subjects/ courses of study, shall also be recommended by the Affiliation Committee.
Meetings		(3)	The Affiliation Committee shall meet as and when necessary.	Meetings		(3)	No Change
Quorum		(4)	The Quorum for the meeting of the Committee shall be one-third of its total membership.	Quorum		(4)	No Change
Degree Colleges	2.		The Colleges for the purpose of the Ordinance shall be Degree Colleges including the professional ones, providing instructions for relevant degree courses (General/Honours/ Professional courses).	**Degree College / Institution**	2.	(1)	The College/Institution for the purpose of this Ordinance shall be Degree College / Institution providing instructions in subjects / courses of study for relevant degrees.
			Admission to the privileges of the University for various courses leading to a particular degree shall be decided separately.	**Admission to the Privileges of the University**		(2)	Admission of a college / institution (providing instructions in subjects / courses of study for relevant degrees) to the privileges of the University shall mean Affiliation for the purposes of this Ordinance and related Regulations.
				Affiliation of a Subject / Course of Study		(3)	Admission to the privileges of the University for various subjects / courses of study leading to a relevant degree (General/ Honours/ Professional) shall mean Affiliation and shall be granted as per this Ordinance and related regulation.
				Stages of affiliation of a college / institution / subject / course of study		(4)	Affiliation of a college / institution / subjects / courses of study as per the provisions of this Ordinance and related regulation shall be granted in two stages: (a) provisional affiliation; and (b) permanent affiliation.

Existing				Proposed			
Starting a New College/ Institution/ Course	3.	(1)	When it is proposed to start a new college/ institution/course, the sponsoring body, or in the case of a Government College/Institution, the Head of the College / Institution / sponsoring authority concerned, shall submit an application to the Registrar / Director, CDC in a prescribed form not later than August 15 of the preceding year in which it is intended to start the college / institution / course. The application shall be accompanied by a project report giving details along with required fees as laid down hereunder.	**Starting a New College / Institution**	3.	(1)	When it is proposed to start a new college/ institution, the sponsoring body, or in the case of a Government college/institution the authority concerned, shall submit an application to the Registrar on the prescribed proforma not later than August 15 of the preceding year in which it is intended to start the college / institution. The application shall be accompanied by a project report giving details along with the required fees.
Initial Screening of the application		(2)	On the receipt of the application along with prescribed fees, the Affiliation Committee shall scrutinize the application and may seek further clarification, if necessary, from the sponsoring body in writing. If the Committee is satisfied with the project report and having found that there is a prima facie case for starting a new college/institution, then it shall recommend constitution of an inspection team. The inspection team shall comprise of not less than three members including the Director of Public Instruction / Higher Education of the State concerned or his nominee and the subject expert(s). The Convener of the Inspection Team shall be a person not below the rank of Professor.	**Initial Screening of the Application** **Inspection Team**		(2) (3)	On receipt of application along with the prescribed fees, the Affiliation Committee shall scrutinise the application and may seek further clarifications, if necessary, from the sponsoring body / authority concerned in writing. If the Committee is satisfied with the project report and having found that there is a prima facie case for starting a new college / institution, then it shall recommend constitution of an Inspection Team. The Inspection Team shall comprise of not less than three members including the Director of Public Instruction / Higher Education of the State concerned or her / his nominee and the subject expert(s). The Convener of the Inspection Team shall be a person not below the rank of Professor.

Existing				Proposed			
Inspection Team		(3)	The Inspection Team shall take necessary steps to examine the request, inspect the site and submit its report on the need for the proposed college / institution / course, the suitability of the site, feasibility of the plan submitted, the adequacy of physical and financial resources offered, library/laboratory facilities and submit the necessary recommendations to the Affiliation Committee. If the Affiliation Committee is satisfied with the report, it shall recommend to the Academic Council for permission to start a College / institution / course.	**Inspection**		(4)	The Inspection Team shall submit its recommendations, on the prescribed proforma within 15 days of the visit, to the Affiliation Committee on the need for the proposed college / institution after inspecting the site. The Inspection Team shall verify the suitability of the site, feasibility of the plan submitted, the adequacy of physical and financial resources offered, library/laboratory facilities and other requirements as prescribed in the proforma. If the Affiliation Committee is satisfied with the report, it shall recommend to the Academic Council for consideration of the application to start the college / Institution. The Academic Council shall send its recommendations to the Executive Council for grant of permission.
Preliminary Steps by the Sponsoring Agency for Provisional Affiliation		(4) 1.	On receipt of permission to open a college/ institution or to start a new course, the sponsoring agency shall make all necessary preparations. If a new college/institution is to be opened, steps shall be taken to constitute a Governing Body and make appointment of the Principal / Director and other teaching and non-teaching staff as the case may be, in accordance with provisions of the Statutes, Ordinances and Regulations. If a new course is to be started in any existing college/ institution, necessary arrangements in terms of physical facilities, library and laboratory equipment shall be made along with appointment of teaching/non-teaching staff required for the purpose.	**Preliminary Steps by the Sponsoring Agency / Authority Concerned for Provisional Affiliation**		(5)	On receipt of permission to open a college / institution, the sponsoring agency / authority concerned shall constitute a Governing Body and make appointment of the Principal / Director and other teaching and non-teaching staff as the case may be, in accordance with provisions of the Statutes, Ordinances and Regulations of the University.
		2.	The college / institution seeking provisional affiliation should have a regular and qualified Principal, teaching and non-teaching staff as per University norms.				Delcted

Existing				Proposed			
Application for Provisional Affiliation		(5)	The sponsoring agency, having made all arrangements and preparations to open a college / institution or to start a new course(s) in the existing college / institution shall inform the University forthwith about the appointment and about the fact that the college / institution / course has started not later than 15 days after the beginning of the academic session and shall make an application to the University for provisional affiliation.	**Application for Provisional Affiliation**		(6)	The Principal / Director of the new college / institution shall apply to the University on the prescribed proforma along with the prescribed fee for provisional affiliation of the proposed subject(s) / course(s) of study.
Grant of Provisional Affiliation		(6)	The Chairman of the Affiliation Committee shall constitute either a fresh Inspection Team or send the same team (the one on whose report permission was granted) to visit the college/institution on any working day in the first academic session latest by 31st October and submit a report in the form as may be prescribed in the Regulations. The Affiliation Committee after receiving the report will forward the same to the Academic Council along with its comments and observations. If the Academic Council is satisfied with the report, it may grant provisional affiliation for a period of three years only. Affiliation may ordinarily be granted in the first instance, to start general level courses. Provided that in the case of a college/institution sponsored by the Government or by an Educational Society of repute, affiliation may be granted to general and major level/professional courses simultaneously.	**Grant of Provisional Affiliation**		(7)	The Chairman of the Affiliation Committee shall constitute an Inspection Team to inspect the college / institution. The Inspection Team shall submit its recommendations on the prescribed proforma, within 15 days of the visit, to the Affiliation Committee. The Affiliation Committee after receiving the report shall forward the same to the Academic Council along with its comments and observations. If the Academic Council is satisfied with the report, it may recommend to the Executive Council for grant of provisional affiliation for a period of not more than three years.
				Inspection Team for Provisional Affiliation		(8)	The Inspection Team for inspecting a college / institution for the purpose of provisional affiliation shall comprise of not less than three members including subject expert(s). The Convener of the Inspection team shall be a person not below the rank of Professor.

Existing				Proposed			
Renewal of Provisional Affiliation	4.	(1)	Provisional affiliation to a college/institution shall be granted for a period not exceeding three years at a time. Request for renewal shall be submitted in the prescribed form six months before the expiry of the period of provisional affiliation. If a college/institution does not apply for renewal of affiliation well within the period of provisional affiliation, the affiliation granted shall stand terminated automatically.	**Application for Renewal of Provisional Affiliation**	4.	(1)	Request for renewal of provisional affiliation shall be submitted to the Registrar on the prescribed proforma, along with required fee, six months before the expiry of the period of provisional affiliation. If a college / institution does not apply for renewal within the period stipulated above, the affiliation granted shall stand terminated automatically on the expiry of the period of provisional affiliation. Provisional affiliation to a college / institution shall be renewed for a period of not more than three years at a time.
		(2)	The Chairman of the Affiliation Committee shall constitute an Inspection Team to report on the request for renewal. The Inspection Team shall visit the college, review its progress and performance in general and submit a report along with its recommendations for renewal/withdrawal of provisional affiliation. The Affiliation Committee after reviewing the report, shall forward the same to the Academic Council along with its comments for necessary action.	**Grant of Renewal of Provisional Affiliation**		(2)	The Chairman of the Affiliation Committee shall constitute an Inspection Team to inspect the college / institution. The Inspection Team shall submit its recommendations on the prescribed proforma, within 15 days of the visit, to the Affiliation Committee. The Affiliation Committee after receiving the report shall forward the same to the Academic Council along with its comments and observations. If the Academic Council is satisfied with the report, it may recommend to the Executive Council for the renewal of provisional affiliation for a period of not more than three years at a time.
				Inspection Team for Renewal of Provisional Affiliation		(3)	The Inspection Team for inspecting a college / institution for the purpose of renewal of provisional affiliation shall comprise of members as given in clause 3: (7) above.
Inspection	5.		Every college/institution admitted to the privileges of the University shall be inspected as per the provision laid down in the Statutes / Ordinanaces/ Regulations.				**SHIFTED AS CLAUSE 8**

Existing				Proposed			
Permanent Affiliation	6.	(1)	A college/institution which has been granted provisional affiliation, after the lapse of the stipulated period as prescribed in the Regulation, may apply for permanent affiliation which may be considered by the Executive Council on the basis of recommendation of the Academic Council, if the college has been enjoying temporary affiliation for ten years or more.	**Application for Permanent Affiliation**	5.	(1)	A college/institution which has been granted provisional affiliation, after the completion of ten years of its unconditional affiliation to the university, may apply for permanent affiliation to the Registrar on the prescribed proforma with the required fee.
				Grant of Permanent Affiliation		(2)	The Chairman of the Affiliation Committee shall constitute an Inspection Team to inspect the college / institution. The Inspection Team shall submit its recommendations on the prescribed proforma, within 15 days of the visit, to the Affiliation Committee. The Affiliation Committee after receiving the report shall forward the same to the Academic Council along with its comments and observations. If the Academic Council is satisfied with the report, it may recommend to the Executive Council for grant of permanent affiliation.
				Inspection Team for Permanent Affiliation		(3)	The Inspection Team for inspecting a college / institution for the purpose of grant of permanent affiliation shall comprise of members as given in clause 3: (7) above.
				Application for Starting a new subject / course of study by an affiliated college / institution	6.	(1)	When a college / institution proposes to start instructions in a new subject / course of study for relevant degree, it shall submit an application for permission to the Registrar on the prescribed proforma along with the required fee.

Existing				Proposed			
				Initial Screening of the Application		(2)	On receipt of application along with the prescribed fee, the Director, CDC shall scrutinise the application and may seek further clarifications, if necessary, from the college / institution in writing. Having satisfied herself / himself the Director, CDC, with the approval of the Chairman of the Affiliation Committee, may grant permission to start the new subject / course of study with clear instructions that the college / institution takes necessary steps to fulfill all the requirements under the provisions of the relevant Ordinances and Regulations of the University in this regard.
				Application for provisional affiliation to the new subject / new course of study		(3)	The college / institution, having made all arrangements and preparations to start the new subject / course of study shall apply to the Registrar on the prescribed proforma for provisional affiliation.
				Grant of provisional affiliation to the new subject / new course of study		(4)	The Chairman of the Affiliation Committee shall constitute an Inspection Team, as given in clause 3: (7) above, to inspect the college / institution. The Affiliation Committee after receiving the report will forward the same to the Academic Council along with its comments and observations. If the Academic Council is satisfied with the report, it may recommend to the Executive Council for grant of provisional affiliation for a period of three years only.
				Application for Permanent affiliation to a provisionally affiliated subject / course of study in a permanently affiliated college / institution	7.	(1)	A college / institution which has been granted permanent affiliation may apply for permanent affiliation to a provisionally affiliated subject / course of study after the completion of five years of its unconditional affiliation to the University.

Existing				Proposed			
				Grant of Permanent Affiliation to a provisionally affiliated subject / course of study in a permanently affiliated college / institution		(2)	The Chairman of the Affiliation Committee shall constitute an Inspection Team to inspect the college / institution. The Inspection Team shall submit its recommendations on the prescribed proforma, within 15 days of the visit, to the Affiliation Committee. The Affiliation Committee after receiving the report shall forward the same to the Academic Council along with its comments and observations. If the Academic Council is satisfied with the report, it may recommend to the Executive Council for grant of permanent affiliation.
				Inspection Team for Permanent Affiliation to a provisionally affiliated subject / course of study in a permanently affiliated college / institution		(3)	The Inspection Team for inspecting a college / institution for the purpose of grant of permanent affiliation shall comprise of members as given in clause 3: (7) above.
				Inspection	8		Every college/institution admitted to the privileges of the University shall be inspected as per the provisions laid down in the Statutes / Ordinanaces/ Regulations.
Power to lay down new conditions		(2)	The Executive Council may, from time to time, lay down new conditions for affiliation (general or specific, regarding staff, building, equipment, library, laboratories, finance or other relevant matters) and specify the date by which these conditions must be satisfied, failing which the college/institution may not be allowed to enjoy the privileges of the University.	**Power to lay down New Conditions**	9		The Executive Council may, from time to time, lay down new conditions for affiliation (general or specific, regarding staff, buildings, equipments, library, laboratories, finance or other relevant matters) and specify the date by which these conditions must be satisfied, failing which the college/institution may not be allowed to enjoy the privileges of the University.

Existing				Proposed			
Admission of Students		(3)	No student shall be admitted to any college/ institution/course of study before permission to start classes is granted by the University. Breach of this rule may invite refusal of any permission to the college/institution.	**Admission of Students**	10		No student shall be admitted to any college/ Institution / subject / course of study before permission is granted by the University. Breach of this rule may invite refusal of any permission to the college / institution.
Affiliation and Other fees		(4)	A sponsoring Agency seeking permission to open a new college/institution or start a new course(s) seeking provisional/permanent affiliation shall deposit the reserve fund and pay the fees as specified below:- (i) Fees for permission to open a new college/ institution - Rs. 15,000/- (ii) Fees for renewal of provisional affiliation/ permanent affiliation - Rs. 5,000/- (iii) Fees for permission to open a new course/subject Rs. 3,000/- per course. (iv) All colleges/institutions affiliated permanently have to deposit affiliation fee of Rs. 5,000/- after every three years. (v) Annual enrolment fee @ Rs. 10/- per student on rolls as on the closing day of admission of the year. (vi) Reserve fund in long term deposits in the name of the college for period of at least 5 years. For General stream - Rs. 4,00,000/- For Major stream - Rs. 5,00,000/- Provided that the Government college/institutions are exempted from depositing the reserve fund.	**Affiliation and Other Fees**	11		As specified in the relevant Regulation

Existing				Proposed			
	7.		The Executive Council shall have the power to withdraw any affiliation or permission from a college/institution at any time whenever, in the opinion of the Executive Council, the college/institution has failed to comply with the Rules, Regulations, Statutes, Ordinances or any other directives of the University, or if the College authorities have failed to maintain order and discipline in the College or the normal regular and proper functioning of the College has become impossible due to mismanagement of the affairs of the college or any other reasons including non-payment of affiliation fee etc.	**Power to Withdraw Permission or Any Affiliation from a College / Institution**	12.		The Executive Council shall have the power to withdraw permission or any affiliation from a college/institution at any time whenever, in the opinion of the Executive Council, the college/institution has failed to comply with the Statutes, Ordinances, Regulations, Rules or any other directives of the University, or if the college / institution has failed to maintain order and discipline in the college / institution or the normal regular and proper functioning of the college / institution has become impossible due to mismanagement of the affairs of the college / institution or for any other reasons including non-payment of affiliation fee etc.
Dissolution of a College/institution/ Course of study	8.	(1)	No college/institution/course of study shall be dissolved or abolished by its 'Governing Body' or Advisory Committee without making prior arrangement for admission of its students in another affiliated college(s) and without making alternative arrangement for the employment of the permanent members of the staff and also without obtaining prior approval of the Academic Council, Executive Council, the State Government, and the University Grants Commission. Provided that no college/institution/course of study shall be dissolved/abolished in the midst of an academic session.	**Dissolution of a College /Institution / Subject / Course of Study**	13.		No college/institution/subject/course of study shall be dissolved/ abolished/ suspended by the 'Governing Body' or Advisory Committee of the college / institution without making prior arrangements for admission of its students in another affiliated college(s) / institution(s) and without making alternative arrangements for the employment of the permanent members of the teaching an other staff and also without obtaining prior approval of the Academic Council, Executive Council, the State Government, and the University Grants Commission. Provided that no college / institution/subject/course of study shall be dissolved/abolished/ suspended in the midst of an academic session.
Removal of Difficulties	9.		Any difficulty arising in interpretation of, giving effect to, any provisions of this Ordinance, shall be referred to the Vice-Chancellor, whose interpretation or decision thereon shall be final.	**Removal of Difficulties**	14.		Any difficulty arising in interpretation of, giving effect to, any provisions of this Ordinance, shall be referred to the Vice-Chancellor, whose interpretation or decision thereon shall be final.

RB-7

REGULATION ON AFFILIATION AND OTHER RELATED FEES

1. **Fee for Permission / Affiliation**: Sponsoring Agency / Authority Concerned / College / Institution shall pay the fees as specified below:

   (i) Fees for permission to open a new college/ institution: Rs. 15,000/-

   (ii) Fees for provisional affiliation to new subject(s) / course(s) of study: Rs. 3,000/- per subject / course of study

   (iii) Fees for renewal of provisional affiliation: Rs. 5,000/-

   (iv) Fees for permanent affiliation: Rs. 5,000/-

   (v) All colleges / institutions affiliated permanently have to deposit affiliation fee of Rs. 5,000/- after every three years.

2. **Annual Enrolment** Fee: Colleges / institutions shall pay annual enrolment fee @ Rs. 10/- per student on rolls as on the closing day of admission of that year.

3. **Reserve Fund**: Colleges / institutions shall deposit in Bank(s) reserve fund in the name of the college / institution for a period of at least 5 years as specified below:

For General stream:	Rs. 4,00,000/-
For Honours stream:	Rs. 5,00,000/-
For Professional stream:	Rs. ? (to be decided in A.C.)

Government colleges / institutions are exempted from depositing the reserve fund.

5:2: - **Syllabus:**

(i) M.Ed. Syllabus of Education Department.

The School Board in Humanities and Education in its meeting held on 16.10.06 approved in principle the M.Ed. Syllabus of Education as suggested by the members as Annexure 'A'

The matter is placed before the Council for consideration.

DEPARTMENT OF EDCUATION
NEHU, SHILLONG

REVISED M.Ed SYLLABUS

The one year M.Ed programme, spread over Two Semesters, shall consist of eight courses as given below:

SEMESTER – I

M.Ed: 101 Foundations of Education

M.Ed: 102 Educational Psychology

M.Ed: 103 Methodology of Educational Research

M.Ed: 104 System of Teacher Education in India

SEMESTER – II

M.Ed: 201 Theory and Practice of Teaching

M.Ed: 202 Educational Testing

M.Ed: 203 Option –I (Any one of the following)

- 203.1 Science Education
- 203.2 Environmental Education
- 203.3 Pre - School Education
- 203.4 Experimental Education
- 203.5 Educational Administration and Management

M.Ed: 204 Option–II (Any one of the following)

- 204.1 Dissertation
- 204.2 Educational Planning and Finance
- 204.3 Special Education for Gifted and Mentally Challenged
- 204.4 Economics of Education
- 204.5 Curriculum Development
- 204.6 Educational and Vocational Guidance

M.Ed: 101 FOUNDATIONS OF EDUCATION

Unit I. Philosophical Foundations

- Nature of Philosophy and its Relationship with Education
- Meaning & Scope of Philosophy of Education
- Functions of Philosophy of Education
- Aims of Education in Relation to Philosophy Life

Unit II. Schools of Educational Philosophy

Philosophy & Educational Implications of the following Schools:

- Indian Schools : Vedanta, Samkhya, Nyaya & Buddhism,
- Western Schools : Existentialism, Dialectic Materialism, Logical Positivism

Unit III. Knowledge, Values and Education

- Concept, Sources & Forms of Knowledge
- Criterion of Knowledge
- Philosophical Bases of Curriculum
- Concept and Heirarchi of Values
- Theories of Values: Subjective & Objective
- Role of Education in Values Formation

Unit IV. Sociological Foundations

- Meaning & Scope of Sociology of Education
- Functions of Education from Sociological Perspectives
- Education as a Factor of Social Stratification and Social Mobility
- Concept of Culture, Education as a Process of Enculturation
- Conservative and Creative Functions of Education for Cultural Enrichment
- Concept & Impact of Sanskritization, Westernization and Globalization on Education

Unit V. Education, Social Change and Development

- Concept and Factors of Social Change and Modernization
- Education as an Instrument of Social Change and Modernization
- Concept and Indicators of Development
- Role of Education in Social, Political and Economic Development
- Equality Vs Equity in Education

SUGGESTED READINGS

1. Arkara Jacob — ***Education in Sociological Perspective, Rawat Publication, Newe Delhi, 2004***
2. Blake, Nigel et; al — ***The Philosophy of Education, Blackwell Publishers Ltd., Oxford U.K, 2003***
3. Blackledge, D. & Hunt, Barry — ***Sociological Interpretations of Education***, London, Groom Helm, 1985.
4. Brubacher, R. S. — ***Modern Philosophies of Education***, Chicago, University Press. 1955.
5. Chanda S. S. & Sharma R.K. — ***Sociology of Education***, New Delhi, Atlantic Publishers, 2002.
6. Chandra, S.S. — ***Sociology of Education***, Guwahati, Eastern Book House, 1996.
5. Curren Randall (Edited) — ***A Companion to Philosophy of Education***, New York Blackwell Publishing. 2003.
6. Cook L, A. & Cook,E. — ***Sociological Approach to Education***, New York, McGraw Hill, 1970.
7. Dewey, J. — ***Democracy and Education: An Introduction into Philosophy of Education***, New York, The Free Press, 1966
8. Durkheim, E. — ***Education and Sociology***, New York, The Free Press, 1966.
9. Heyting, Frieda (Edited) — ***Methods in Philosophy of Education***, London, Routledge, 2001
10. Hemlata, T. — ***Sociological Foundations of Education***, New Delhi, Kanishka Publishers, 2002
11. Jayaram, — ***Sociology of Education***, New Delhi, Rawat, 1990
12. Kneller, G. F. — ***Introduction to Philosophy of Education***, New York, John Witty & Sons, 1971.
13. Luther, M.N. — ***Values and Ethics in School Education***, New Delhi, Tata McGraw Hill, 2001.
14. Moon, Bob (Edited) — ***International Companion to Education***, London, Routledge, 2000.
15. Mukherjee, R. K. — ***Ancient Indian Education***, Delhi, Motilal Banarasidas, 1974.
16. Pandey, R. S. — ***An Introduction to Major Philosophies of Education***, Vinod Pustak Mandir. Agra, 1996.
17. Pandey R.S. — ***Development of Indian System of Education*** Vinod Pustak Mandir. Agra, 2003.
18. Shah BV & Shah KV — ***Sociology of Education, Rawat Publications*** Jaipur, 1998.
19. Sharma A.P. — ***Development of Western Educational Thoughs***, Concept Publication, New Delhi, 2001.
20. Sharma Mani — ***Educational Practices of Classical Indian Philosophies***, H.P. Bhargava Book Hosue, Agra, 2005
21. Shukla, S. & K. Kumar — ***Sociological Perspective in Education***, New Delhi, Chanakya Publication, 1985.

