

ಮಂಗಳೂರು
MANGALORE



ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
UNIVERSITY

(Accredited by NAAC)

ಕ್ರಮಾಂಕ/ No. : MU/ACC/CR 19/2017-18/A2

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ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199

Office of the Registrar

Mangalagangothri - 574 199

ದಿನಾಂಕ/Date:04.12.2021

NOTIFICATION

Sub: Syllabus for M.Sc. Audiology Programme.

Ref: 1. Academic Council approval vide agenda

No.: ಎಸಿಸಿ:ಶ್ಯ.ಸಾ.ಸ.1:19(2021-22) dated 04.08.2021

2. Hon'ble Vice Chancellor's order dated 19.11.2021

Pursuant to the above, the syllabus for M.Sc. Audiology Programme which has been approved by the Academic Council at its meeting held on 04.08.2021 is hereby notified for implementation with effect from the academic year 2020-21 subject to the pending approval for the amendments to the Regulations Governing the Choice Based Credit System (CBCS) for the two years (Four Semesters) Post Graduate Degree Programmes in the Faculties of Arts, Science, Commerce and Education from the Government.


REGISTRAR

To,

1. Principals of the College concerned.
2. Dr. Divyanjali Shetty, Chairperson, BOS in Speech Language & Hearing, Dr.M.V. Shetty, College of Speech & Hearing, Maladi Court, Mangalore- 15.
3. The Registrar (Evaluation), Mangalore University.
4. The Superintendent (ACC), O/o the Registrar, Mangalore University.
5. The Asst. Registrar (ACC), O/o the Registrar, Mangalore University.
6. Guard File.

Mangalore University

Regulation and Syllabus

for

MASTER OF SCIENCE (AUDIOLOGY)

M.Sc. (AUD)

(CHOICE BASED CREDIT SYSTEM – SEMESTER SCHEME)

From the Academic year 2021-22 onwards

**REGULATIONS GOVERNING THE CHOICE BASED CREDIT SYSTEM FOR THE TWO