M.Ed: 102 EDUCATIONAL PSYCHOLOGY

Unit I. Introduction to Educational Psychology and Human Development

- Educational Psychology: Concept and Scope
- Various Schools of Psychology and their Relevance to Education
- Human Development: Principles of Growth and Development,
- Piaget's Theory of Cognitive Development.

Unit II. Psychology of Learning

- Concept and Kinds of Learning, Gagne's Hierarchy of Learning, Tolman's Sign-Significate Theory, Hull's Reinforcement Theory of Learning
- Motivation and Motivators in Learning
- Methods and Techniques of Evaluating the Outcome of Learning
- Recent Developments and their Application in Learning Situation

Unit III. Intelligence and Creativity

- Intelligence: Meaning and Development,
  Spearman's Two-Factor Theory; Structure of Intellect by Guilford,
  Emotional Intelligence: Meaning, Objectives and Development
- Creativity: Meaning and Process,
  Fostering Creativity in Children,
  Problems when Creativity is repressed

Unit IV. Personality and Adjustment

- Personality: Determinants of Personality,
  Psycho-Analytical Theories of Personality (Freud, Jung & Adler)
  Personality and Behaviour of Teacher in the Classroom
- Adjustment: Concept of Maladjustment; Mechanisms of Adjustment;
  Mental Health of a Teacher,
  Causes of Teacher Maladjustment & its Improvement

Unit V. Group Dynamics

- Group Dynamics: Group Process, Interpersonal Relations
- Sociometric Grouping
- Social – Emotional Climate of the Classroom and
- Influence of Teacher Characteristics

Practicals (To be evaluated internally)

(Select atleast two)

- Mirror Drawing
- Maze Learning
- Span of Attention
- Span of Memory

SUGGESTED READINGS

1. Benthanr Susan — ***Psychology and Education, Rautledge Publication, New York, 20002***
2. Bhatnagar S. — ***Advanced Educational Psychology,*** Agra, Bhargava Book House, 2002.
3. Bron R.A. Allyn & Bacon — ***Essentials of Psychology,*** Guwahati, Nivedita DK Distributors. 2002.
4. Chand T — ***Educational Psychology,*** Agra, Bhargava Book House, 2002.
5. Crow, R.B. & Crow, A. — ***Educational Psychology,*** New Delhi, Eurasia Publishing House, 1964.
6. Dececee, J. P. — ***The Psychology of Learning & Instruction,*** New Delhi, Prentice Hall, 1970.
7. Dhir R.N. — ***Educational Psychology,*** Chandigarh, Abhishek Publication, 2002.
8. Elliet, Knatochwill Trauers, Cook L — ***Educational Psychology: Effective Teaching, Effective Learning, McGrow-Hill, 2000***
9. Gagne, R. M. — ***The Conditions of Learning*** (2nd edition) New York, Rinehart &Winston, 1976.
10. Guilford, J.P. — ***The Nature of Human Intelligence,*** New York, McGraw Hill, 1967.
11. Hall, C. S. & Lindsey, G. — ***Theories of Personality*** (3rd Edition), New York, John Wiley, 1978.
12. Hilgard, E.O. — ***Theories of Learning*** (4th Edition), New York. Appleton-Century Crgts, 1976.
13. Judd C.H. — ***Educational Psychology,*** Guwahati, Nivedita DK Distributors, 2002.
14. Kuppuswamy, B — ***Advanced Educational Psychology,*** Jalandhar, Jalandhar University Publications, 1963.
15. Long Martyn — ***The Psychology of Education, Roulledge Falner Publication, London, 2000***
16. Nayak, A.K. & Rao,V.K. — ***Educational Psychology*** APH, Publishing Cooperation, New Delhi 2002
17. Rathus S.P. — ***Essentials of Psychology,*** Guwahati, Nivedita DK Distributors. 2002.
18. Sahoo F.M. — ***Psychology in Indian Context,*** Agra, Bhargava Book House, 2002.
19. Sharma R.N. — ***Educational Psychology,*** Guwahati, DVS Publication, 2002.
20. Sharma Yogendra — *Textbook of* ***Educational Psycholog, Kanishka Publication, New Delhi, 2004***
21. Sharmila P — *Educational Psycholog, A.P.H. Publication, New Delhi, 2005*
22. Woolfolk, Anita — ***Educatonal Psychology,*** Pearsm Educaion Pvt. Ltd. Delhi, 2004
23. Woodworth, R.S — ***Psychology: A Study of Mental Life,*** New York, Century, 1995.

M.Ed: 103 METHODOLOGY OF EDUCTIONAL RESEARCH

Unit I. Elements of Educational Research

- Methods of Acquiring Knowledge: Experience, Traditions, Authority, Logical and Scientific Method of Inquiry
- Meaning and Scope of Educational Research
- Types of Educational Research: Fundamental, Applied & Action Research
- Formulation of Research Problem: Identification & Selection, Defining and Delimitation
- Hypothesis: Characteristics, Types, Formulation and Testing
- Preparation of Research Proposal

Unit II. Sampling & Tools of Data Collection

- Sampling : Population & Sample, Sample Size
- Methods of Sampling
  (i) Probability Sampling: Random, Systematic, Stratified & Cluster
  (ii) Non- Probability Sampling : Purposive, Quota and Incidental
- Tools of Data Collection:
  Questionnaire, Observation, Interview
  Rating Scales, Schedule, Standardized Tests

Unit III. Methods of Research

- Historical Method : Sources of Data Collection, External and Internal Criticism, Interpretation of Data
- Descriptive Method : Survey Studies
  Correlational Studies
- Experimental Method : Proceedure, Internal & External Validity, Methods of Control
  Single Group & Parallel Group Design

Unit IV. Normal Probability Curve

- Concept of Probability & Binomial Distribution
- Concept & Characteristics of Normal Probability Curve
- Testing Normality: Kurtosis and Skewness
- Applications of Normal Probability Curve

Unit V. Statistical Techniques

- Correlation Analysis
  (i) Concept of Product Moment Correlation
  (ii) Product Moment Correlation for Ungrouped and Grouped Data
- Significance of mean
  (i) Concept of Statistics & Parameter, Confidence Interval & Level of Significance
  (ii) Sampling Distribution of Mean and Standard Error of Mean
  (iii) Significance of Mean for Large & Small Sample
- Testing the significance of difference between means
  (i) Concept of Degree of Freedom, Critical Ratio and t-Ratio
  (ii) Concept of One Tailed & Two Tailed Tests
  (iii) Test of Significance for Two Independent and Correlated Sample (Large and Small)

Practicum (To be evaluated internally)
Any one of the following

- Preparing a Research Proposal on a Topic of your choice
- Preparing a Review of Related Literature on a Topic

SUGGESTED READINGS

1. Best, J.W. & Kahn, J.V. — ***Research in Education***, (6th edition) New Delhi, Prentice Hall, 1989.
2. Buch, M. B. — ***A Survey of Research in Education***, Baroda, CASE, M. S. University, 1974.
3. Cook, Bill — ***Fundamentals of Action Research*** Sage publications, 2005
4. Fox, D. J. — ***The Research Process in Education***, New York. Holt Rhinehart and Winston, Inc. 1969.
5. Garrett. H.E. — ***Statistics in Psychology and Education***, Bombay. Vikils, Feiffer & Semen's Ltd, 1988.
6. Good, Barr & Scates — ***Methodology of Educational Research***, New York Appleton Crofts, 1962.
7. Guilford, J.P. & Fruchter, B. — ***Fundamental Statistics in Psychology & Education***, New York, McGraw Hill, 1974.
8. Kerlinger F.N. — ***Foundation of Behaviour Research***, Delhi, Surjeet Publications, 1978.
9. Koul, L. — ***Methodology of Educational Research***, New Delhi, Vikash Publications, 1998.
10. Kurpius, S.E et.al — ***Testing and Measurement***, Sage Publication, 2006
11. Kurtz, A. K. & Mayo, S.T. — ***Statistical Methods in Education and Psychology***, New Delhi, Narosa Publishing House, 1980.
12. Lewis-Beck, MS.(Ed) — ***The Sage Encyclopedia of Social Science Research Methods***, New Delhi, Sage Publications, 2004
13. Rajamanickam, — ***Statistical Methods in Psychology and Educational Research***, Concept Publishing Company, New Delhi 2001
14. Sax, G. — ***Empirical Foundation of Educational Research***, New Jersey, Englewood Cliffs, 1968.
15. Seigal, Sydne, Y. — ***Non-parametric Statistics for Behavioural Science***, New Delhi, McGraw Hill, 1978.
16. Singh, Arun Kumar — ***Test, Measurement and Research Methods in Behavioural Sciences***, New Delhi, Mc Graw Hill, 1986
17. Sukia S. .P, & Others — ***Elements of Educational Research***, (3rd edition), Bombay, Allied Publishers, 1974.
18. Tuckman, B.W. — ***Analysing and Designing Educational Research***, New York, Harcourt Brace Jovanovich, Inc., 1978.
19. Tuckman, B.W. — ***Conducting Educational Research*** (2nd edition), New York, Harcourt Brace Javanovich, Inc., 1979.
20. Van Dalen, D.B & Meyer, W.J. — ***Understanding Educational Research***, New York, McGraw Hill C., 1979.

M.Ed: 104 SYSTEM OF TEACHER EDUCATION IN INDIA

Unit I. **Basic Concepts**

- Concept of Training and Teacher Education
- Need and Scope of Teacher Education Programme.(Pre-Service and In-Service)
- Objectives of Teacher Education at Pre-Primary, Elementary, Secondary and Higher Secondary Levels

Unit II. **Structure and Development of Teacher Education**

- Structure of Teacher Education in India (Pre-Service and In-Service)
- A Brief Review of the Historical Development of Teacher Education in India during Post- Independence Period
- A Study of Recommendations of Education Commission (1964-66) and National Policy on Education (1986 and Revised-1992)

Unit III. **Models of Teacher Education**

- Social Oriented Progressive Model
- Competency Based Model
- Academic Orientation Model
- Personalistic Orientation Model

Unit IV. **Agencies of Teacher Education**

- Role and Functions of NCERT, SCERT / DERT and NIEPA
- Role and Functions of CTE and IASE
- Role and Functions of DIET
- Administrative Control of Teacher Education.

Unit V. **Curriculum and Evaluation of Teacher Education**

- Curriculum for Teacher Education at Pre-Primary, Elementary, Secondary, Higher and Secondary Levels as per NCTE National Framework (2005)
- Performance Appraisal of Teachers

SUGGESTED READING

1. Attekar, A.S, ***Education in Ancient India*** Nand Kishore Bros, Banaras 1951

2. Buch M.B and Palasane M.M. ***Reading in Inservice Education*** Sardar Patel University 1947

3. Basu A.N. ***Education in Modern India*** Orient Book Co, Calcutta 1947

4. Brunar, J.S. ***Towards a Theory of instruction*** the Battanap Press, Massachusetts 1966

5. CERT ***Innovation in Inservice Education and Training of Teacher's Practice & Theory,*** OECD, Paris, 1978

6. Chaurasia G ***Teacher Education and Professional Organization, Authors press*** Delhi 2000

7. Chaurasia G ***New Era in Teacher Education,*** Sterling Publication, Delhi 1967

8. Chaurasia G ***Innovations & Challenges in Teacher Education,*** Vikas Publication, New Delhi 1977.

9. Dev Gowda A.C. ***Teacher Education in India,*** Bangalore Book Bureau, Bangalore 1973

10. Ebel, R.L. (ED) ***Teacher Education, American Association of Colleges for Teacher Education*** Queenta 1956.

11. Jangira N.K. ***Teacher Training and Teacher Effectiveness: An Experiment in Teacher Education,*** National Publication House, Delhi, 1984

12. Mukherjee, S.N. (ED) ***Evaluation of Teacher of India (Vol-I)*** S. Chand & Co, Delhi, 1968

12. NCTE ***Teacher Education Curriculum: A Framework,*** NCERT, New Delhi 1978, 2005.

13. Sharma, S.P. ***Teacher Education-Principles Theories and Practices,*** Kanishka Publishers New Delhi,. 2003

14. Tuckman B.W. ***Measuring Educational Outcome: Fundamental of Testing,*** New York, Harcourt Brace Jovanovich, 1975

M.Ed: 201 THEORY AND PRACTICE OF TEACHING

Unit I. Basic Concepts

- Concept and Principles of Teaching
- Levels of Teaching: Memory, Understanding and Reflective
- Process of Teaching: Planning, Organizing, Leading and Controlling
- Competencies in Teaching
- Characteristics of a Good Teacher

Unit II. Theories of Teaching

- Formal Theories of Teaching: Socrates' Maieutic Theory; Herbert Spencer's Communication Theory, Dewey's Moulding Theory
- Descriptive Theories of Teaching: Gagne's Hierarchical Theory of Instruction, Atkinson's Optimal Learning Theory
- Normative Theories of Teaching: Gage's Cognitive Theory, Ryan's Theory of Teacher Behaviour and Clark's General Theory

Unit III. Models of Teaching

- Concept and Elements of Teaching Model
- Information Processing Models – Ausubel's Advance Organizer
- Social Interaction Models- John Dewey's Group Investigation
- Personal Development Models- Carl Roger's Non-Directive
- Behavioural System Models – Skinner's Programmed Instruction

Unit IV. Student Teaching

- Concept of Student Teaching
- Organization and Supervision of Teaching Practice
- Lesson Planning
- Teaching of Concepts, Principles and Problem Solving

Unit V. Modification of Teacher Behaviour

- Teaching Skills: Introducing a Lesson, Questioning, Stimulus Variation, Reinforcement, Increasing Pupil's Participation and Integrations of Different Skills
- Micro Teaching: Concept and Technique
- Evaluation of Teaching – Flander's Interactional Analysis Category System(FIACS)

Practical (To be evaluated internally)

- Demonstration Lesson
- Observation of Teaching Practice and Feedback

The practical under this paper will comprise of a demonstration lesson to be given by all the students before their class fellows on one of the school teaching subjects.

The students who will be observing the demonstration will have to record observations of altleast five demonstration lessons and provide feedback to the student giving the demonstration.

SUGGESTED READING

1. Allen D.W. — ***Micro Teaching: A Description;*** California: Standford University, 1966

2. Anand C.L. — ***Aspects of Teacher Education***, Delhi S.Chand and Co 1988

3. Arendset R.L. et.al;. — ***Handbook for the development of instructional Modules, in Competency Based Teacher Education Programmes***, Synacause New York: The Centre for the Study of Teaching. 1971

4. Bruner J.S. — ***Towards a Theory of Instruction***, New York: Norton 1966

5. Chaurasis G — ***Teacher Education and Professional Organizations***, Delhi, Authors Press. 2000

6. Grower, R. & Walters S — ***Teaching Practice Handbook***, London, ELBS, Heinemann Educational Books Ltd.1987

7. Mangal S.K. — ***Foundations of Educational Technology***, Ludhiana, Tandon Publications. 2001

8. Marshal, Weil.& Joyce Bruce, — ***Information Processing Models of Teaching*** Englewood Cliffs, New Jersey: Prentice-Gall. 1978.

9. Marshal, Weil.& Joyce Bruce, with Beverly Showers — ***Models of Teaching***, New Delhi: Prentice-***Hall*** 1992.

10. Mukherjee, S.N. — ***Admission and Organization in Teacher Training Institutions***, New Delhi, NCERT 1987

11. Panda, B.N. & Tewari, A.D. — *Teacher Education*, New Delhi, A.P.H. Publishing 1997

12. Sharma, S.P. — ***Teacher Education, Principles, Theories and Practices***, Delhi: Kanishka publishers. 2003

M.Ed: 202 EDUCATIONAL TESTING

Unit I. Basic Concepts

- Concept of Test, Measurement & Evaluation in Education
  Classification of Tests
- Assumptions Underlying Measurement
  Scales of Measurement: Nominal, Ordinal, Interval and Ratio Scale
- Process & Purpose of Evaluation
  Formative and Summative Evaluation
- Norm- Referenced vs Criterion- Referenced Testing,
  Grading System, Semester System

Unit II. Test Indices

- Reliability: Concept, Methods and Factors Affecting Reliability.
- Validity: Concept, Methods and Factors Affecting Validity
- Relationship Between Reliability & Validity.
- Norms: Concept and Types (Age, Grade, Percentile, Z-score, T-score, Stannine).

Unit III. Test Construction & Standardization

- Testing by Objective : Bloom's Taxonomy of Educational Objectives
- Principles of Test Construction
- General Steps of Test Construction & Standardization with special reference to Achievement Test: Planning, Blue Print, Item writing, Item Analysis and Standardization
- Construction of Attitude scale by Thurston and Likert's Method

Unit IV. Statistical Analysis - I

- Partial (First order) and Multiple Correlation
- Concept of Regression and Prediction
- Simple Regression Equation and Prediction from Equation

Unit V. Statistical Analysis - II

- Concept of Parametric and Non-Parametric Test
- Concept of Analysis of Variance
  One Way Analysis of Variance (ANOVA)
- Chi- Square Test and its Uses
  (i) Test of Goodness of Fit
  (ii) Test of Independence

Practical Work (To be evaluated internally)

Atleast two of the following tests

(i) Intelligence Test
(ii) Personality Test
(iii) Adjustment Inventory
(iv) Interest Inventory

SUGGESTED READINGS

1. Anastasi A. — ***Psychological Testing*** (4th edition), New York, McMillan Pub Co, 1976.

2. Bloom B.S.& Others. — ***Handbook of Formative and Summative Evaluation of Student Learning***. New York, McGraw Hill Book Co., 1971.

3. Cronbach L J. — ***Essentials of Psychological Testing*** (3rd edition), New York, Harper & Row publishers, 1970

4. Cronbach, Lee J. — ***Essentials of Psychological Testing***, New York, Harper and Row, International Education, 1964

5. Ebel R. L. & Frisbei D. A. — ***Essentials of Educational Measurement***, New Delhi, Prentice Hall, 1986

6. Edwards A. L. — ***Techniques of Attitude Scale Construction***, Bombay, Feiffer & Simens private Ltd, 1975.

7. Freeman F. S. — ***Theory and Practice of Psychological Testing***, (3rd edition), New Delhi, Oxford & IBH Pub. Co., 1976.

8. Harper (Jr.) A. E. & Harper E.S. — ***Preparing Objective Examination, A Handbook for Teachers, Students and Examiners***, New Delhi, Prentice Hall, 1990.

9. Kurpius,SR & Stafford, ME — ***Testing and Measurement, New Delhi, Sage Publication, 2006***

10. Linn Robert L & Norman E. Gronlund — ***"Measurement and Assessment in Teaching"*** Pearson Education Pvt. Ltd. Delhi 2003.

11. Sax G. — ***Principles of Educational Measurement and Evaluation***, California, Woodworth Publishing, 1974.

12. Singh (ed). — ***Criterion – Referenced Measurement***, (selected readings), New Delhi, NCERT, 1990.

13. Tenbrink T .D — ***Evaluation: A Practical Guide for Teachers***, New York, and McGraw Hill. 1974.

14. Thorndike R.L. & Hagen E. P. — ***Measurement and Evaluation in Psychology and Education, (4th edition)***, New York, John Wiley & Sons, 1977.

15. Tuckman B.W. — ***Measuring Educational Outcome: Fundamental of Testing***, New York, Harcourt Brace Jovanovich, 1975

16. Varma, M. — ***An Introduction to Educational and Psychological Research***, New Delhi, Asia Publishing House, 1965

17. Vernon, P.E. — ***Personality Test and Assessment***, London, Methuen Co, 1962

Option -I

M.Ed: 203.1 SCIENCE EDUCATION

Unit I. **Theoretical Background**

- Historical Development of Science: Pre-Scientific Era and Emergence of Modern Science
- Major Contribution of Science to Mankind
- Need and Scope of Science Education

Unit II. **Scientific Inquiry**

- Nature of Science: Observation, Reasoning and Experimentation
- Nature of Scientific Knowledge: Hypothesis, Postulate, Theory and Law
- Scientific Method: Concept & Process
- Scientific Attitude : Concept & Development

Unit III. **Policy & Curriculum in Science Education**

- Science Education as Envisaged in Education Commission (1964-66), National Policy on Education (1986)
- Criteria of Validity for an Ideal Science Curriculum
- Science Curriculum at Different Stages: Objectives, Content, Pedagogy and Assessment as per National Curriculum Framework (2005)

Unit IV. **Pedagogical Bases of Science Education**

- Theory of Constructivism and its Implications for Science Teaching
- Contributions of Jean Piaget and Bruner
- Instructional Design in Science Education: Taba's Inductive Thinking, Suchman's Inquiry Training
- Principles of Science Learning

Unit V. **Creativity in Science**

- Scientific Creativity : Concept & Components
- Creative Process Involved in Building Scientific Theories
- Developing Scientific Creativity

SUGGESTED READINGS

1. Anderson R.D., ***Developing Children's Thinking Through Science***, New Delhi: Prentice Hall, 1060.

2. Bernal J.D. ***Science in History***, Penguin Books, Chicago, 1969.

3. Das R.C. ***Science Teaching in Schools***, Sterling Publishing New Delhi 1085.

4. Frank P. ***Modern Science and its Philosophy***, Collier Books 1961.

5. Hammerman, Elezabeth ***Becoming a better Science Teacher.*** Sage Publications, New Delhi, 2006.

6. Harre, R. ***Introduction to the logic of Science for Secondary Schools***, London: University of London press, 1961.

7. Kelly, A.E & Lesh RA ***Handbook of Research Design in Mathematics & Science Education.*** Lowernce Erlbaum Associates, Mahwah. New Jessey 2000.

8. NCERT: ***National Curriculum Framework Position Paper National Focus Group on Teaching of Science*** NCERT, New Delhi 2006

9. Popper K.R. ***The logic of Scientific Discovery***, London: Hutchinson & Co.Ltd. 1968.

10. Sharma Y.K. ***Teaching of Physical Science***, Kanishka Publishers, New Delhi 2003

11. Sommerville J. ***The way of Science, its Growth and Method***, 1953

12. Waddington D.J.(Ed) ***Teaching School Chemistry.*** Unesco (1984) Published by Sterling Publishers New Delhi 1972.

Option -I

M.Ed : 203.2 ENVIRONMENTAL EDUCATION

Unit I. Environmental Concepts

- Concept of Environment(Abiotic and Biotic) and Ecosystem
  Concept of Biosphere and Bio-Diversity
- Man and Environment
- Environment and Development

Unit II. Environmental Education

- Concept and Scope of Environmental Education
- Aims and Objectives of Environmental Education
- Distinction Between Environmental Science and Environmental Education
- Principles and Foundations of Environmental Education
- Environmental Education for Sustainable Development

Unit III. Environmental Degradation

- Environmental Pollution: Land, Air, Water, Noise
- Global Environmental Issues: Ozone Layer Depletion, Green House Effect, Acid Rain
- Need for Conservation and Preservation of the Environment

Unit IV. Curriculum for Environmental Education

- Principles of Curriculum Development in Environmental Education
- Interdisciplinary and Multi-Disciplinary Approaches to Curriculum Development
- Curriculum of Environmental Education at Primary, Secondary and Higher Secondary Level

Unit V. Pedagogy for Environmental Education.

- Seminar, Workshop, Field Surveys, Projects and Exhibition
- Role of Print and Non-Print Media

Practical Work (To be evaluated internally)

Any one of the following

(i) Planting Sapling in a Pot
(ii) Field Trip and Preparation of Report

SUGGESTED READINGS

1. Chhatwal G.R. — ***Encyclopedia of Environmental Education***, New Delhi Anmol Publications. 1998.
2. Cunningham W.P. & Saigo B.W. — ***Environmental Science: A Global Concern,*** Dubuque, IA, Wm.C. Brow Publishers.
3. Damodar, M. — ***Environmental Education***, New Delhi, Kalyani Publication.
4. Desh, B. & Berberet G — ***Environmental Education for Conservation and Development,*** New Delhi, Nataraj Publications 1987
5. Enger.E.D. & Smith B.F. — ***Environmental Science: A Study of Interrelationship*** Dubuque, IA, Wm.C. Brow Publishers.
6. Fisher, W.F. — ***Towards Sustainable Development,*** Jaipur and New Delhi, Rawat publications. 1997
7. Gupta S.P. — ***Environmental Issues for the 21st Century,*** New Delhi, Mittal Publication 2003
8. Gupta N.L. & Gurjar R.K, — ***Sustainable Development,*** Vol. I., Jaipur and New Delhi, Rawat publications. 1993
9. Jana, M.M. — ***Environmental Degradation and Development and Strategies in India,*** New Delhi, Ashish Publishing House.
10. Misra. S.G. & Mani, D — ***Ecosystem Pollution:*** New Delhi, Indus Publishing Company, 1993
11. Nanda V.K. — ***Environmental Education,*** New Delhi, Anmol Publications. 1997.
12. Paulsamy S. — ***Introduction to Environmental Biology***, Delhi, Emkay Publications 1998
13. Raven P.H. & Beng L.R. — ***Environment,*** USA, John Wiley & Sons, Inc.2006.
14. Sharma, R.A. — ***Environmental Education***, Meerut, Surya Publication, 1997
15. Shrivastava R. & Singh D.P. — ***Environmental Education*** New Delhi Anmol publication Pvt. Ltd.
16. Sungoh, S.M. — ***Environmental Education***, Shillong, Ri Khasi Press. 2001
17. Swan J.A. & W.B. Stapp — ***Environmental Education***, new York, John Wiley and Sons Publication.
18. Trivedi P.R. & Gurdeep — ***Concepts in Environment,*** New Delhi Askashdeep Publishing House. 1997
19. Trivedy R.V — ***Handbook of Environmental Laws, Acts, Guidelines, Companies and Standards.*** Vol II Hyderabad, B.S. Publishers. 2004

Option -I

M.Ed: 203. 3 PRE - SCHOOL EDUCATION

Unit I. **Basic Concepts**

- Concepts, Need, and Objectives of Pre-School Education
- Methods of Child Study
- Significance of Child Rearing Practices & Learning
- Development of Pre-School Education in India

Unit II. **Contributions of Educational Philosophers**

- Jean Jacques Rousseau
- Frederich Wilhelm August Froebel
- Maria Montessori
- Mahatma Gandhi
- Tarabai Modak

Unit III. **Different Aspects of Child Development**

- Physical Development
- Emotional Development
- Social Development
- Cognitive Development
- Language Development

Unit IV. **Activities and Evaluation of Pre-School Education**

- Activities and Programmes for Pre-School Education
- Characteristics of a balanced Pre-School Curriculum
- Planning of Pre-School Curriculum
- Evaluation of Pre-School Curriculum and its activities

Unit V. **Methods, Programmes and Trends in Pre School Education**

- Nursery, Balwadi and Anganwadi Programmes and Activities
- Agencies of Pre-School Education - Central Social Welfare Board, State Social Welfare Board, Indian Council for Child's Welfare, ICDS and UNICEF
- Researches in Pre-School Education

SUGGESTED READINGS

1. Aggarwal, J.C. — ***Methods and materials of Nursery Education***, Delhi, Doaba House, 1990.

2. Day Barbara — ***Early Childhood Education: Organising Learning Activities***, New York, McMillan, 1983.

3. Dehart G.B; Grafc L.A. & Cooper R.G. — ***Child Development, its Nature and Course USA, Mc. Graw Hill Higher Education 2000***

4. Dutt, N.K. — ***Psychological Foundations of Education***, Delhi, Doaba House, 1974.

5. English, H.B. — ***Dynamics of Child Development***, New York, Holt, Rinehart and Winston, 1961.

6. Grewal, J.S. — ***Early Childhood Education***, Agra, National Psychological Corporation, 1984.

7. Hurlock, E.B. — ***Developmental Psychology***, Bombay, Tata McGraw Hill Publishing Co., 1968.

8. Nedinnus, G.R. & Johnson, R.C — ***Child Development and Personality***, New York, Harper and Row Publishers, 1974.

9. Riley J. — ***Learning in the Early Years, A guide for teachers***. New Delhi, Sage Publication. 2003.

10. Siddiqui Miyibul Hasan — ***Early Childhood Education*** New Delhi, S.B. Nargia APH Publishing Cooperation. 2004

11. Shukla R.P. — ***Early Childhood Care and Education***, New Delhi, Sarup Publication, 2004.

12. Spoked, B. L. (Ed): — ***Handbook of Research in Early Childhood Education***, New York, The Free Press, 1982.

13. Sue. C. Wort — ***Early Childhood Curriculum***, Guwahati, Nivedita Book Distributors, 2002.

14. Tandon R.K. — ***Child Psychology, APH Publishing Corporation, New Delhi: 2002***

15. Travers, J.E. — ***The Growing Child Introduction to Child Development***, New York, John Kluey, 1977.

Option -I

M.Ed 203.4 EXPERIMENTAL EDUCATION

Unit I. Basic Concepts

- Meaning of an Experiment in Education, Law of Single Variable (cause & effect relationship)
- Kinds of Variables: Dependant, Independent, Intervening, Extraneous and Controlling Extraneous Variables
- Mill's Experimental Inquiry: Method of Agreement, Difference, Residue Concomitant Variation & Joint method
- Scope of Experimental Education

Unit II. Experimental Designs

- Meaning and purpose of Experimental Design
- Essential characteristics of a good Experimental Design
- Basic Principles of Experimental Design (Manipulation, Randomization, Replication and Control.)
- Basic Experimental Errors (S-type, G-type and R-type)
- Controlling Error Variance: Maximize Experimental Variance, Minimize error variance, Controlling Extraneous Variance ((Max-Min-Con).
- Criteria for selecting an experimental Design (Appropriateness, Adequacy of Control, Internal & External Validity)

Unit III. Types of Experimental Designs

Focus, Layout, Data Analysis, Advantages and Limitations of the following designs

- Pre-Experimental Designs
- One Group Pre-Test Post- Test design
- Two Group Post Test Only Comparison design
- Post test only Equivalent Group Design
- Pretest Post Test Equivalent Group Design
- Quasi – Experimental Design

Unit IV. Lindquist's Basic Experimental Design

Focus, Layout, Data Analysis, Advantages and Limitations of the following designs

- Simple Randomized Design
- Level X Treatment Design
- Subject X Treatment Design
- Group Within Design
- Random Replication Design
- Factorial Design

Unit V. Statistical Foundation

- Concept of Analysis of Variance
- Assumptions Underlining ANOVA
- Two Way Analysis of Variance
- One Way Analysis of Co-variance (ANCOVA)

SUGGESTED READINGS:

1. Best, J.W. & James V.K. — ***Research in Education***, New Delhi, Prentice Hall of India, 1992.

2. Bhatnagar, R.P. & Poonam Rajhans — ***Experimental Designs of Research in Behavioural Sciences***, Meerut, Bhatnagar Agencies, 1989.

3. Broota K.D. — ***Experimental Design in Behavioural Research***, New Delhi, Wiley Eastern, 1989.

4. Collins Mary & Drever James. — ***Experimental Psychology***, New Delhi, Gayatri Offset Press, 1976.

5. Cronbach, Lee J. — ***Essentials of Psychological Testing***, New York, Harper and Row, International Education, 1964.

6. Ferguson, G. — ***Statistical Analysis in Psychology and Education***, New York, McGraw Hill, 1966.

7. Garett, H.E. — ***Statistics in Psychology and Education***, London, Holt Rinehart and Winston, 1969.

8. Guilford J.P — ***Fundamental Statistics in Psychology and Education***, New York, McGraw Hill, 1965.

9. Kerlinger F.N. — ***Foundation of Behavioural Research***, Indian Edition, Delhi, Surjeet Publications, 2000.

10. Koul, Lokesh — ***Methodology of Educational Research***, New Delhi, Vikash Publishing House, 1997.

11. Linguist, E.F. — ***Design and Analysis of Experiments in Psychology and Education***, Boston, Houghton and Mifflin Company, 1963.

12. Ray, William S. — ***An Introduction to Experimental Design***, New York, The McMillan, 1960.

13. Rusk Robert R. — ***An Outline of Experimental Education***, New York, The McMillan, 1960.

14. Sharma R.A. — ***Fundamentals of Educational Research***, Meerut, Loyal Book Depot, 1984.

15. Winer, B.J. — ***Statistical Principles in Experimental Design***, London, McGraw Hill, 1971.

Option –I

M.Ed: 203.5 EDUCATIONAL ADMINISTRATION AND MANAGEMENT

Unit I. Basic Concepts

- Concept of Educational Administration & Management,
- Development of Management Thought and Practices
- Scope and Functions of Educational Administration
- Leadership Qualities and Professional Competencies of Educational Administrator

Unit II. Micro Planning for School Management

- Concept of Micro & Macro planning
- Institutional Planning: Principles and Process
- Block Resource Centre (BRC) and Cluster Resource Centre (CRC)- Their use for Resource Generation
- School Mapping: Need, Factors and Scope
- Community Participation: Mobilizing Community for the School and the School for the Community
- Organization of Village Education Committee (VEC)

Unit III. Resource Management in Educational Institution

- Resource and their Types: Human and Material Resources
- Management of Time: Time Schedules for Various Activities, Preparation of Daily, Weekly, Monthly and Yearly Plans for the School
- Management of Physical Resource: School Building, Library, Laboratory, Hostels Playground
- Management of Human resource: Inter-Personal, Inter- Group Relationship, Teacher – Taught Relation, Teacher-Teacher Relations, Head-Teacher Relationship. Relationship with Management and Administrator
- Management of Financial Resource: Developing and Monitoring Budgets at School Level

Unit IV. Different Authorities of Educational Administration

- Role, Functions and Powers of different Authorities of Educational Administration: MHRD, NIEPA, State Authority, Local Authorities and Bodies with special reference to Meghalaya,

Unit V. Educational Supervision

- Principles & Techniques of Educational Supervision
- Managing the School Activities – Role of Teachers in Administrative Work
- Organization of Co-Curricular Activities
- Managing Examination and Evaluation

SUGGESTED READINGS

1. Ananda W.P. Gurung — ***General Principles of Management for Educational Planner and Administrators***, Paris, UNESCO, 1984.

2. Bhagia, H.M. et.al — ***Educational Administration in India and Other Developing Countries***, New Delhi, Commonwealth Publication, 1990.

3. Flippo,E.B. — ***Personnel Management***, New York, McGraw Hill, (7th edition) 1984.

4. Fred Luthens — ***Organisational Behaviour***, Tokyo, McGraw Hill, International Book Co., 1996.

5. Goel, S.D. — ***Modern Management Techniques***, New Delhi, Deep and Deep, 1987.

6. Hostrop, R.W — ***Managing Education for Results***, New Delhi, ETC Publication, 1975.

7. Kumar A. — ***Personal Management, Theory and Practice***, Guwahati, DVS Publication, 2001.

8. NIEPA — ***Modern Management Techniques in Educational Administration***, New Delhi, Asian Inst. of Educational Planning and Administration, 1971.

9. NIEPA — ***Educational Management in India***, New Delhi, NIEPA, 1986.

10. Oberoi P — *Organization Development*, Guwahati, DVS Publication, 2002.

11. Tanner D. & Lawrel T — ***Supervision in Education Problems and Practices***, New York, McMillan Pub. Co., 1987.

12. Thomas, J. Sergiovann et.al — ***Educational Governance and Administration***, New Delhi, Prentice Hall, 1987.

13. Werral, N — ***People and Decision***, London, Longman, 1980.

Option –II

M.Ed: 204.1 DISSERTATION

The Dissertation will be offered as an optional paper under M.Ed 204 (Option-II). The evaluation of this paper will be done by an External Examiner out of 75 marks and by internal Examiner (supervisor) out of 25 marks at the end of the second semester.

It will be mandatory for the students offering Dissertation in second semester to finalize their research proposal as a part of the Practicum during the First Semester under M.Ed:103 (Research Methodology of Education).

The last date for the submission of Dissertation will be the date of the University Examination for the first paper of M.Ed. Second Semester Examination.

Option -II

M.Ed: 204.2 EDUCATIONAL PLANNING AND FINANCE

Unit I. Basic Concepts

- Concept and Scope of Educational Planning
- Objectives and Principles of Educational Planning
- The Process of Educational Planning
- Factors Determining Priorities in Educational Planning

Unit II. Approaches to Educational Planning

- Social Demands Approach
- Rate of Return Approach
- Man-Power Requirement Approach

Unit III. Methodology of Educational Planning

- Appraisal and Analysis of Educational Data
- Formulation of Policy and Proposals
- Projection, Programming and Project Analysis
- Costing and Financing of Educational Plan
- Decision and Implementation of Plan
- Evaluation and Revision

Unit IV. Educational Planning in India

- Development of Educational Planning in India
- Educational Planning Machinery at National, State, District, Block and Clusters Level
- Education in Five Year Plans

Unit V. Education Financing

- Concept, Need and Scope of Educational Finance
- Principles of Financing of Education
- Criteria for Allocation of Funds
- Types of Educational Expenditure
- Process of Financing Education : Planning, Budgeting and Control of Funds

SUGGESTED READINGS

1. Azad,J.L. — ***Educational Financing in India***, New Delhi. Sterling Publishers, 1973.

2. Comb, P.H & Hallak. J., — ***Managing Educational Costs***, New York: ***Oxford University Press, 1972.***

3. Government of India — ***Five Year Plans (First to Ten)*** New Delhi Planning Commission

4. Hanson, A.H. — ***The Process of Planning: A Study of India's Five Year plans*** (1950-1964) London: Oxford university Press, 1966.

5. Harbinson F & Mayers- C.II. — ***Education, Manpower and Economics Growth***, Oxford & IBH. Publication Co. New Delhi, 1964

6. Misra, A — ***Educational Finance in India***, Bombay: Asia publishing House 1963

7. Naik. J.P. — ***Educational Planning in India*** Bombay: Allied Publishers, 1965

8. Padmanabham, C.B. — ***Educational Financing and Structural Adjustment Policies in India***, Delhi: Common Wealth, 1998.

9. Rao V.K.R.V. — ***Education and Human Resource Development***, Applied Publishers, Delhi 1961

10. Singh, B. (ed), — ***Education as Investment***, Delhi: Meenakshi Prakashan, 1967

11. Sri Prakash, — ***Expenditures on Education***, New Delhi: NIEPA, 1994

12. Sodhi, T.S. — ***Education and Economic Development,*** New Delhi: Vani Educational Books, 1984.

Option -II

M.Ed: 204.3 SPECIAL EDUCATION FOR GIFTED AND MENTALLY CHALLENGED

Unit I. Basis Concepts

- Concept of Special Education and Exceptional Children
- Classifications of Exceptional Children
- Need and Scope of Special Education for Gifted and Mentally Challenged

Unit II. Education of the Gifted Children

- Concept of Giftedness
- Identification and Characteristics of Gifted Children
- Role of the Gifted Children in Social Progress
- Special Education Programme for Gifted Children

Unit III. Education of the Creative Children

- Meaning and Nature of Creativity
- Identification and Characteristics of Creative Children
- Educational Programmes for Creative Children
- Constraints of Creativity,
- Problems when Creativity is Repressed

Unit IV. Education of the Mentally Challenged Children

- Concept and Classification of Mentally Challenged Children
- Identification and Characteristics of Mentally Challenged Children
- Special Education Programme for Mentally Challenged Children
- Guidance Services to Mentally Challenged Children

Unit V. Educationally Backward Children

- Concept of Educationally Backward Children
- Factors Responsible for Educational Backwardness
- Identification and Characteristics of Backward Children
- Treatment of Backwardness and Remedial Teaching

SUGGESTED READINGS

1. Bhargava, M. — ***Introduction to Exceptional Children, Their Nature and Educational Provisions***, New Delhi, Sterling Publishers, 1994.
2. Bruer, A.M. & Shea, M — ***Teaching Exceptional Students in your Classroom***, London, Allyn and Bacon, 1989.
3. Chauhan, S.S — ***Education of Exceptional Children***, New Delhi, Indus Publishing Company, 1989.
4. Dubey, M.N. — ***Gifted and Talented Education***, New Delhi, Mittal Publication, 2005
5. Cruick Shank M.M. and Johnson (eds) — ***Education of Exceptional Children and Youth***, London, McGraw Hill, 1975.
6. Farwel, M. — ***Special Education Needs*** Paul Chapman Publishing- Sage Publication 2004
7. Gallagher J.J. — ***Teaching the Gifted Child (2nd edition.)***, Boston, Allyn & Bacon, 1975.
8. Gupta P.K. — ***Education for Creativity*** Cosmo publication, New Delhi 2004
9. Heck, A.O. — ***The Education of the Exceptional Children***, New York, McGraw Hill, 1953.
10. Kirk, S. & Gallalagher — ***Education of the Exceptional Children***, New Delhi, Oxford IBH, 1979.
11. Martens, D.M. & Melaughliu, J.A. — ***Research and Evaluation, Methods in Special in Special Education*** Corwin Press, Sage Publication 2005
12. Mishra, R.C. — ***Guidance & Counselling (2 Vols)*** Eastern Book House, Guwahati, 2005
13. Parker, B.N. — ***Discovering programs for Talent Development*** Corwin Press, Sage Publication, New Delhi 2003
14. Perter, L. — ***Educating Young Children with Special Needs***, New Delhi, Sage Publication, 2002
15. Porter, L — ***Educating Young Children with Special needs***, Paul Chapman Publishing), New Delhi, Sage Publications 2003.
16. Reddy, G.L. — ***Mental Retardation, Education and Rehabilitation***, New Delhi, DPH Publication, 2004
17. Sarsani, M.R — ***Creativity in Education, New Delhi, Sarup Publication, 2005***
18. Shelton, C.F — ***The Exceptional Teachers Handbook***, New Delhi, Cowries Pres, Sage Publication, 2000.
19. Smith, D. — ***Working With Gifted and Talented Pupils in the Secondary Schools***, Paul Chapman Publishing, Sage publication, 2005
20. Sukumaran, P.S. — ***Parental Involvement in the Education of Mentally Challenged Children***, Ekta Book Distributor, Catalogue New Delhi 2000.
21. Torrance & Myers — ***Creative Learning and Teaching, New York, Dodd Mead Publications, 1970.***
22. Torrance,E. P. — ***Guiding Creative Talent, New Delhi, Prentice Hall, 1970.***
23. Venkataiah — ***Special Education*** Ekta Book Distributor, Catalogue New Delhi 2005
24. Wall, K. — ***Special Needs and Early Years-A Practioners Guide***, New Delhi, Paul Chapman Publishing, 2003.
25. Wards, V.S. — ***Educating the Gifted, Ohio, Merrill Book Company, 1961***
26. Wehman, P. & Melaughlin, P.T. — ***Programme Development in Special Education***, New Delhi, McGraw Hill Publishers, 1981.

Option-II

M.Ed: 204:4 ECONOMICS OF EDUCATION

Unit I. Basic Concepts

- Concept, Need, and Scope of Economics of Education
- Relationship Between Education and Economics
- Education as an Economic Good, Education as Consumption and Investment
- Education as Industry: A Critical Analysis
- Economic Thoughts on Education: Classical, Neo-Classical and Modern

Unit II. Education, Human Capital and Human Resources Development

- Concept and Importance of Human Capital
- Schultz's Human Capital Theory of Education and its Limitations
- Concept and Importance of Human Resource Development
- Strategies for Developing Human Resources with reference to developing countries

Unit III. Education and Economic Development

- Concept of Economic Growth and Development
- Educational Pre-requisites for Economic Growth
- Contribution of Education to Economic growth
- Relative Significance of Different Levels/Types of Education in Economic development with special reference to India

Unit IV. Cost and Benefits of Education

- Social and Private Cost, Opportunity Cost, Unit Cost
- Direct (Social & Private) and Indirect benefits of Education (spill-over and externalities)
- Approaches to Measuring the Benefits of Education:
  (i) Correlation Approach
  (ii) Residual Approach
  (iii)Rate of Return Approach (i.e. Cost- Benefit Analysis)
- Criteria for Financing Education

Unit V. Efficiency of Education

- Efficiency of Educational System: Internal and External
- Education and Agricultural Productivity
- Cost-Effectiveness Analysis in Education

SUGGESTED READINGS

1. Ansari, M.M. — ***Education and Economic Development***, New Delhi, AIU Publication, 1987.

2. Blaug Mark — ***Economics of Education & the Education of an Economist*** New York, University Press, 1987.

3. Blaug Mark — ***An Introduction to Econonics of Education***, England, Penguin Books Ltd. 1980.

4. Garg, V.P. — ***The Cost Analysis in Higher Education***, New Delhi, Metropolitan Book Co., 1985.

5. Harbison & Myers — ***Education, Manpower and Economics growth***, New Delhi, Oxford & IBH. (Indian Edition) 1968.

6. Kneller, G. F. — ***Education & Economic Growth***, New York, John Wiley, 1968.

7. Nagpal C.S. & Mittal A.C. (eds) — ***Economics of Education***, New Delhi, Anmol Publications, 1993.

8. Pandit, H. N — ***Measurement of cost Productivity & Efficiency of Education***, New Delhi, NCERT, 1969.

9. Prakash Sri. & Choudhury, S. — ***Expenditure on Education: Theory, Models and Growth***, New Delhi, NIEPA, 1994.

10. Pscharo Pulos, G. & Woodhall, M — ***Education for Development- An Analysis of Investment choices***, London, World Bank Publisher, 1985.

11. Schultz, T. W — ***The Economic Value of Education***, Columbia, Columbia University Press, 1963.

12. Sethi, Vinita — ***Educational Development and Resource Mobi****l*ization, New Delhi, Kanishka Publication, 1997.

13. Sodhi, T. S — ***Education and Economics Development***, Ludhiana, Mukand Publications, 1978.

14. Tilak, J.B.G. — ***Economics of Inequality in Education***, New Delhi, Sage Publications, 1987.

15. Vaizey John — ***Economics of Education***, London, Faber & Faber, 1962.

16. Varghese, NV & Mehta A.C — ***Investment Priorities and Cost Analysis*** NIEPA, New Delhi, 2001.

Option - II

M.Ed: 204.5 CURRICULUM DEVELOPMENT

Unit I. **Basic Concept**

- Meaning and Nature of Curriculum
- Concept of Curriculum Development
- Criteria of Curriculum Development
- Curriculum Design: Subject Centred and Activity-Cum-Experience Centred

Unit II. **Foundations of Curriculum Development**

- Philosophical Foundation
- Socio-Cultural Foundation
- Psycho-Linguistic Foundation

Unit III. **Process of Curriculum Development**

- Identification of Objectives
- Selection and Organization of Content
- Selection and Organization of Learning Activities and Experiences
- Evaluation of Content, Learning Activities and Experiences
- Curriculum Revision

Unit IV. **Instructional Material and Curriculum Transaction**

- Preparation and Evaluation of Text Book
- Analysis of Curricular Content: Designing Units, Suitable Presentation Mode
- Teacher as a Curriculum Practitioner
- Instructional Planning for Effective Teaching

Unit V. **Curriculum Evaluation & Curriculum Change**

- Approaches to Curriculum Evaluation
- Models of Curriculum Evaluation
- Concept of Curriculum Change
- Dimensions of Curriculum Change : Substantive, Instructional and Organizational
- Factors Influencing Curriculum Change

SUGGESTED READINGS

1. Aggarwal. J. C — ***Curriculum Reform in India***: Delhi, Doaba, 1990.

2. Brent, Allen — ***Philosophical foundations for the Curriculum***, Boston, Allen and Unwin, 1978.

3. Bridges, Leshia. — ***Handbook of Procedure for the Design of Instruction*** Pittsburg 1970

4. Bushnath Davis S & Rappaport (eds) — ***Planned Change in Education: A system Approach***, New York 1971.

5. Das, R.C. — ***Curriculum and Evaluation***, New Delhi. NCERT, 1987.

6. Dell, Ronald C. — ***Curriculum Improvement: Decision Making & Process***, (6th edition). London, Allyn & Bacon, Inc. 1986.

7. Diamond, Robert M. — ***Designing & Improving Courses & Curricula in Higher Education A systematic Approach***, California, Jossey Bass Inc. Publishers, 1989.

8. English, F.W, — ***Deciding What to Teach and Test***, CA, Corwin Press, Sage Publications, Thousand Oaks, 2000.

9. Erickson, H. L, — ***Concept based Curriculum and Instruction***, CA, Corwin Press, Sage Publications, Thousand Oaks, 2000.

10. Flinders D. J (Ed) — ***The Curriculum Studies***, New Delhi, Atlantic Publishers, 1977.

11. Levy Aneh — ***The International Encyclopedia of Curriculum***, Pergamon press, Oxford New York (1991)

12. Oliver Albert I — ***A Guide to Problems, Principle and Process***, Harfer & Row Publishers 1977.

13. Ornstein Allan.C, & Hunkins Francis P. — ***Curriculum Foundations, Principle and Issues***

14. Saylor J. Galen, William Alexander & Arthur J. Lewis — ***Curriculum planning for Better Teaching & Learning*** (4th edition), New York, Holt Rinehart & Winston, 1980.

15. Saylor J. Galen, William Alexander M — ***Planning Curriculum for Schools***, New York, Holt Rinehart & Winston, 1974.

16. Taba, Hidda — ***Curriculum Development: Theory and Practice*** New York; Harcourt Brace and World Inc...,1962

17. Thangasamy K.S., — ***Instructional Technology and Curriculum Development***, Neelkamal Publications Pvt. Ltd. Educational Publishers, Hyderbad 2006

Option-II

M.Ed: 204.6 EDUCATIONAL AND VOCATIONAL GUIDANCE

Unit 1. Introduction to Guidance

- Meaning and Need of Guidance
- Principles and Assumptions of Guidance
- Development and Present Status of Guidance Services in India

Unit II. Types of Guidance

- Nature, Scope and functions of
  - Educational Guidance
  - Vocational Guidance
  - Personal Guidance
  - Social Guidance
  - Group Guidance

Unit III. Vocational Development and Techniques of Guidance

-Vocational Development : Concept
: Vocational Guidance and Vocational development

-Technique of Guidance: Tests of Intelligence, Aptitude, Interests
: Observation, Interview, Cumulative Record and Case Study

Unit IV. Counselling

- Nature and Principles of Counselling
- Approaches to Counselling
- Role and Functions of Counsellor and Carrier Master
- Professional Education of Counsellor

Unit V. Guidance Services

- Functions of Guidance Services
- Individual Information Service
- Occupational Information Service
- Placement and Follow-up Services
- Guidance for Mentally Retarded & Delinquents

SUGGESTED READINGS

1. Bengalee, M.D. — ***Guidance and Counselling***, Bombay, Sheth Publishers, 1984

2. Bhattacharya — ***Guidance In Education***, Bombay, Asian Publishing House, 1964.

3. Bernard, H. W. & Fullner, D.W — ***Principles of Guidance, A Basic Test*** (Indian Education), New Delhi, Allied Publishers Pvt.Ltd, 1987.

4. Chandra, R — ***Guidance and Counselling***, New Delhi, Kalpaz Publishers, 2002.

5. Cronbach, Lee — ***Essentials of Psychological Testing***, London, Harper & Row, 1964.

6. Crow, L.D. & Crow, A — ***An Introduction to Guidance***, New York, American Book, Co., 1951.

7. Fuster, J.M. — ***Psychological Counselling in India***, Bombay, McMillan and Co., Ltd., 1964.

8. Jayaswal S. — ***Guidance and Counselling***, Lucknow, Prakashan Kendra, 1981.

9. Kochhar, S.K — ***Guidance in Indian Education***, New Delhi, Sterling Publishers Pvt.Ltd., 1979.

10. Mathewson, Robert, H. — ***Guidance Policy and Practice***, New York, Harper and Row, 1962.

11. Pasrisha Prem & Screck, Thomas C. — ***A Handbook for Developing Guidance Services in Secondary Schools***, Baroda, M.S. University, 1964.

12. Pasrisha Prem. — ***Guidance and Counselling in Indian Education***, New Delhi, NCERT, 1976.

13. Safaya, Rai — ***Guidance and Counselling***, Chandigarh, Abhishek Publishers, 2002.

14. Swamy R.V.(ed). — ***Guidance Service in Colleges and Universities***, Bangalore, Bangalore University and Directorate of Employment and Training, 1971.

15. Vaugh, T. D. — ***Educational and Vocational Guidance Today***, London, Routledgeki and Kegar Paul, 1970.

16. Wadhwa, Khurshid A & Rohela Pritam K. — ***Guidance Services in Schools***, New Delhi, Albio Press, 1964.

17. Williamson E.G. — ***Student Personnel Services in Colleges and Universities***, New York, McGraw Hill, Book, Co, Inc., 1961.

(ii) M.A. Syllabus of Philolsophy.

The School Board in Humanities & Education in its meeting held on 16.10. 06 approved the inclusion of 2 more items vide unit 1 & 3 on "Rights of the Disable" (as Annexure 'A') in compliance with the Supreme Court writ petition No.2288 2006 Education Department, Government of Meghalaya.

The matter is place before the Council for consideration.

ANNEXURE 'A'

DEPARTMENT OF PHILOSOPHY: NEHU: SHILLONG

SYLLABUS TO BE APPROVED BY THE ACADEMIC COUNCUL MEETING ON

20TH NOVEMBER, 2006

Semester – IV

PHIL. 4004

PHILOSOPHY OF HUMAN RIGHTS

UNIT – I : **The Concept of Human Right**
- (a) Origin of the Idea of Human Rights
- (b) Human Rights versus Other Rights
- (c) Individual, Community and Human Rights
- (d) Rights of the Disabled-Issues and Theories

UNIT – II: **Theories of Human Rights**
- (a) Divine Rights Theory
- (b) Liberalism and Republicanism
- (c) Socialist and Marxist Theory

UNIT – III: **Declarations and Covenants**
- (a) The Rise of Internationalism
- (b) Foundations of the Idea of the United Nations
- (c) Politics of Human Rights
- (d) Standard Rules on the Equalization of opportunities for Persons with Disabilities(1993)

UNIT – IV: **Human Rights in Indian Context**
- (a) Foundations of Indian Constitution
- (b) Human Rights, Fundamentalism, Terrorism
- (c) Gender, Minorities and Human Rights.

Suggested Readings:

1. Micheline R. Ishay (Ed.), *The Human Rights Reader*, Routledge, New York, 1997
2. David Boucher and Paul Kelley (Eds.), *The Social Contract from Hobbes to Rawls*, Routledge, London, 1994.
3. Eugene Kamenka and Alice Erh-Soon Tay (Eds.), *Human Rights*, Edward Arnold Pub. Ltd., London, 1993.
4. Jeremy Waldron, *Liberal Rights*, Cambridge University Press, Cambridge, 1993.
5. Johan Galtung, *Human Rights in another Key*, Polity Press, Cambridge, 1994.
6. Mathew H. Kramer, *Debate over Rights: Philosophical Enquiries*, Clarendon Press, Oxford, 1998.
7. C.J. Nirmal, *Human Rights in India*, Oxford University Press, Oxford, 2000.
8. N. Jayapalan, *Women and Human Rights*, Atlantic Publishers, New Delhi, 2001.

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9. B.P. Singh Sehgal, *Human Rights in India: Problems and Perspectives*, Deep and Deep Pub., New Delhi, 1995.
10. M.A. Khan, *Human Rights and the Dalits*, Uppal Pub. House, New Delhi, 1995.
11. P.C. Mehra, *Tribal Rights*, Shiva Publishers, Udaipur, 1996.
12. Lennard I Davis (eds.,) The Disability Studies Reader , Routledge, London, 1997

Additional Readings:

1. Satish Chandra, *International Documents on Human Rights*, Mittal Publications, New Delhi, 1990.
2. Tim Dunne and Nicholas J. Wheeler (Eds.), *Human Rights in Global Politics*, Cambridge University Press, Cambridge, 1999.
3. Ram Ahuja, *Rights of Women: A Feminist Perspective*, Rawat Pub., Jaipur, 1992.
4. Richard Reoch, *Human Rights: the New Consensus*, Regency Press, London, 1994.
5. O. Mandelsohn and Upendra Baxi (Eds.), *Rights of the Subordinated Peoples*, Oxford University Press, New Delhi, 1994.
6. Sachchidananda and R.P. Sinha, *Women's Rights: Myth and Reality*, Printwell Pub., Jaipur, 1984.
7. *United Nations and Human Rights—1945-1995*, Dept. of Pub. Information, United Nations, New York, 1973.
8. B.P. Singh Sehgal, *Global Terrorism: Socio-Political and Legal Dimensions*, Deep and Deep Pub., New Delhi, 1995.
9. Robin West (Ed.), *Rights*, Dartmouth, Singapore, 2001.

(iii) Revised Syllabus for M.Sc.(Mathematics).

The School Board of Physical Sciences in its meeting held on 30.10.06 approved the draft revised syllabus for M.Sc. (Mathematics). with following modification as at Annexure 'A'.

(a) The name of the Course No.MM35 would be Computer Programme (Practical)
(b) The name of the Course No. MM45 would be Computer Oriented Numerical Analysis (Practical).
(c) The note to the paper setters will be put at one place as preamble/preface.

The matter is placed before the Council for consideration.

5:2:3(2)

Annexure 'A'

(DRAFT) REVISED SYLLABUS

FOR
M. Sc. (MATHEMATICS)

COURSE STRUCTURE

SEMESTER-WISE DISTRIBUTION

Total marks: 1800

First Semester (Total marks: 400)

MM11	Elementary Number Theory	(100 marks, 45 lectures)
MM12	Topics in Basic Mathematical Structures	(100 marks, 45 lectures)
MM13	Classical Mechanics	(100 marks, 45 lectures)
MM14	Ordinary Differential Equations and Environment.	(100 marks, 45 lectures)

Second Semester (Total marks: 500)

MM21.	Algebra	(100 marks, 45 lectures)
MM22.	Analysis	(100 marks, 45 lectures)
MM23.	Linear Algebra	(100 marks, 45 lectures)
MM24.	Partial Differential Equations	(100 marks, 45 lectures)
MM25.	Topology	(100 marks, 45 lectures)

Third Semester (Total marks: 450)

MM31.	Computer Programming	(100 marks, 45 lectures)
MM32.	Complex Function Theory	(100 marks, 45 lectures)
MM33.	Optional paper	(100 marks, 45 lectures)
MM34.	Optional paper	(100 marks, 45 lectures)
MM35.	Computer Programming (Practical)	(50 marks, 32 lab hours)

Fourth Semester (Total marks: 450)

MM41.	Numerical Analysis	(100 marks, 45 lectures)
MM42.	Optional paper	(100 marks, 45 lectures)
MM43.	Optional paper	(100 marks, 45 lectures)
MM44.	Optional paper	(100 marks, 45 lectures)
MM45.	Computer Oriented Numerical Analysis (Practical)	(50 marks, 32 lab hours)

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OPTIONAL PAPERS

OP1. Differential Geometry

OP2. Theory of Relativity

OP3. Theory of Field Extensions

OP4. Fluid Mechanics

OP5. Measure Theory and Functional Analysis

OP6. Mathematical Methods

OP7. Ring Theory

OP8. *p*-adic Analysis

OP9. Relativistic Cosmology

OP10. Algebraic Topology

OP11. Algebraic Geometry

OP12. Dynamical Oceanography

OP13. Commutative Algebra

OP14. Tensor Analysis and Riemannian Geometry

OP15. Non-linear Dynamical Systems

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Notes for the Paper Setters and Examiners
To be forwarded along with the syllabus

Note for the paper setter:

Two questions are to be set from each unit. Any five questions are to be attempted taking one from each unit. Each question will be divided into two parts. Part (a) will follow the traditional pattern, while part (b) will be devoted to true/false type questions. If this recommendation is followed, the following note should precede the question paper.

Note for examinees:

Part (a) of each question carries nine marks. In part (b) – which carries six marks – one has to determine whether the assertions made there are true or false choosing any two out of three. One has to justify the answer by a proof or a concrete counter example. This justification would normally extend from four to six lines.

DETAILS OF SYLLABI

COMPULSORY PAPERS

MM11: ELEMENTARY NUMBER THEORY

UNIT I

Divisibility; Euclidean algorithm; primes; congruences; Fermat's theorem, Euler's theorem and Wilson's theorem; Fermat's quotients and their elementary consequences; solutions of congruences; Chinese remainder theorem; Euler's phi-function.

UNIT II

Congruence modulo powers of prime; power residues; primitive roots and their existence; quadratic residues; Legendre symbol, Gauss' lemma about Legendre symbol; quadratic reciprocity law; proofs of various formulations; Jacobi symbol.

UNIT III

Greatest integer function; arithmetic functions, multiplicative arithmetic functions (elementary ones); Mobius inversion formula; convolution of arithmetic functions, group properties of arithmetic functions; recurrence functions; Fibonacci numbers and their elementary properties.

UNIT IV

Diophantine equations – solutions of $ax + by = c$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^2$; properties of Pythagorean triples; sums of two , four and five squares; assorted examples of diophantine equations.

UNIT V

Simple continued fractions, finite and infinite continued fractions, uniqueness, representation of rational and irrational numbers as simple continued fractions, rational approximation to irrational numbers, Hurwitz theorem, basic facts of periodic continued fractions and their illustrations (without proofs); Pell's equations.

Textbooks:

1. An Introduction to the Theory of Numbers (6^{th} edition) – I. Niven, H. S. Zuckerman and H. L. Montegomery, John Wiley and sons, Inc., New York, 2003.
2. Elementary Number Theory (4^{th} edition) – D. M. Burton, Universal Book.Stall, New Delhi, 2002.

Reference books:

1. History of the Theory of Numbers (Vol. II, Diophantine Analysis) – L. E. Dickson, Chelsea Publishing Company, New York, 1971.
2. An Introduction to the Theory of Numbers (6^{th} edition) – G. H. Hardy and E. M. Wright, The English Language Society and Oxford University Press, 1998.
3. An Introduction to the Theory of Numbers (3^{rd} edition) – I. Niven and H. S. Zuckerman, Wiley Eastern Ltd., New Delhi, 1993.

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MM12: TOPICS IN BASIC MATHEMATICAL STRUCTURES

UNIT I

The algebra of sets, Cartesian products of sets, power set of a set; detailed study of relations, equivalence relations and functions; sequences; partial and total order, partially ordered sets (posets), maximal and minimal elements, largest and smallest elements, upper and lower bounds, inductive posets, Zorn's lemma; Statement of Schroder-Bernstein theorem.

UNIT II

Binary operations; groups – elementary properties and examples, subgroups, cyclic groups, homomorphism of groups, Lagrange's theorem, permutation groups, permutations as products of cycles, even and odd permutations.

UNIT III

Ordered fields, least upper bound property, the field of real numbers, Archimedean property, density of rational numbers, existence of n^{th} root of positive real numbers, the extended real number system, the complex field, euclidean spaces.

UNIT IV

Finite and infinite sets, countable and uncountable sets; metric spaces, open and closed sets, limit points, interior points, Convergence of sequences, existence of convergent subsequences of bounded sequences in $\mathbb{R}^k$, nested interval theorem, Heine-Borel theorem, Bolzano-Weierstrass threorem.

UNIT V

Construction of real numbers using Cauchy sequences, series and convergence of series, series of nonnegative terms, the number e, the root and

ratio tests, limit supremum and limit infimum, power series, summation by parts, absolute convergence, addition and multiplication of series, rearrangements.

Textbooks:

1. Naïve Set Theory (3rd edition) – P. R. Halmos, D. Van Nostrand Co., Inc, Princeton, New Jersey, 2002.
2. Principles of Mathematical Analysis (5th edition) – W. Rudin, McGraw Hill Kogakusha Ltd., 2004.
3. An Introduction To The Theory of Groups (4th edition) – J. J. Rotman, Allyn and Bacon, Inc., Boston, 2002.

Reference books:

1. Mathematical Analysis (5th edition) – T. Apostol, Addison-Wesley; Publishing Company, 2001.
2. Introduction to Real Analysis (3rd edition) – R. G. Bartle and D. R. Sherbert, John Wiley & Sons, Inc., New York, 2000.
3. A First Course in Abstract Algebra (4th edition) – J. B. Fraleigh, Narosa Publishing House, New Delhi, 2002.
4. Contemporary Abstract Algebra (4th edition) – J. A. Gallian, Narosa Publishing House, New Delhi, 1999.
5. Basic Real Analysis – H.H. Sohrab, Birkhauser (2003).

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MM13: CLASSICAL MECHANICS

UNIT I

Generalized coordinates; holonomic & non-holonomic systems; D'Alembert's principle; Lagrange's equations; calculus of variations.

UNIT II

Hamilton's principle, Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-conservative and non-holonomic systems, conservation theorems and symmetry properties.

UNIT III

Eulerian angles; Euler's theorem on the motion of a rigid body; infinitesimal rotations; rate of change of a vector; coriolis force; Euler's equations of motion; force free motion of a rigid body; heavy symmetrical top with one point fixed.

UNIT IV

Hamilton's equations of motion, conservation theorems and physical significance of Hamiltonian, Hamilton's equations from variational principle, principle of least action.

UNIT V

Equations of canonical transformation; integral invariants of Poincare'; Lagrange and Poisson brackets as canonical invariants, equations of motion in Poisson bracket notation; infinitesimal contact transformations; constants of motion and symmetry properties.

Textbook:

1. Classical Mechanics (3^{rd} edition) – H. Goldstein, Addison Wesley Publications, Massachusetts, 2002.

Reference books:

1. Classical Mechanics – C. R. Mondal, Prentice-Hall of India, 2001.
2. Classical Mechanics – T. W. B. Kibble, Orient Longman, London, 1985.
3. Mechanics – L. D. Landau and E. M. Lipshitz, Pergamon Press, Oxford, 1976.
4. Lectures on Mechanics – J. E. Marsden, Cambridge University Press, 1992.

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MM14: ORDINARY DIFFERENTIAL EQUATIONS AND ENVIRONMENT

GROUP – A

(Ordinary Differential Equations)

UNIT I

Linear equations with variable coefficients – introduction, initial value problems for the homogeneous equations; solutions of homogeneous equations; Wronskian and linear independence; non-homogeneous equations; homogeneous equations with analytic coefficients; Legendre equation, justification of power series method; Legendre polynomials and Rodrigues' formulae.

UNIT II

Linear equations with regular singular points – introduction; Euler equation; second order equations with regular singular points – example and the general case, convergence proof, exceptional cases; Bessel equation; regular singular points at infinity.

UNIT III

Existence and uniqueness of solutions – introduction; equations with variable separated; exact equations, Lipschitz condition; non-local existence of solutions; uniqueness of solutions; existence and uniqueness theorem for first order equations; statement of existence and uniqueness theorem for the solutions of ordinary differential equation of order n.

UNIT IV

Existence and uniqueness of solutions of systems; central forces and planetary motion; some special equations; complex n-dimensional space; systems as vector equations; existence and uniqueness of solutions to systems; existence and uniqueness for linear systems and for equations of order n.

GROUP – B

(Application of Mathematics in Environmental Studies)

UNIT V

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

Textbooks:

1. An Introduction to Ordinary Differential Equations – E. A. Coddington, Prentice-Hall of India Private Ltd., New Delhi, 2001 .
2. Spherical Harmonics – T. M. Mac Robert, Pergamon Press. 1967.
3. Operations Research (for Group B) – K. Swarup, P. K. Gupt and Man Mohan, Sultan Chand & Sons, New Delhi, 2000.

Reference books:

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

3. Applied Operation Research: A Survey (for Group B) – G. E. Whitehouse and B. L. Wechsler, John Wiley & Sons, 1975.
4. Ecology: The Experimental Analysis of Distribution and Abundance (2^{nd} edition) (for Group B) – C. J. Krebs, Harper and Row Publishers, 1978.
5. Differential Equations, Dynamical Sysstems and an Introduction to Chaos – M.W. Hirsch, S. Smale, and R.L. Devaney, Elsevier (2004).

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MM21: ALGEBRA

UNIT I

Normal subgroups, quotient groups; commutator subgroups; isomorphism theorems, correspondence theorem; group of symmetries, symmetric and dihedral groups and their elementary properties.

UNIT II

Group action; Cayley's theorem; orbit decomposition; counting formula; class equation, consequences for p-groups; normal and subnormal series, composition series, Jordan-Holder theorem; solvable groups; Nilpotent groups.

UNIT III

Conjugacy classes in S_n and A_n; simplicity of A_n; direct product; structure theorem for finite abelian groups; invariants of a finite abelian group; Sylow's theorems (proofs using group actions) and their applications.

UNIT IV

Basic properties and examples of ring, domain, division ring and field; division ring of quaternion; rings of continuous functions; matrix rings; direct products of rings; idempotent and nilpotent element in a ring; characteristic of a domain; field of fractions of an integral domain; ring homomorphisms (always unitary); ideals; factor rings; prime and maximal ideals, principal ideal domain; Euclidean domain; unique factorization domain.

UNIT V

A brief review of polynomial rings over a field; reducible and irreducible polynomials, Gauss theorem for reducibility of $f(x) \in \mathbf{Z}[x]$; Eisenstein's criterion for irreducibility of $f(x) \in \mathbf{Z}[x]$ over $\mathbf{Q}$, roots of polynomials; finite fields of orders 4, 8, 9 and 27 using irreducible polynomials over $\mathbf{Z}_2$ and $\mathbf{Z}_3$.

Textbooks:

4. Basic Abstract Algebra (3rd edition) – P.B. Bhattacharya, S. K. Jain and S. R. Nagpal, Cambridge University Press, 2000.
5. Basic Algebra I (3rd edition) – N. Jacobson, Hindustan Publishing corporation, New Delhi, 2002.
6. Contemporary Abstract Algebra (4th edition) – J. A. Gallian, Narosa Publishing House, New Delhi, 1999.

Reference books:

1. Topics in Algebra (4th edition) – I. N. Herstein, Wiley Eastern Limited, New Delhi, 2003.
2. A First Course in Abstract Algebra (4th edition) – J. B. Fraleigh, Narosa Publishing House, New Delhi, 2002.
3. Abstract Algebra – D.S. Dummit, R.M. Foote, John Wiley&Sons (2003)

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MM22: ANALYSIS

UNIT-I

Limits of functions, continuous functions, continuity and compactness, uniform continuity, continuity and connectedness, intermediate value theorem; discontinuities and their classifications, monotonic functions, infinite limits and limits at infinity.

UNIT-II

Differentiation of real-valued functions and its elementary properties; mean value theorem; Taylor's theorem; differentiation of vector-valued functions; elementary properties of Riemann integral (brief review); integration of vector-valued functions.

UNIT-III

Sequences of functions, pointwise and uniform convergence; uniform convergence and continuity; completeness of C(X); uniform convergence and integration; uniform convergence and differentiation; nowhere differentiable functions; Stone-Weierstrass theorem for complex valued functions on an interval.

UNIT-IV

Directional derivatives; derivatives of functions of several variables and their interrelationship; chain rule; mean value theorem; higher order partial

derivatives; equality of mixed partial derivatives, Schwarz lemma; Taylor's theorem.

UNIT-V

Inverse function theorem; implicit function theorem; extremum problems with and without constraints.

Textbooks:

1. Principles of Mathematical Analysis (5th edition) – W. Rudin, McGraw Hill Kogakusha Ltd., 2004.
2. Mathematical Analysis (5th edition) – T. Apostol, Addison-Wesley; Publishing Company, 2001.
3. The Elements of Real Analysis (3rd edition) – R. G. Bartle, Wiley International Edition, 1994.

Reference books:

1. Advanced Calculus (4th Edition) – R.C. Buck & E.F. Buck, McGraw Hill Book Company, 1999.
2. Introduction to Topology and Modern Analysis (4th edition) – G. F. Simmons, McGraw Hill Kogakusha Ltd., 2000.
3. Introduction to Real Analysis (3rd edition) – R. G. Bartle and D. R. Sherbert, John Wiley & Sons, Inc., New York, 2000.

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MM23: LINEAR ALGEBRA

UNIT-I

Vector spaces and their basic properties; linear transformations, rank and nullity of linear transformations, vector space of linear transformations, algebra of linear transformations, invertible linear transformations, nilpotent transformations; minimal polynomials; matrix representation of a linear transformation; isomorphism between the algebra of linear transformations and that of matrices; similarity of matrices and linear transformations; trace of matrices and linear transformations.

UNIT-II

Characteristic roots and characteristic vectors, characteristic polynomials, relation between characteristic polynomial and minimal polynomial; Cayley-Hamilton theorem (statement and illustrations only);

diagonalizability, necessary and sufficient condition for diagonalizability; projections and their relation with direct sum decomposition of vector spaces; invariant subspaces; primary decomposition theorem.

UNIT-III

Cyclic subspaces; companion matrices; a proof of Cayley-Hamilton theorem; triangulability; canonical forms of nilpotent transformations; Jordan canonical forms; rational canonical forms.

UNIT-IV

Inner product spaces, properties of inner products and norms, Cauchy-Schwarz inequality; orthogonality and orthogonal complements, orthonormal basis, Gram-Schmidt process; adjoint of a linear transformation; Hermitian, unitary and normal transformations and their diagonalizations.

UNIT-V

Forms on inner product spaces and their matrix representations; bilinear forms; Hermitian forms; symmetric bilinear forms; orthogonal diagonalization of real quadratic forms.

Textbooks:

1. Topics in Algebra (4^{th} edition) – I. N. Herstein, Wiley Eastern Limited, New Delhi, 2003.
2. Linear Algebra (2^{nd} edition) – K. Hoffman and R. Kunze, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
4. First Course in Linear Algebra – P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Wiley Eastern Ltd., New Delhi, 2000.

Reference books:

1. Linear Algebra – G. E. Shilov, Prentice Hall, 1998.
2. Finite Dimensional Vector Spaces – P. R. Halmos, Van Nostrand Inc., 1965.
3. Introduction to Matrices and Linear Transformations (3^{rd} edition) – D. T. Finkbeiner, D.B. Taraporevala, Bombay, 1990.
4. Linear Algebra, A Geometric Approach – S. Kumaresan, Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.

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MM24: PARTIAL DIFFERENTIAL EQUATIONS

UNIT I

Definition of PDE, origin of first-order PDE; determination of integral surfaces of linear first order partial differential equations passing through a given curve; surfaces orthogonal to given system of surfaces; non-linear PDE of first order, Cauchy's method of characteristic; compatible system of first order PDE; Charpit's method of solution, solutions satisfying given conditions, Jacobi's method of solution.

UNIT II

Origin of second order PDE, linear second order PDE with constant coefficients, linear second order PDE with variable coefficients; characteristic curves of the second order PDE; Monge's method of solution of non-linear PDE of second order.

UNIT III

Separation of variables in a PDE; Laplace's equation, elementary solutions of Laplace's equations; families of equipotential surfaces.

UNIT IV

Wave equation, the occurrence of wave equations, elementary solutions of one-dimensional wave equation; vibrating membranes, three dimensional problems.

UNIT V

Diffusion equation, resolution of boundary value problems for diffusion equation, elementary solutions of diffusion equation, separation of variables.

Text Book:

1. Elements of Partial Differential Equation (3rd edition) – I. N. Sneddon, McGraw Hill Book Company, 1998.

Reference Book:

2. Partial Differential Equations (2nd edition) – E. T. Copson, Cambridge University Press, 1995.

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5:2:3(18)

MM25: TOPOLOGY

UNIT I

Definition and examples of topological spaces; basis and sub basis; order relations, dictionary order, order topology; subspace topology; Kuratowski's closure axioms.

UNIT II

Continuity and related concepts; product topology; quotient topology; a brief introduction to minimal uncountable well ordered set S_Ω; countability axioms; Lindelof spaces and separable spaces.

UNIT III

Connected spaces, connected sets in $\mathbb{R}$; component, path component; local connectedness, local path connectedness.

UNIT IV

Compact spaces; limit point compact; sequentially compact spaces; locally compact spaces; one point compactification; finite product of compact spaces, statement of Tychonoff's theorem.

UNIT V

Separation axioms; Urysohn's lemma; Tietze's extension theorem; statement of Urysohn's metrization theorem.

Textbooks:

1. Topology, a first course – J. R. Munkres, Prentice-Hall of India Ltd., New Delhi, 2000.
2. General Topology – J. L. Kelley, Springer Verlag, New York, 1990.
3. An introduction to general topology (2^{nd} edition) – K. D. Joshi, Wiley Eastern Ltd., New Delhi, 2002.

Reference books:

1. General Topology – J. Dugundji, Universal Book Stall, New Delhi, 1990.
2. Foundations of General Topology – W. J. Pervin, Academic Press, New York, 1964.
3. General Topology – S. Willard, Addison-Wesley Publishing Company, Massachusetts, 1970.

4. Basic Topology – M.A. Armstrong, Springer International Ed. 2005.

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MM31: COMPUTER PROGRAMMING

UNIT I

Working of a digital computer; machine language on a small hypothetical computer; decimal, binary, octal and hexadecimal representation of numbers and mutual conversions; remarks about logic gates and machine language in binary system; high level language, character sets for FORTRAN and C; constants and variables in FORTRAN and C; arithmetic expressions in FORTRAN and C; arithmetic statements in FORTRAN; assignment and multiple assignments and mode of statements in C; built-in functions and libraries in FORTRAN and C; input and output statements in FORTRAN and C; comment statements; data types; TYPE declarations; statement labels; elementary programs in FORTRAN and C.

UNIT II

Logical IF statements in FORTRAN and C; GOTO, nested logical IF, arithmetic IF, computed GOTO and assigned GOTO statements in FORTRAN; switch, break, continue GOTO statements in C; DO loops, nested DO loops, REPEAT WHILE structures in FORTRAN; WHILE, FOR, DO WHILE loops in C.

UNIT III

Subscripted variables and arrays in FORTRAN and C; single and multiple subscripts, dimension statements, assigned DO type notations for input/output of arrays, DO loops with subscripts in FORTRAN; array variables, syntax rules, use of multiple subscripts in arrays, reading and writing multi-dimensional arrays, for loops, for arrays in C; format specifications in FORTRAN and C.

UNIT IV

Statement functions, functions subprogram, COMMON statements, use of procedure names and arguments in FORTRAN; character manipulation, execution time format declaration, EQUIVALENCE declarations in FORTRAN; some algorithms and programs on theory of matrices and numbers.

UNIT V

Function definition, function prototypes, arguments, call by value, call by reference, pointers, character arrays, automatic variables in C; external variables and scopes in C; some applications of C.

Textbooks:

1. Computer Programming in FORTRAN 77 – V. Rajaraman, Prentice-Hall of India Pvt. Ltd., 2005.
2. Computer Programming in C – V. Rajaraman, Prentice-Hall of India Pvt. Ltd., 2005.
3. Computer Applications of Mathematics and Statistics – A. K. Chattapadhyay and T. Chattapadhyay, Asian Books Pvt. Ltd., New Delhi, 2005.

Reference books:

1. Computer Programming in FORTRAN IV – V. K. Gupta, Pragati Prakashan, 2004.
2. The C Programming Language – B. W. Kernighan and D. M. Ritchie, Prentice Hall, India, 1995.
3. Computer Programming for FORTRAN 77 – Ramkumar, Tata McGraw Hill, 2002.
4. Primes and Programming – An Introduction to Number Theory with Programming – P. Goblin, Cambridge University Press, 1993.

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MM32: COMPLEX FUNCTION THEORY

UNIT I

Brief theory of formal power series, radius of convergence of power series, exponential, cosine and sine, logarithm functions introduced as power series, their elementary properties.

UNIT II

Integration of complex-valued functions and differential 1-forms along a piecewise differentiable path, primitive , local primitive and primitive along a path of a differential 1-form, homotopic pats, simply connected domains. index of a closed path, holomorphic functions, Cauchy's theorem and its corollaries.

UNIT III

Cauchy's integral formula, Taylor's expansion of holomorphic functions, Cauchy's estimate; Liouville's theorem; fundamental theorem of algebra; zeros of an analytic function and related results; maximum modulus theorem; Schwarz' lemma.

UNIT IV

Laurents's expansion of a holomorphic function in an annulus, singularitiesof a function, removable singularities, poles and essential singularities; extended plane nd stereographic projection, residues, calculus of residues; evaluation of definite integrals; argument principle; Rouche's Theorem.

UNIT V

Complex form of equations of straight lines, half planes, circles, etc., analytic (holomorphic) function as mappings; conformal maps; Mobius transformation; cross ratio; symmetry and orientation principle; examples of images of regions under elementary analytic function.

Textbooks:

1. Functions of one complex variable – J. B. Conway, Springer International Student edition, Narosa Publishing House, New Delhi, 2000.
2. Elementary Theory of Analytic Functions of one or several complex variables – H. Cartan, Courier Dover Publications, New York, 1995.

Reference books:

1. Complex Analysis (2^{nd} Edition) – L. V. Ahlfors, McGraw-Hill International Student Edition, 1990.
2. Complex Variables and applications – R. V. Churchill, McGraw-Hill, 1996.
3. An Introduction to the Theory of functions of a complex Variable – E. T. Copson, Oxford university press, 1995.
4. An Introduction To Complex Analysis – A. R. Shastri, Macmillan India Ltd., 2003.
5. Complex Variables and Applications – S. Ponnusamy, and H. Silverman, Birhkäuser, 2006.

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MM35: COMPUTER PROGRAMING (PRACTICAL)

The following programs are to be practised:

1. Determination of roots of quadratic equations, $Ax^2+Bx+C=0$.
2. Arranging given set of numbers in increasing/decreasing order, calculation of Mean.
3. Evaluation of sum of power series eg. e^x, sin x, cos x, log (1 + x).
4. Calculation of GCD/LCM of two integers.
5. Evaluation of factorial of a positive integer and evaluation of binomial coefficients.
6. Evaluation of factorial of binomial coefficients mod 2.
7. Sieve method for primality test.
8. Generation of twin primes.
9. Solution of congruence using complete residue system.
10. Evaluation Legendre polynomial from recurrence relation.
11. Addition, subtraction and multiplication of matrices.
12. Transpose, determinant (up to order 4).
13. Inversion of real matrices (up to order 4).
14. Searching a pattern in a given text and replacing every occurrence of it with another given string.
15. Writing a given number in words using function.
16. Arranging a set of names in alphabetical order.

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MM41: NUMERICAL ANALYSIS

UNIT I

A brief introduction to algebraic and transcendental equations and their roots; direct and iterative methods for determination of roots of these equations; initial approximations; bisection method, secant method, Regula-Falsi method, Newton-Raphson method for determination of roots of algebraic and transcendental equations; error analysis, rate of convergence and algorithm for each of these methods.

UNIT II

A brief introduction to systems of linear algebraic equations and their solutions, eigenvalue problem and its solution; direct and iterative methods; forward and backward substitution method; Cramer's rule; Gauss elimination method: Gauss-Jordan elimination method; Gauss-Jacobi iteration method; Gauss-Seidel iteration method; power method for eigenvalue problem; iterative method for matrix inversion; error analysis, rate of convergence and algorithm for each of these methods.

UNIT III

Lagrange and Newton interpolation; Lagrange interpolating polynomial and Newton divided differences interpolating polynomial; linear interpolation; Newton's divided difference interpolation and its generalizations; finite difference operators; relation between differences and derivatives; Gregory-Newton forward and backward difference interpolation; truncation error bounds and algorithm for each of these interpolations.

UNIT IV

Differentiation and integration; numerical differentiation; methods based on linear and quadratic interpolation with error of approximation; methods based on finite differences; optimum choice of step length; numerical integration; methods based on interpolation; determination of the error term; trapezoidal rule; Simpson's rule; error of integration; algorithms for numerical differentiation and integration.

UNIT V

Ordinary differential equations and their numerical solutions; initial value problems; error estimates; Euler-Richardson method, Runge-Kutta methods and Predictor-Corrector method; error analysis and algorithm for each of these methods; partial differential equations; finite-difference method with error analysis and algorithm.

Textbooks:

1. Numerical Methods for scientific and Engineering computation – M. K. Jain, S. R. K. Iyenger and R. K. Jain, New Age international publishers, New Delhi, 2003.
2. Fundamental of Computer Numerical Analysis – M. Friedman and A. Kandel, CRC Press, Boca Raton, 1993.

3. Applied Numerical Analysis (5th edition) – C. F. Gerald and P. O. Wheatley, Addison-Wesley, New York, 1998.
4.

Reference books:

1. Introduction to Numerical Analysis (2nd edition) – K. E. Atkinson, John Wiley, 1989.
2. Elementary Numerical Analysis: An Algorithmic Approach (3rd edition) – S. D. Conte and C. de Boor, McGraw Hill, New York, 1980.
3. Numerical Mathematical Analysis – J. B. Scarborough, Oxford & IBH Publishing Co., 2001.
4. Computer Oriented Numerical Analysis – V. Rajaraman, Prentice-Hall of India Pvt. Ltd., 2002.

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MM45: Computer Oriented Numerical Analysis (Practical)

The following programs are to be practised:

1. Solving simple/algebraic/transcendental equations; Newton's method (real roots only),
2. Solutions of system of linear equations, using Gauss' elimination method.
3. Solutions of system of linear equations, using Gauss-Siedel Iterative method.
4. Matrix inversion using Gauss' elimination method.
5. Matrix inversion using Gauss-Jordan method.
6. Power method for finding largest Eigen value.
7. Interpolation using Lagrange's formula.
8. Interpolation using Newton's divided difference formula.
9. Numerical differentiation using Newton's formula.
10. Numerical differentiation using Lagrange's formula.
11. Numerical integration using trapezoidal rule.
12. Numerical integration using Simpson's rules.
13. Improving the numerical integral using Richardson's Extrapolation.
14. Numerical solutions of ordinary differential equations (initial value problems) using Euler-Richardson method.
15. Numerical solutions of ordinary differential equations (initial value problems) using Runge-Kutta methods.
16. Numerical solutions of ordinary differential equations (initial value problems) using Predictor-Corrector method.

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OPTIONAL PAPERS

OP1: DIFFERENTIAL GEOMETRY

UNIT I

Vectors; tangent vectors; tangent spaces; tangent vector fields; derivative mappings; translations; affine transformations and rigid motions (isometries); exterior derivatives.

UNIT II

Space curves; arc length; tangent vectors and vector fields on a curve; curvature and torsion; Serret-Frenet formulas; osculating plane; osculating circle; osculating sphere; fundamental theorem of local theory of space curves (existence and uniqueness theorems).

UNIT III

Surfaces and their (local) parametrization on coordinate systems; change of parameters; parametrized surfaces; curves on surfaces; tangent and normal vectors; tangent and normal vector fields on a surface; first, second and third fundamental forms of a surface at a point; Gauss mapping.

UNIT IV

Normal sections and normal curvature of a surface at a point; Meusnier's theorem; elliptic, hyperbolic, parabolic and planar points; Dupin indicatrix; principal directions; principal curvatures of a surface at a point; Mean curvature and Gaussian curvature of a surface at a point.

UNIT V

Line of curvature; asymptotic curves; conjugate directions; fundamental equations of the local theory of surfaces; statement of Bonnet's fundamental theorem of local theory of surfaces.

Textbook:

1. A first course in Differential Geometry – Chun-Chin Hsiung, Willey-Interscience Publications, John Wiley & Sons, 1981.

Reference books:

1. A treatise on the differential geometry of curves and surfaces – P. Eissenhart, Dover Publications, Inc., New York, 1960.
2. Differential Geometry of three dimensions – C. R. Weatherburn, The English Language Book Society and Cambridge University Press, 1964.
3. An Introduction to differential geometry – T. S. Willmore, Oxford, Clarendon Press, 1979.

4. A course in differential geometry – W. Klingenberg, Graduate Texts in Mathematics 51, Springer-Verlag, 1978.
5. Elementary differential Geometry – A. Pressley, Springer International Edition, 2005.

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OP2: THEORY OF RELATIVITY

UNIT I

The special theory of relativity: inertial frames of reference; postulates of the special theory of relativity; Lorentz transformations; length contraction; time dilation; variation of mass; composition of velocities; relativistic mechanics; world events, world regions and light cone; Minkowski space-time; equivalence of mass and energy.

UNIT II

Energy-momentum tensors: the action principle; the electromagnetic theory; energy-momentum tensors (general); energy-momentum tensors (special cases); conservation laws.

UNIT III

General Theory of Relativity: introduction; principle of covariance; principle of equivalence; derivation of Einstein's equation; Newtonian approximation of Einstein's equations.

UNIT IV

Solution of Einstein's equation and tests of general relativity: Schwarzschild solution; particle and photon orbits in Schwarzschild space-time; gravitational red shift; planetary motion; bending of light; radar echo delay.

UNIT V

Brans-Dicke theory: scalar tensor theory and higher derivative gravity; Kaluza-Klein theory.

Textbooks:

1. The Theory of Relativity (2nd edition) – R.K. Pathria, Hindustan Publishing co. Delhi, 1994.
2. General Relativity & Cosmology (2nd edition) – J.V. Narlikar, Macmillan co. of India Limited, 1988.

Reference books:

1. Aspects of Gravitational Interactions – S. K. Srivastava and K. P. Sinha, Nova Science Publishers Inc. Commack, New York , 1998.
2. Essential Relativity – W. Rindler, Springer-Verlag, 1977.
3. General Relativity – R.M. Wald, University of Chicago Press, 1984.

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OP3: THEORY OF FIELD EXTENSIONS

UNIT I

A brief review of basic properties of polynomial rings over a field; reducible and irreducible polynomials, Gauss theorem for reducibility of $f(x) \in \mathbf{Z}[x]$, Eisenstein criterion for irreducibility of $f(x) \in \mathbf{Z}[x]$ over $\mathbf{Q}$; extension fields, finite extensions; algebraic and transcendental elements, adjunction of algebraic elements, Kronecker theorem, algebraic extensions.

UNIT II

Splitting fields – existence and uniqueness; extension of base field isomorphism to splitting fields; simple and multiple roots of polynomials, criterion for simple roots, separable and inseparable polynomials; perfect fields; separable and inseparable extensions.

UNIT III

Finite fields; prime fields and their relation to splitting fields; Frobenius endomorphisms; Mobius inversion formula; number of monic irreducible polynomials of given degree over a finite field; resultant and discriminant of polynomials; Stickleberger's theorem.

UNIT IV

Algebraically closed fields and algebraic closures, existence and uniqueness of algebraic closure; primitive element theorem; normal extensions; automorphism groups and fixed fields; Galois pairing; determination of Galois groups, fundamental theorem of Galois theory, fundamental theorem of algebra.

UNIT V

Roots of unity and cyclotomic polynomials; cyclic extensions; sovability by radicals; solvability of algebraic equations; symmetric functions; ruler and compass constructions.

Textbooks:

1. Basic Abstract Algebra (3rd edition) – P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Cambridge University Press, 2000.
2. Basic Algebra I (3rd edition) – N. Jacobson, Hindustan Publishing corporation, New Delhi, 2002.
3. Galois Theory – T. I. F. R. Mathematical pamphlets, No. 3, 1965

Reference books:

1. Topics in Algebra (4th edition) – I. N. Herstein, Wiley Eastern Limited, New Delhi, 2003.
2. A First Course in Abstract Algebra (4th edition) – J. B. Fraleigh, Narosa Publishing House, New Delhi, 2002.
7. Contemporary Abstract Algebra (5th edition) – J. A. Gallian, University of Minnesota, Duluth, 2004.

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OP4: FLUID MECHANICS

UNIT I

Lagrangian and Eulerian methods of description; Governing equations of fluid motion; stream line; velocity potential, path line, velocity and circulation; equations of continuity in Lagrangian and Eulerian methods; equivalence of the two forms of equations of continuity; Boundary surface; acceleration; Euler's equations of motion; integrals of Euler's equations of motion, Lagrange's equations of motion; Cauchy's integrals; equation of energy.

UNIT II

Motion in two dimensions; stream function; complex potential; source; sink and doublet; image, images in two dimensions, images of a source with regard to a plane, a circle and a sphere; image of a doublet; circle theorem; theorem of Blasius.

UNIT III

Vortex Motion, Helmholtz properties of vortices, velocity in a vortex field, motion of a circular vortex, infinite rows of vortices, Ka'rma'n vortex street.

UNIT IV

Viscous fluid, Stokes-Navier equations; diffusion of vorticity, dissipation of energy; steady motion of a viscous fluid between two parallel planes; steady flow through cylindrical pipes; Reynolds' number.

UNIT V

Waves in liquids; equations of small amplitude wave motion (gravity waves); simple harmonic progressive waves in liquids of finite depth; group velocity and wave velocity, energy of waves; transmission of energy; equations of long wave motion (tidal waves); long waves in a canal.

Textbooks:

1. A treatise of Hydromechanics (3rd edition) – W. H. Besant, A. S. Ramsey and G. Bell, 1997.
2. Ideal and Incompressible Fluid Dynamics – M. E. O'Neill and F. Chorlton, John Wiley publications, 1986.

Reference books:

1. Theoretical Hydrodynamics – L. M. Milne-Thomson, Macmillan Publishing co., 1985.
2. Text Book of Fluid Dynamics – F. Chorlton, Van Nostrand Reinhold Co., London, 1990.

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OP5: MEASURE THEORY AND FUNCTIONAL ANALYSIS

UNIT I

Ring and σ-rings of sets, rings and σ-rings of sets generated by a family of subsets; set functions; construction of the Lebesgue measure, a non-measurable set; Borel sets; Cantor set.

UNIT H

Measure spaces; measurable functions, simple functions; Lebesgue integration on a measurable space; Lebesgue's monotone convergence theorem, Fatou's lemma, Lebesgue's dominated convergence theorem; comparison of Lebesgue integral with Riemann integral.

UNIT III

Classical Banach spaces, L^p spaces; Holder's inequality, Minkowski's inequality; convergence and completeness; Riesz-Fischer theorem; bounded linear functionals on L^p spaces, Riesz representation theorem.

UNIT IV

General Banach spaces – definition and examples; continuous linear transformations between normed linear spaces; Hahn-Banach theorem and its consequences.

UNIT V

Embedding of a normed linear space in its second conjugate space; strong and weak topologies; open mapping theorem; closed graph theorem; uniform boundedness theorem; Hilbert spaces – definition and examples.

Textbooks:

1. Principles of Mathematical Analysis (5^{th} edition) – W. Rudin, McGraw Hill Kogakusha Ltd., 2004.
2. Real Analysis (4^{th} edition) – H. L. Royden, Macmillan Publishing co. inc, New York, 1999.
3. Introduction to Topology and Modern Analysis (4^{th} edition) – G. F. Simmons, McGraw Hill Kogakusha Ltd., 2000.

Reference books:

1. Measure Theory and Integration – G. de Barra, Wiley Eastern Ltd, New Delhi, 1997.
2. Functional Analysis – W. Rudin, Tata McGraw hill Book Company, 1974
3. Functional Analysis – B. V. Limaye, Willy Eastern Ltd., 1991.
4. First course in Functional Analysis – C.Goffman and G. Pedrick, Prentice-Hall of India Pvt. Ltd, New Delhi, 1974.
5. Measure Theory – P.R. Halmos, Springer International Student Edition, Narosa Publishing House, New Delhi, 1991.

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OP6: MATHEMATICAL METHODS

UNIT I

Laplace transforms, properties of Laplace transform, inversion formula convolution, application to ordinary and partial differential equations; Fourier

transform, properties of Fourier transform, inversion formula, convolution, Parseval's equality; Fourier transform of generalized functions, application of transforms to heat wave and Laplace equation.

UNIT II

Formulation of integral equations, integral equations of Fredholm and Volterra type, solution by successive substitution and successive approximation; integral equations with degenerate kernels.

UNIT III

Integral equations of convolution type and their solutions by Laplace transform, Fredholm's theorems; integral equations with symmetric kernel; eigenvalues and eigenfunctions of integral equations and their simple properties.

UNIT IV

Generalized functions; Minusinkski's operational calculus of one variable (algebra of addition and convolution of functions, ordered pairs of functions, convolution quotients of a function with a nonzero function), Dirac delta function.

UNIT V

Eigenvalue problem; ordinary differential equations of the Sturm-Liouville type; eigenvalues and eigenfunctions; expansion theorem; extrema properties of the eigenvalues of linear differential operators, formulation of the eigenvalue problem of a differential operator as a problem of integral equation.

Textbooks:

1. Laplace Transform Theory – M. G. Smith, Van Nostrand Inc., 2000.
2. Generalized Functions and Partial Differential Equations – G. E. Shilov, Bernard Seckler, Gordon and Breach, 1999.
3. Integral Equations – David Porter and David S. G. Stirling, Cambridge University Press, 1993.

Reference books:

1. The Use of Integral Transforms – I. N. Sneddon, Tata McGraw Hill, New Delhi, 1974.
2. Fourier Transforms – R. R. Goldberg, Cambridge University Press, 1970.
3. Lectures on integral equations – H. Widom, Van Nostrand, 1969.

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OP7: RING THEORY

UNIT I

Basic concepts of rings, modules, operations on ideals and sub-modules: matrix rings, polynomial rings; direct products of rings; fields and division rings; idempotent and nilpotent elements in a ring.

UNIT II

Isomorphism theorems; exact sequences; the group of homomorphisms and its properties relative to exact sequences.

UNIT HI

Direct sums and direct products of modules, external and internal direct sums, direct summands; Zorn's lemma, every vector space has a basis; free modules and projective modules; torsion free and torsion modules over commutative domains; exact sequences and projectivity.

UNIT IV

Injective modules, injectivity and divisibility over domains; exact sequences and injectivity; Baer's theorem and its elementary applications; simple modules, semisimple modules (as per Bourbaki); Schur's lemma.

UNIT V

Equivalent conditions for semisimple modules; Wedderburn structure theorem (only statement); characterization of semisimple rings via projective and injective modules.

Textbooks:

1. Elementary Rings and Modules – I. T. Adamson, Oliver and Boyd. Edinburgh, 1995.
2. Notes on Homological Algebra – J. J. Rotman, Van nostrand, 1990.
3. Basic Algebra II (3rd edition) – N. Jacobson, Hindustan Publishing Corporation, New Delhi, 2002.

Reference books:

1. Algebra, Second Edition – S. Lang, Addison-Wesley, Massachusetts, 1984.
2. Algebra, Vol. 2: Rings – I. S. Luthar and I.B.S. Passi, Narosa Publishing House, New Delhi, 1999.

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OP8: *p*-ADIC ANALYSIS

UNIT I

Norm on a field; Archimedean and non-Archimedean norm; *p*-adic norm on rationals; metric induced by a norm; isosceles triangle principle; equivalent norm; Ostrowski's theorem.

UNIT II

Completion $\mathbb{Q}_p$ of $\mathbb{Q}$ with respect to the *p*-adic norm; *p*-adic numbers and *p*-adic integers; standard expansion of *p*-adic numbers; arithmetic in $\mathbb{Q}_p$; Hensel's lemma; sequence and series in $\mathbb{Q}_p$, exponential and logarithmic series in $\mathbb{Q}_p$.

UNIT III

Topology on $\mathbb{Q}_p$; existence of nontrivial locally constant functions; Teichmuller functions and expansions; compactness and sequential compactness of $\mathbb{Z}_p$; continuous functions from $\mathbb{Z}_p$ to $\mathbb{Q}_p$.

UNIT IV

A brief introduction to Mahler expansion and Mahler coefficients of a continuous function from $\mathbb{Z}_p$ to $\mathbb{Q}_p$; *p*-adic interpolation; *p*-adic gamma function and its elementary properties; Gauss multiplication formula; Mahler's expansion of gamma function; the 2-adic gamma function.

UNIT V

Vector space norm and their equivalence; extension of *p*-adic norm from $\mathbb{Q}_p$ to its algebraic closure $\bar{\mathbb{Q}}_p$; incompleteness of $\bar{\mathbb{Q}}_p$; completion Ω of $\bar{\mathbb{Q}}_p$; Krasner's lemma; proof of Ω being algebraically closed.

Textbooks:

1. *p*-adic Number, *p*-adic Analysis, and Zeta-Functions – Neal Koblitz, Graduate Text in Mathematics, vol 58, Springer-Verlag.
2. An Introduction to *p*-adic Number and *p*-adic Analysis – A. J. Baker, Lecture Notes, University of Glasgow.
3. A Course in *p*-adic Analysis – A. M. Robert, Graduate Text in Mathematics, vol. 1998, Springer.

Reference book:

1. Introduction to *p*-adic analytic Number Theory – M. Ram Murty, Lecture notes, Harishchandra Research Institute. Allahabad,2001.

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OP9: RELATIVISTIC COSMOLOGY

UNIT I

Gravitational collapse of a homogeneous dust ball; observational background for cosmology; Weyl's postulates: cosmological principle; Hubble's law; angular size; flux of radiation; surface brightness.

UNIT II

Cosmological field equations for Friedmann models (dust and radiation models); cosmologies with nonzero cosmological constant; cosmic microwave radiation background; Newtonian cosmology.

UNIT III

Perfect cosmological principle; creation of matter; creation field; C-field cosmology; observable parameters of the steady state theory; event horizon.

UNIT IV

Mach's principle, Brans-Dicke theory, Hoyle-Narlikar theory, variation of gravitational constant, Dirac cosmology, white holes.

UNIT V

Big-bang nucleosynthesis; horizon and flatness problems of the early universe; inflation as remedy to these problems, dark energy; dark matter and present cosmic acceleration.

Text Book:

1. General Relativity and Cosmology – J. V. Narlikar, Mcmillan Co of India Ltd., 1978.

Reference books:

1. Gravitation and Cosmology: Principles and Applications – S. Weinberg, John Wiley and sons, 1972.
2. Cosmology and Particle Physics – R. D. Teureiro and M. Quiros, World Scientific, 1988.
3. An Introduction to Cosmology – J. V. Narlikar, Mcmillan Co of India Ltd., 1983.
4. General Relativity – R.M. Wald, University of Chicago Press, 1984.

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OP10: ALGEBRAIC TOPOLOGY

UNIT I

Homotopy of paths, fundamental group of a topological space, fundamental group functor, homotopy of maps of topological spaces; homotopy equivalence; contractible and simply connected spaces; fundamental group of $\mathbb{S}^1$, $\mathbb{S}^1 \times \mathbb{S}^1$ etc.; degree of maps of $\mathbb{S}^1$.

UNIT II

Calculation of fundamental groups of $\mathbb{S}^n$ ($n > 1$) using Van Kampen's theorem (special case); fundamental group of a topological group; Brouwer's fixed point theorem; fundamental theorem of algebra; vector fields, Frobenius theorem on eigenvalues of 3 x 3 matrices.

UNIT III

Covering spaces, unique lifting theorem, path-lifting theorem, covering homotopy theorem, applications; criterion of lifting of maps in terms of fundamental groups; universal coverings and its existence; special cases of manifolds and topological groups.

UNIT IV

Simplicial and singular homology, reduced homology, Eilenberg-Steenrod axioms (without proof), relation between Π_1 and H_1; relative homology.

UNIT V

Calculations of homology of $\mathbb{S}^n$; Brouwer's fixed point theorem for $f: \mathbb{E}^n \to \mathbb{E}^n$ ($n > 2$) and its applications to spheres and vector fields; Meyer-Vietoris sequence and its application.

Textbooks:

1. Topology, a first course – J. R. Munkres, Prentice-Hall of India Ltd., New Delhi, 2000.
2. Algebraic topology, a first course (2nd edition) – M. J. Greenberg and J. R. Harper, Addison-Wesley Publishing co., 1997.
3. Algebraic Topology – A. Hatcher, Cambridge University Press, 2002.

Reference books:

1. Algebraic Topology (2nd edition) – E. H. Spanier, Springer-Verlag, New York, 2000.
2. An Introduction to Algebraic Topology – J. J. Rotman, Graduate Text in Mathematics, No. 119, Springer, New york, 2004.
3. Algebraic topology, a first course (2nd edition) – W. Fulton, Graduate Text in Mathematics, No. 153, Springer, New york, 1995.
4. Foundations of Algebraic Topology (2nd edition) – S. Eilenberg and N. E. Steenrod, Princeton University Press, 1995.

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OP11: ALGEBRAIC GEOMETRY

UNIT I

Introduction; affine varieties, Hilbert's Nullstellensatz, polynomial function and maps; rational functions and maps.

UNIT II

Projective space; projective varieties; rational functions and morphisms; smooth points and dimension, smooth and singular points, algebraic characterizations of the dimension of a variety.

UNIT III

Plane cubic curves, plane curves, intersection multiplicity, classification of smooth cubics, the group structure of an elliptic curve.

UNIT IV

Cubic surfaces, the existence of lines on a cubic, configuration of the 27 lines, rationality of cubics.

UNIT V

Introduction to the theory of curves, divisors on curves, the degree of a principal divisor, Bezout's theorem, linear system on curves, projective embeddings of curves.

Textbook:

1. Elementary Algebraic Geometry – K. Hulek (translated by H. Verrill), Student Mathematical Library, vol 20, American Mathematical Society, 2003.

Reference books:

1. Algebraic Geometry – R. Hartshorne, Springer-Verlag, 1977.
2. Algebraic Geometry: A First Course – J. Harris, Springer-Verlag, 1992.
3. Elliptic Curves – Notes on NBHM Instructional conference held at TIFR, Mumbai, 1991.

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OP12: DYNAMICAL OCEANOGRAPHY

UNIT I

Thermodynamics of equilibrium state; Gibbs' relation; Gibbs-Duhem relation; sea water as a two-component solution; conditions of equilibrium of sea-water; conditions for the absence of convection – Vaisala frequency.

UNIT II

Thermodynamics of irreversible processes; equations of conservation of mass; equations of motion; equations of conservation of energy.

UNIT III

Wave motion in the ocean, basic equations; separation of variables; analysis of the simplest cases.

UNIT IV

Equations of the theory of ocean currents and their properties; equations of evolution of potential vorticity; Boussinesq's approximations; averaging of basis equations; the basis equations in spherical coordinates; coefficients of turbulent exchange; boundary conditions; quasi-static approximation; geostrophic motion.

UNIT V

Ekman theory; wind driven currents in a homogeneous ocean; pure drift current, the basis equations of Ekman theory; vertical structure of the flow-Ekman boundary layers; certain very simple solutions; western boundary current.

Textbooks:

1. Fundamentals of Ocean Dynamics – V. M. Kamenkovich, Elsivier, 1997.
2. Waves in the Ocean – P. H. Leblond and B. A. Mysak, Elsivier, 1987.
3. Thermodynamics and Introduction to Thermo statistics (Second Edition) – Herbert B. Callen, John Willey, 1985.

Reference books:

1. The Theory of Rotating Fluids – H. P. Greenspan, Cambridge University Press, First Edition, 1968.
2. Geo-physical Fluid Dynamics – J. Pedlosky, first edition, Springer-Verlag, 1979.

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OP13: COMMUTATIVE ALGEBRA

UNIT I

Preliminaries on rings and ideals; local and semilocal rings; nilradical and Jacobson radical; operations on ideals; extension and contraction ideals; modules and module homomorphisms; submodules and quotient modules; operations on submodules; annihilator of a module; generators for a module, finitely generated modules; Nakayama's lemma; exact sequences.

UNIT II

Existence and uniqueness of tensor product of two modules; tensor product of n modules; restriction and extension of scalars; exactness properties of tensor products; flat modules.

UNIT III

Multiplicatively closed subsets; saturated subsets; ring of fractions of a ring; localization of a ring; module of fractions and its properties; extended and contracted ideals in a ring of fractions; total ring of fractions of a ring.

UNIT IV

Primary ideals; *p*-primary ideals; primary decomposition, minimal primary decomposition, uniqueness theorems; primary submodules of a module.

UNIT V

Chain conditions, ascending chain conditions on modules; maximal condition; Noetherian modules; descending chain condition; minimal condition; Artinian modules, their properties; Noetherian rings; Hilbert basis theorem; Artinian rings; structure theorem for Artinian rings.

Textbook:

1. Introduction to Commutative Algebra – M. F. Atiyah and I. G. Macdonald, AddisonWesley, 2000.

Reference books:

1. Undergraduate Commutative Algebra – M. Reid, London Math. Soc. Student Texts, No. 29, 1995.
2. Algebra (Volume 2: Rings) – I. S. Luther and I. B. S. Passi, Narosa Publishing House, New Delhi, 1999.
3. Algebra (Volume 3: Modules) – I. S. Luther and I. B. S. Passi, Narosa Publishing House, New Delhi, 1999.
4. Algebra – S. Lang, Addison-Wesley Publishing Company, London, 2000.

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OP14: TENSOR ANALYSIS AND RIEMANNIAN GEOMETRY

UNIT I

Idea of differentiable manifolds with n dimensions; space of n dimensions, subspaces; transformation of coordinates; scalar; contravariant (tengent) and covariant (cotangent) vectors; scalar product of two vectors;

tensor space of rank more than one contravariant and covaniant tensors; symmetric and skew-symmetric tensors; addition and multiplication of tensors; contraction; composition of tensors; quotient law; reciprocal symmetric tensors of the second order.

UNIT II

Riemannian space; fundamental tensor; length of a curve; magnitude of a vector; associated covariant and contravariant vectors; inclination of two vectors, orthogonal vectors; coordinate hypersurfaces; coordinate curves; field of normals to a hypersurface; principal directions for a symmetric covariant tensor of the second order; Euclidean space of n dimensions.

UNIT III

Levi-Civita tensors; Christoffell symbols and second derivatives; need for covariant derivative; parallel transformations; covariant derivative of a contravariant and covariant vector; curl of a vector and its derivative; covariant differentation of a tensor; divergence of a vector.

UNIT IV

Gaussian curvature; Riemann curvature tensor; geodesics; differential equations of geodesics; geodesic coordinates; geodesic deviation; Riemannian coordinates; geodesic in Euclidean space; straight lines.

UNIT V

Parallel transport along an extended curve; curvature tensor; Bianchi identities; Ricci tensor; scalar curvature; Killing vector field; space-time symmetries (homogeneity and isotropy); space time of constant curvature; conformal transformations.

Textbooks:

1. An Introduction to Riemannian Geometry and Tensor Calculus – C. E. Weatherburn, Cambridge university Press, 1986.
2. General Relativity and Cosmology – J. V. Narlikar, The Mac-Millan Company of India Ltd., 1978.

Reference books:

1. Aspects of Gravitational Interactions – S. K. Srivastava & K. P. Sinha, Nova Science publications Inc., Commack, NY, 1998.
2. Tensor Analysis – 1. S. Sokolnikoff, John Wiley & Sons, Inc., 1964.

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5&2&3(42)

OP15: NON-LINEAR DYNAMICAL SYSTEMS

UNIT I

First order continuous autonomous systems – some terminology, classification of fixed points of autonomous systems, attractors and repellors, natural boundaries, case study: population growth.

UNIT II

Second order continuous autonomous systems – autonomous second order systems, constant cofficient equations, phase curves and fixed points, classification of fixed points of linear systems, analyzing non-linear systems, case studies: lead absorption in the body, interacting species.

UNIT III

Discrete Systems – examples of discrete systems, some terminology, linear discrete systems, non-linear discrete systems, quadratic maps.

UNIT IV

Bifurcations in one-dimensional flows – introduction, saddle-node bifurcation. transcritical bifurcation, Pitchfork bifurcation.

UNIT V

Bifurcation in two-dimensional flows – saddle-node, transcritical, and Pitchfork bifurcations, Hopf bifurcations.

Textbooks:

1. Introduction to Non-Linear Systems – J.Berry and Arnold, Great Britain 1996.
2. Non Linear Dynamics and Chaos – S. H. Strogatz, Addision- Wesley Publishing Company, USA, 1994.

Reference books:

1. Introduction to Applied Non-Linear Dynamical systems and Chaos (Vol-2)– S. Wiggins, TAM, Springer-Verlag, NewYork, 1990.
2. Differential Equations, Dynamical Sysstems and an Introduction to Chaos – M.W. Hirsch, S. Smale, and R.L. Devaney, Elsevier (2004).

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Proposed "Choice-Based Credit System" at NEHU (Mathematics Department)

1. M.Sc. Mathematics shall be associated with credit value 178.

2. Out of 178 credits a student has to earn at least 148 credits from the courses offered by the Department of Mathematics which include all the compulsory papers and any two optional papers.

3. Students shall be allowed to chose courses of 30 credits of her/his own choice, in consultation with her/his advisor, from among courses offered by NEHU or any other University or Institute following CBCS in their M.Sc. programme, and recognized by NEHU for such purpose.

4. A student is deemed to have completed a course successfully and earned the appropriate credit if and only if he passes the course.

COURSE STRUCTURE
SEMESTER-WISE DISTRIBUTION
UNDER CHOICE-BASED-CREDIT-SYSTEM

Abbreviations: L = Lectures per week, T = tutorials per week, P = practicals per week, C = credits.

First Semester

Code	Name of paper	L	T	P	C
MM11	Elementary Number Theory	4	1	0	10
MM12	Topics in Basic Mathematical Structures	4	1	0	10
MM13	Classical Mechanics	4	1	0	10
MM14	Ordinary Differential Equations and Environment	4	1	0	10
	TOTAL	16	4	0	40

Contact hours per week: 20

Second Semester

Code	Name of paper	L	T	P	C
MM21	Algebra	4	1	0	10
MM22	Analysis	4	1	0	10
MM23	Linear Algebra	4	1	0	10
MM24	Partial Differential Equations	4	1	0	10
MM25	Topology	4	1	0	10
	TOTAL	20	5	0	50

Contact hours per week: 25

Third Semester

Code	Name of paper	L	T	P	C
MM31	Computer Programming	4	1	0	10
MM32	Complex Function Theory	4	1	0	10
MM33	Optional paper	4	1	0	10
MM34	Optional paper	4	1	0	10
MM35	Computer Programming (Practical)	0	0	4	4
	TOTAL	16	4	4	44

Contact hours per week: 24

Fourth Semester

Code	Name of paper	L	T	P	C
MM41	Numerical Analysis	4	1	0	10
MM42	Optional paper	4	1	0	10
MM43	Optional paper	4	1	0	10
MM44	Optional paper	4	1	0	10
MM45	Computer Oriented Numerical Analysis (Practical)	0	0	4	4
	TOTAL	16	4	4	44

Contact hours per week: 24

(v) Course on Law: Course No.4.2 History il
(Legal and Constitutional History).

The School Board of Social Sciences in its meeting held on 27.10.06 approved Course No:4:2 History II (Legal and constitutional History) for the Law Department as at Annexure 'A'.

The matter is placed before the Council for consideration.

Revised

5: 2: 5(2)

ANNEXURE 'A'

4.2 - HISTORY - II

(Legal and Constitutional History)

(The entire syllabus is divided into five units. Ten questions shall be set in all with two questions from each unit. The candidates shall be required to answer five questions in all selecting one from each unit. All questions carry equal marks)

UNIT - 1

[Early Developments (1600 – 1836)]

- Charters of the East India Company: 1600, 1661, 1726 and 1753
- Settlements: Surat, Madras, Bombay and Calcutta
- Courts: Mayor's Court of 1726 and Supreme Court of 1774
- Statutes: Regulating Act, 1773; The Act of Settlement 1781, Pitts India Act, 1784.

UNIT - II

(Judicial Reforms)

- Conflict: Raja Nand Kumar, Patna Case and Cossijurah
- Warren Hastings: Judicial Plans of 1772, 1774 and 1780
- Lord Cornwallis: Judicial Plans of 1787, 1790 and 1793
- Lord William Bentinck (With special focus on Appraisal of Criminal Law)

UNIT - III

(Evolution of Law and Legal Institutions)

- Development of Personal Laws
- Development of Law in Presidency Towns
- Development of Civil law in Mofussil: Special Emphasis on Justice, Equity and Good Conscience
- Codification of Laws: The Charter of 1833, The First Law Commission, The Charter of 1853, The Second Law Commission
- Establishment of High Courts, 1861
- Privy Council and Federal Court: Appeals and working of Privy Council, Appraisal of Privy Council, Features of Federal Court

UNIT - IV

(Legal Profession and Education)

- Early Developments through Mayor's Court, Supreme Court, Company's Adalat, High Court, Legal Practitioners Act of 1879
- Legal Education: History and Basic Aims of Legal Education

UNIT - V

(Constitutional History)

- The Indian Councils Act, 1858, 1861, 1892 & 1909
- The Government of India Act, 1919
- The Government of India Act, 1935

Readings:

Jain, M.P., *Constitutional Law of India,* Tripathi, Bombay, (2003)

Jain: M.P., *Outlines of Indian Legal History*, Wadhwa & Co., Nagpur (2003)

Kulshreshtha, V.D., *Landmark in Indian Legal & Constitutional History*, Eastern Book Co., Lucknow (1994)

Mittal, J.K., *Indian Legal History*, Central Law Agency, Allahabad (1998)

Paranjape, N.V., *Indian Legal and Constitutional History*, Central Law Agency, Allahabad (1998)

Pandey, J.N., *Constitutional Law of India*, CLA, Allahabad (2005)

(vi) Draft Syllabus for B.Sc.(Honours) Microbiology.

Prof. A. K. Mishra, Chairman, BUGS in Microbiology forwarded the draft Syllabus for B.Sc.(Honours) Microbioloy which placed as Annexure 'A'.

The matter is placed before the Council for consideration.

Annexure 'A'

Board of Undergraduate Studies (Microbiology)
North Eastern Hill University
Shillong

Draft Syllabus for B. Sc. (Honours) Microbiology
(Adopted by BUGS in its meeting held on October 20, 2006)

Year	Course code	Course Title	Marks	
			Theory*	Practical
1st				
	MICB-T101	Introductory Microbiology	70	
	MICB-P102	Introductory Microbiology lab		30
	MICB-T103	Bacteriology and Virology	70	
	MICB-P104	Bacteriology and Virology lab		30
2nd				
	MICB-T205	Elementary Biochemistry and Microbial Physiology	70	
	MICB-P206	Elementary Biochemistry and Microbial Physiology lab		30
	MICB-T207	Microbial Genetics, Biostatistics and Computer Applications	70	
	MICB-P208	Microbial Genetics, Biostatistics and Computer Applications lab		30
	MICB-T209	Microbial Ecology and Environmental Microbiology	70	
	MICB-P210	Microbial Ecology and Environmental Microbiology lab		30
3rd				
	MICB-T311	Molecular Biology and Recombinant DNA Technology	70	
	MICB-P312	Molecular Biology and Recombinant DNA Technology lab		30
	MICB-T313	Medical Microbiology and Immunology	70	
	MICB-P314	Medical Microbiology and Immunology lab		30
	MICB-T315	Industrial and Food Microbiology	70	
	MICB-P316	Industrial and Food Microbiology lab		30
		Total	560	240
		Grand Total	**800**	

*Each Theory paper shall comprise six units. Contact hours for each unit shall be 8-10 hours.
Duration of Examination: Theory Papers- 3 hrs.; Practical Papers- 3 hrs.

Note: In addition to above courses, the students shall be required to pass in English (core paper), Man and Environment (core paper), and Chemistry (pass course papers). Students shall also opt for and pass either Zoology or Botany (pass course papers). The distribution of marks shall be:

B.Sc. (Microbiology Hon.) papers	800 marks
English	100 marks
Man and environment	100 marks
Chemistry subsidiary	400 marks
Botany/ Zoology subsidiary	400 marks
Total	1800 marks

MICB-T101: Introductory Microbiology
(Theory)

Unit I History and development of Microbiology, Scope and future of Microbiology, spontaneous generation, microbiology and human health, beneficial and harmful microbes.

Unit II Diversity of microbial world: Principles of classification, classification of bacteria, viruses, algae, fungi and protozoa.

Unit III Methods for studying microorganisms: Microscopy and staining, development of pure culture technique, isolation, purification and preservation of microbes. Sterilization techniques. Types of culture media and their formulation.

Unit IV Classification of bacteria – Bergey's Manual of Systematic Bacteriology (2nd edition), major characteristics used in bacterial taxonomy. Classification, morphology, cultivation, reproduction and significance of *Rickettsia*, *Chlamydia*, *Mycoplasma* and *Streptomyces*.

Unit V Study of bacteria - size, shape and arrangement of bacterial cells, fine structure, composition and function of bacterial cell wall, cell membrane, cytoplasm, nucleoid, flagella, pili/fimbriae, slime layer, capsule, spores and cyst. Parallelism between bacteria and cyanobacteria, Brief account of Archaebacteria. 16S rDNA based phylogeny. Concept of polyphasic taxonomy.

Unit VI Discovery of viruses and important landmarks in virology. Development of virology as an important discipline. Classification and nomenclature of viruses. Study of viruses - general structure and properties of viruses, virus purification and assay, isolation and cultivation of viruses. Salient features of bacteriophages, plant viruses and animal viruses (T4 and λ, ϕx174, TMV, caulimovirus, HIV, pox, retro, picorna, rhabdovirus, influenza and Herpes), Prions and viriods – nature and significance. Virus – vector relationships (transmission of plant and animal viruses).

Suggested readings:

Atlas R. M. (1997) *Principles of Microbiology*, Wm C Brown Publishers.
Atlas R. M., (1997). *Microbiology- Fundamentals and applications*, Macmillan Publishing Company, New York.
Bold H. C. and Wynne M. J. (1985) *Introduction to Algae*, Prentice Hall of India Private Limited, New Delhi.
Brock T. D. and Madigan M.T. (1984). *Biology of Microorganisms*, Prentice Hall of India Private Limited, New Delhi.
Carlile M. J., *et al.* (2001). *The Fungi*, (Second edition), Academic Press, London.
Dubey R. C. and Maheshwari D. K. (1999). *A Text Book of Microbiology*, S. Chand & Company Ltd, New Delhi.
Mehrotra R. S. and Aneja K. R. (1990). *An Introduction to Mycology*, New Age International, New Delhi
Pelczar M. J. and Reid R. D. (2000) *Microbiology* (5th ed), Tata McGraw Hill.
Prescott L. M., *et al.* (1993) *Microbiology*, Wm C Brown Publ.
Stanier R. Y., *et al.* (1995) *General Microbiology*, MacMillan Edu. Ltd.
Tolaro K. and Tolaro A. (1993) *Foundations in Microbiology*, Wm C Brown Publishers.

MICB-P102: Introductory Microbiology Lab
(Practical)

1. Preparation of culture media- solid and liquid (Complete, minimal and selective)
2. Isolation and enumeration of microorganisms from soil using serial dilution technique and plating.
3. Isolation of microbes from air by Settle-Plate technique.
4. Study of bacteria by simple and negative staining
5. Study of bacteria by differential staining (Gram's Staining) technique.
6. Microscopic examination of bacteria (*E. coli*, *B. subtilis*, *Staphylococcus*), cyanobacteria (*Anabaena* and *Plectonema*), yeast, protozoa (amoeba and malarial parasite), molds (*Penicillium* and *Fusarium*).

Suggested readings

Sundara Rajan S. (2001). *Tools and Techniques of Microbiology*. Anmol Publications, New Delhi

and same as in MICB-T101

MICB-T103: Bacteriology and Virology
(Theory)

Unit I General description of various groups of eubacteria according to Bergey's Manual of Systematic Bacteriology (2nd edition).

Unit II General account of different groups of archaeabacteria and their economic importance.

Unit III Bacterial reproduction - Asexual methods of reproduction. Introductory account of recombination in bacteria. Bacterial growth curve - definition of growth, growth curve, mathematical nature and expression of growth, generation time and growth rate, quantitative and qualitative measurements of growth. Concept of geometric and arithmetic nature of growth, batch, continuous and synchronous cultures– chemostat and turbidostat. Physical growth requirements (Temperature, pH, redox potential, moisture and light).

Unit IV Viral multiplication - interaction of viruses with cellular receptors, different modes of entry, different transcriptional methods of replication of RNA (+ and -) and DNA viruses. Assembly, maturation and exit of mature progeny virions. Detailed description of lytic and lysogenic cycles.

Unit V Viral transformation - Concepts of oncogenes, tumor suppression genes Oncogenic viruses. Epidemiology, prevention and control of viral diseases - Viral vaccines, antiviral compounds, interferons and their mode of action. Plant viral diseases (tobacco mosaic, cauliflower mosaic, maize streak) and their control by cross protection and molecular approach.

Unit VI Detection, identification and characterization - Principles of important diagnostic techniques employed for viral detection and characterization. Application of virology in molecular biology and biotechnology: viral vectors and their properties. Applications of viral vectors in transgenic studies.

Suggested reading

Alexander M., (1979). *Introduction to Soil Microbiology*, Wiley Eastern Limited, New Delhi.
Alexopoulos C. J., Mims, C. W. and Blackwell, M. (1996). *Introductory Mycology*, (Fourth edition) John Wiley and Sons, New York.
Atlas R. M. (1997). *Microbiology- Fundamentals and applications*, Macmillan Publishing Company, New York.
Benson H. J. (1990). *Microbiological Applications*, WCB McGraw-Hill New York.
Brock T. D. and Madigan M. T. (1984). *Biology of Microorganisms*, Prentice Hall of India Private Limited, New Delhi.
Hull R. (2002). *Matthews' Plant Virology*, fourth edition, Academic Press, London.
Pelczar M.J., *et al.* (2006). *Microbiology*, McGraw Hill Book Company, New York.
Prescott L. M., *et al.* (2005). *Microbiology*, WCB McGraw- Hill New York.
Stanier R. Y. and Ingraham J. L. (1977). *General Microbiology*, Prentice Hall of India Private Limited, New Delhi.

MICB-P104: Bacteriology and Virology Lab
(Practical)

1. Enumeration of bacterial colonies from a soil sample by pour plate method.
2. Purification of bacterial culture by streaking method.
3. Characterization of any one bacterial culture.
4. Estimation of bacterial growth by spectrophotometry.
5. Isolation of Actinomycetes and cyanobacteria.
6. Measurement of cell dimensions by micrometry.
7. Study the symptoms and infectivity of plant viruses (mosaic and leaf curl viruses), chlorotic and necrotic lesions.

Suggested reading

Aneja K.R. (1996). *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*, New Age International, New Delhi.

and same as in MICB-T103

MICB-T205: Elementary Biochemistry and Microbial Physiology

(Theory)

Unit I History and devlopment of biochemistry. Ionization of water, ionic product of water, pH, pK, buffers. Molecules of living systems: Structure and function of amino acids, protein, carbohydrate, lipid, DNA and RNA.

Unit II Laws of Thermodynamics and its application to biological systems: First Law of Thermodynamics, heat of formation & heat of reaction. Second Law of Thermodynamics, molecular basis of entropy, Helmholtz and Gibbs free energy. Types of cells, electrodes, oxidation-reduction reaction, standard electrode-phosphate group transfer potentials.

Unit III Introduction to enzymes, Enzyme classification: IUB enzyme classification and nomenclature system. Allosteric enzymes, multi-enzyme complexes, ribozymes. Enzyme Kinetics: Enzyme activity, Concept of ES complex, binding sites, active sites, stereospecificity. transition state theories, significance of activation energy and free energy. Factors affecting enzyme activity -[E], [S], temperature and pH. Michaelis-Menten equation. Regulation of enzyme activity

Unit IV Nutritional classification and requirements of microbes - Photoautotrophs and photoheterotrophs, chemoautotrophs and chemoheterotrophs. Macronutrients, micronutrients. Membrane transport and the uptake of nutrients. Passive and active transport, group translocation. Specific transport systems – ATP linked ion motive pumps, electroneutral and electrogenic transport. Iron transport. Transporting proteins: periplasmic binding proteins and porins. Microbial growth –. Primary and secondary metabolite production during different growth phases. Chemical growth requirements: microbial nutrients, pattern of nutrition and nutritional types, effect of nutrient concentration on bacterial growth.

Unit V Regulation and integration of metabolism. Physiology of fermentation processes - Fermentative modes in microorganisms-alcoholic, Lactic acid – hetero and homo, acetic acid, propionic acid, butyric acid, mixed acid and butanediol fermentation. Microbial respiration in eukaryotes - Chemoautotrophy-oxidation of inorganic compounds-NH_3, S, Fe and H. Bacterial photosynthesis - Oxygenic and anoxygenic photosynthesis, photosynthetic apparatus in prokaryotes, photosynthesis in purple and green bacteria and cyanobacteria.

Unit VI Nitrogen fixation – symbiotic and nonsymbiotic. types of nitrogenase enzymes, assay of nitrogenase activity, mechanism for protection of nitrogenase enzyme, Components I and II, requirement for ATP and reductant.

Suggested reading

Alexander M , (1979). *Introduction to Soil Microbiology*, Wiley Eastern Limited, New Delhi
Alexopoulos, C.J , *et al* (1996). *Introductory Mycology*, (Fourth edition) John Wiley and Sons, New York
Carlile M.J , *et al*. (2001). *The Fungi*, (Second edition), Academic Press, London.
Dubey R.C and Maheshwari D.K. (1999). *A Text Book of Microbiology*, S. Chand & Company Ltd, New Delhi.
Mehrotra R.S. and Aneja K.R. (1990). *An Introduction to Mycology*, New Age International, New Delhi
Moat A.G. and Foster S.W. (2002). *Microbial Physiology*, John Wiley and Sons, New York
Nelson D. L. and Cox M , Lehninger M. (2002). *Principles of Biochemistry*, Macmillan Press/Worth Publishers, New Delhi
Pelczar M.J., *et al* (2006). Microbiology, McGraw Hill Book Company, New York
Prescott Lansing *et al*. (2005). *Microbiology*, WCB McGraw- Hill New York
Price N. C. and Steven L. (1982) *Fundamental in Enzymology*, Oxford University Press
Rajan, S. S. (1999). *College Microbiology volume two*, Vardhana Publications, Bangalore
Rawn J. D. (1999) *Biochemistry*, North Carolina Biol. Suppl Co
Sharma, R.P., Salunkhe, D.K. (2000). *Mycotoxins and Phytoalexins*. CRC Press, Inc. Florida
Stanier R.Y., Ingraham J.L. (1977). *General Microbiology*, Prentice Hall Of India Pvate Limited, New Delhi
Stryer L. (2000) Biochemistry, W. H. Freeman.
Zubay G. (1999) *Biochemistry*, W C Brown Commun., Inc.

MICB-P206: Elementary Biochemistry and Microbial Physiology Lab

(Practical)

1. Preparation of buffer using Handerson-Hasselbalch equation.
2. Estimation of protein (Lowry's Method).
3. Estimation of carbohydrate by Anthrone reagent.
4. Estimation of DNA by diphenyleamine.
5. Estimation of RNA by orcinol.
6. Estimation of amylase activity.
7. Fermentation of glucose, sucrose and lactose, acid and gas production.
8. Estimation of reducing sugar glucose – by DNSA method.
9. Effect of pH and temperature on bacterial growth.
10. Extraction and estimation of pigments from cyanobacteria.

Suggested reading

same as in MICB-T205

MICB-T207: Microbial Genetics, Biostatistics and Computer Applications

(Theory)

Section A

Unit I Genomic organization in prokaryotic and eukaryotic microbes. Bacterial genetics - recombination in bacteria- conjugation, transformation and transduction - generalized and specialized. Fungal genetics - Genetic recombination in fungi: *Neurospora crassa* and *Saccharomyces cerevisiae*. Life cycles and sexual process - Heterokaryosis, parasexuai cycle and vegetative incompatibility, survival of asexual fungi.

Unit II Bacterial viruses (λ, P1, Mu and M13). Plasmids: types (episomes, cosmids), detection and purification. Replication of bacteriophage (λ) and plasmid DNA. Transposable elements – terminology, insertion sequences, type of bacterial transposons.

Unit III Mutations: types (induced and spontaneous), physical and chemical mutagens, isolation of mutants, uses of mutants. Mutations and microbial adaptability. Genetics of nitrogen fixation and regulation. Megaplasmids in nitrogen fixation. Genetic recombination in cyanobacteria.

Section B

Unit IV Random, discrete and continuous variables. Population. Sample. Random sampling. Frequency distribution, graphical representations of frequency distributions. Measures of central tendency (Arithmatic and geometric means, median and mode). Concept of events and probability. Laws of addition and multiplication of probabilities.

Unit V Measures of dispersion (range, mean deviation, standard deviation, coefficient of variation, standard error and standard error of mean). Analysis of variance. Null hypothesis. Tests of significance ('t', paired 't', F and χ^2 tests) and their applications.

Section C

Unit VI Introduction to computers (hardware and software). Operating systems. Introduction to data structures and data base concepts, web and internet. Spreadsheets and presentation software (Microsoft excel). Introduction to bioinformatics (nucleic acid, protein and biological literature databases).

Suggested reading

Das H. K. (ed.) (2004). *Textbook of Biotechnology*. Wiley Dreamtech, New Delhi.
Freifelder, D. (1994). *Microbial Genetics*, Narosa Publishing House, New Delhi
Karp, G. (1964) *Cell Biology*, McGraw Hill Book Company, New York
Stickberger M.W., (1985). *Genetics*, Prentice Hall of India Private Limited, New Delhi.
Walker J.M. and Rapley R. (2003) *Molecular Biology and Biotechnology*. Panima Publ., New Delhi.
Panse V. G. and Sukhatme P. V. (1978) *Statistical methods for agricultural workers*. ICAR
Silverton J. W. (1982). *Introductory Statistics for Biology*. Edward Arnold
Atwood, T. and Smith, D J : Introduction to Bioinformatics. Pearson Education

MICB-P208: Microbial Genetics, Biostatistics and Computer Applications Lab

(Practical)

1. UV induction of mutation in bacteria.
2. Preparation of survival curve.
3. Replica plating technique for isolation of mutants.
4. Study of budding in yeast.
5. Numerical excercises in *Neurospora crassa*.
6. Exercises on data anlysis: graphical representation of data, frequency distribution, t test, χ^2 test.
7. Practical training on handling of computers, internet access and accessing sites like NCBI, PubMed, etc.

Suggested reading

same as in MICB-T207

MICB-T209: Microbial Ecology and Environmental Microbiology

(Theory)

Unit I History and development of microbial ecology and emergence of environmental microbiology and its significance. Microbial communities- structure, species diversity, habitat and niche and food chain. Ecological groups of microorganisms- based on O_2 requirement, carbon sources, temperature (psychrophiles, mesophiles, thermophiles, hyperthermophiles), the extremophiles (acidophiles, alkalophiles, halophiles, barophiles), nutrition (saprophytism, parasitism and symbiosis).

Unit II Microbial interactions– Types of interactions- symbiosis, mutualism, neutralism, amensalism, competition parasitism and predation. Microbe– microbe interactions, plant-microbes interactions and animal- microbes interactions. Biogeochemical cycles– Microorganisms and biochemistry with reference to carbon, nitrogen, phosphorus and sulphur cycles.

Unit III Microbiology of soil- Soil microorganisms (Bacteria, fungi, Actinomycetes, algae, protozoa and viruses) and Physico chemical properties affecting their distribution. Methods to study the soil microorganisms. Aeromicrobiology- Introduction, definition, sources of microorganisms, air microflora of indoor and outdoor air, factors affection air microflora, significance of air borne microflora and the methods to study the air microflora. Microbiology of water- Distribution of microorganisms in the aquatic environment, sources and types of water pollution, biological indicators of water pollution. Microbial assessment of water quality. Treatment and safety of potable water.

Unit IV Biodegradation and biodeterioration. Bioremediation of oil spills. Biogas- benefits from biogas plants, feed stock materials. biogas production. Microbial composition of sewage, strength of sewage, kinds of sewage systems). Sewage treatment and disposal- primary, secondary (aerobic-activated sludge, oxidation ponds, trickling filters) and (anaerobic- septic tank and digester), tertiary treatment.

Unit V Rhizosphere microflora and its effect on crops; phyllosphere microflora and its significance. Mycorrhiza- types and application. Microbes as plant pathogens. Biofertilizers- definition, types (bacterial, fungal, phosphate solubilizers, BGA, Plants-*Azolla*), kinds of associations, mode of application and merits. Biopesticides- Introduction, types, microbial species as bacterial insecticide (*Bacillus thuringiensis*, toxins produced by *B. thuringiensis*, viral insecticide), mode of action. Plant growth promoting microbes (PGPM).

Unit VI Waste as a resource. organic compost (definition, process of composting, factors affecting the composting- micro-organisms, soil and organic matter, role of compost). Biological Oxygen Demand. Microorganisms in pollution control, waste water treatment and reclamation of wasteland. Health hazards due to environmental pollution. Mechanism of heavy metal resistance and tolerance. Bioleaching- copper and Iron.

Suggested reading

Alexander M. (1979). *Introduction to Soil Microbiology*, Wiley Eastern Limited, New Delhi.
Banerjee A.K. and Banerjee N. (2006). *Fundamentals of Microbiology and Immunology*, New Central Book Agency, Kolkata.
Creager J. M. G., *et al.* (1990). *Microbiology Principles and Applications*, Prentice Hall, New Jersey.
Dubey R.C. and Maheshwari D.K. (1999). *A Text Book of Microbiology*, S. Chand. New Delhi.
Harley, H.L. and Smith, S.E. (1983). *Mycorrhizal symbiosis*. Academic Press, New York.
Jennings D.H. and Lysek G. (1999). *Fungal Biology: Understanding the fungal lifestyle*, (2nd edition). BIOS Scientific, Oxford, England.
Madigan M.T., *et al.*.(1997) *Biology of Microorganisms*, (8th edition). Prentice Hall. London.
Mehrotra R.S. (1995). *Plant Pathology*. Tata McGraw Hill, New Delhi.
Mishra R.R. (1996). *Soil Microbiology*. CBS Publ.
Nester, E.W., *et al.* (1995). *Microbiology A Human Perspective*, Wm. C. Brown, Oxford, England.
Pelczar M.J., *et al.* (2006). *Microbiology*, (5th edition) McGraw Hill Book Company, New York.
Prescott Lansing *et al.* (2005). *Microbiology* (5th edition), WCB McGraw- Hill New York.
Subbarao N.S. (2001), *Soil Microorganisms and Plant Growth*, (4th edition). Oxford and IBH Publishing Company, New Delhi.

MICB-P210: Microbial Ecology and Environmental Microbiology Lab

(Practical)

1. Analysis of soil – texture. pH, moisture content and water holding capacity.
2. Isolation and enumeration of bacteria and fungi from rhizosphere.
3. Study of *Rhizobium* from legume root nodules (Gram staining) and isolation of *Rhizobium* and *Azotobacter* from soil.
4. Study of antagonism between soil microorganisms by plate and disc diffusion methods- fungus vs fungus.
5. Study of plant pathogens- Tikka disease, Sandal Spike, Downy mildew and Tomato leaf curl.
6. Microbial examination of water by coliforms, MPN methods – for potable and sewage water.
7. Determination of microbial activity in soil and compost by CO_2 evolution method.
8. Assay of soil enzyme activity (dehydrogenase, cellulase).

MICB-T311: Molecular Biology and Recombinant DNA Technology
(Theory)

Section A

Unit I History and development of molecular biology. Functions of Nucleic acids: DNA and RNA, different conformations of DNA, different types of RNA. DNA replication: Mechanism of DNA replication (circular and linear forms), enzymes and accessory proteins in prokaryotes and eukaryotes.

Unit II Transcription: Enzymes and transcription factors, mechanism of transcription, ORFs. Post-transcriptional modifications (5' capping, termination, 3' end processing and polyadenylation, splicing). Translation: Translational machinery, mechanism of initiation, elongation and termination.

Unit III Regulation of gene expression: Induction, activation and repression, attenuation and antisense control. Operons: *lac*, *trp*, *ara*, *gal* operons, λ phage (lytic to lysogenic), yeast mating types. Concept of post translational gene silencing

Section B

Unit IV Restriction endonucleases: types, nomenclature and mode of action. DNA ligases and polymerases. DNA modifying enzymes (kinases, methylases and dephosphatases). Linkers and adapators. Cloning and Expression Vectors: plasmids (pBR and pUC serieses), bacteriophage λ, M13, insertion sequences, transposons.

Unit V Production and selection of recombinant clones. Marker and reporter genes. Techniques of nucleic acid hybridization. Production of genomic DNA and cDNA libraries, their screening and applications. Production of insulin and somatostatin.

Unit VI Nucelotide sequencing. PCR and DNA amplification. Applications of PCR technology (molecular markers and molecular diagnostics). Concepts of genomics, transcriptomics and proteomics.

Suggested reading

Das H K (ed.) (2004). *Textbook of Biotechnology*. Wiley Dreamtech, New Delhi
Freifelder D. (1994) *Microbial Genetics*. Narosa, New Delhi
Klug WS and Cummings MR, (1997) **Concepts** of genet- ics. Prentice-Hall
Lewin, B. (2004). Genes VIII (International ed.) Pearson Prentice Hall, Pearson Education, Inc
Old, R W. and Primrose, S B. (1994) *Principles of Gene Manipulation*. Blackwell Scientific, London
Strickberger M.W. (1985) *Genetics*. Macmillan Publishing Co., New York
Tamarin R. H. (2002) *Principles of Genetics*. Tata McGraw-Hill.
Walliker J. M. and Rapley R. (2003) *Molecular biology and Biotechnology*. Panima, New Delhi
Watson J. D. *et al.* (2004). *Molecular Biology of the Gene*. Pearson Education

MICB-P312: Molecular Biology and Recombinant DNA Technology Lab
(Practical)

1. Isolation of bacterial plasmid DNA.
2. Gel electrophoresis of DNA and examination of agarose gels.
3. Restriction digestion of plasmid DNA
4. Transformation of *E. coli* with plasmid DNA and isolation of transformed colonies.
5. Nucleotide sequencing using gel photographs.

Suggested reading

Same as in MICB-T311

MICB-T313: Medical Microbiology and Immunology
(Theory)

Section A: Medical Microbiology

Unit I Introduction to infection, invasion, pathogen, pathogenicity, virulence, types of disease carriers, opportunistic infections, transmission of infection and infectious processes. General account of microbial pathogenesis: causative agents, salient clinical symptoms, epidemiology, diagnosis, control measures and therapy. Koch's postulates.

Unit II Specific diseases caused by bacteria: diptheria, cholera, typhoid, tuberculosis, plague and syphilis. Specific diseases caused by viruses: viral hepatitis, influenza, rabies, polio, chicken pox and AIDS. Different types of fungal diseases: superficial, subcutaneous, systemic and opportunistic mycoses. Protozoan diseases: amoebiasis and malaria.

Unit III Mechanism of action of clinically used anti-microbial drugs: inhibitors of cell wall synthesis, agents altering cell membrane function, inhibitors of protein synthesis and inhibitors of nucleic acid synthesis. Genetic and non-genetic drug resistance. Anti-viral and anti-fungal therapeutic agents.

Section B: Immunology

Unit IV History and scope of immunology. Types of immunity: natural, acquired, active, passive. Antigens and antibodies: types of antigens, factors influencing antigenicity; types of antibodies, properties and functions. Antigen and antibody reactions: mechanisms of antigen antibody interactions. Production of polyclonal and monoclonal antibodies and their applications.

Unit V Cells tissues and organs involved in immune system. Immune response- CMI, MHC, AMI; immunological memory and immunological tolerance. Hypersensitivity. Immunohematology. Immunology of tissue transplantation.

Unit VI Components of the complement activation, biological consequence of complement activation and names of complement deficiencies. Vaccines- definitions and types (live attenuated, killed, toxoid, recombinant DNA and synthetic)

Suggested Readings

Ananthanarayan and Panikar (1999) *Text Book of Microbiology*. Orient Longman.
Abbas *et al* (1991) *Cellular and Molecular Immunology*. W B Saunders
Banerjee A K. and Banerjee N. (2006). *Fundamentals of Microbiology and Immunology*, New Central Book Agency, Kolkata
Barrel J T (1988) *Text Book of Immunology*. C V Mosby Co
Jawetz *et al* (1984) *Review of Medical Microbiology*. Appellon Lange
Jawetz *et al* (2004) *Medical Microbiology*. Prentice Hall
Goldsby *et al* (2000) *Immunology*. W H Freeman & Co
Roitt M (1976) *Essential Immunology*. Blackwell Science

MICB P314: Medical Microbiology and Immunology Lab
(Practical)

1. Isolation and identification of microorganisms from ear, nose, throat and sputum.
2. Isolation and identification of microorganisms from clinical samples- blood and urine.
3. Blood grouping.
4. Differential WBC count.
5. Coagulase test.
6. WIDAL test.
7. VDRL test.
8. ODD and RID.
9. Study of slides of pathogenic microorganisms – *Shigella, Clostridium, Staphylococcus, Streptococcus, Entamoeba, Plasmodium* and *Candida*
10. MIC test of *E. coli* using streptomycin/ tetracyclin.

Suggested Readings
Same as in MICB-T313

MICB-T315: Industrial and Food Microbiology

(Theory)

Section A – Industrial Microbiology

Unit I **Introduction to industrial microbiology**: A brief history and development of industrial microbiology. Types of microbial fermentations (solid states and submerged, batch, fed batch and continuous), Sources of industrially important microbes.

Unit II **Fermentors/bioreacters**: History and development of fermentors, types of fermentors; achievement and maintenance of aseptic conditions. Principles of design of fermentors.

Unit III **Microbial production of industrial products**: Organic acids (Lactic, Citric), antibiotics (Penicillin, Streptomycin), amino acids (Lysine and Glutamic acid), enzymes (Proteases, Amylase, Lipases, Cellulases), solvents (alcohol, acetone and Butanol), vitamins (Vitamine B_{12}, rivoflavin). Single Cell Protein (Quorn(R)). Steroids. Biotransformation. Alcoholic beverages-non-distilled (beer) and distilled (whiskey).

Section B- Food and dairy microbiology

Unit IV **Microbes in food:** Natural flora and source of contamination of foods in general. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Detection of food-borne pathogens: *Staphylococcus, E.coli, Bacillus, Salmonella*. Microbial spoilage of various foods: vegetables, fruits, meat & eggs, milk & butter, fish, bread. Food- borne diseases-caused by *Clostridium botulinum, Staphylococcus aureus, Bacillus cereus, E. coli*, Salmonellosis; Mycotoxins with reference to aflatoxins.

Unit V **Principles and methods of food preservation:** Principles, methods of food preservation (physical: temperature. irradiation, aseptic packaging; chemical: organic acids, SO_2, nitrite and nitrates, salt, sugar, ethylene oxide). Biopreservatives – antibiotics, natural antimicrobials from plants.

Unit VI **Dairy and other fermented foods:** Dairy starter cultures, fermented dairy products: yoghurt, kefir, koumiss, butter milk, cheese. Probiotics. Other fermented foods: Idli, dosa, tempeh, soy sauce, poi, wines, sauerkraut, local fermented foods.

Suggested reading

Crueger, W and Crueger, A. (2000). *A Text book of Industrial Microbiology*, Panima Publishing Corporation, New Delhi
Stanbury, P.F., *et al.* (1995) *Principles of Fermentation Technology*, 2nd Edition Pergamon Press
Frazier, W C and Westhoff, D C (1988) *Food Microbiology* 4th Edition, McGraw, Hill, N.Y.
Jay, J.M. (1992). *Modern Food Microbiology*, 4th edition, Van Nostrand Reinhold Co., New York

MICB-P316: Industrial and Food Microbiology Lab

(Practical)

1. Ethanol production from cane sugar and jaggery.
2. Preparation of slides from spoiled foods.
3. Isolation of micro-organisms from common food items such as curd and bread
4. Preparation curd and estimation of its acidity.
5. Bactenal spoilage of milk
6. Methylene Blue Reductase test for milk: dye reduction test.
7. Production of amylase/ protease using fungal/bacterial cultures.
8. Production of penicillin by *Penicillium chrysogenum* and detection by disc diffusion.

Suggested reading

Same as in MICB-T315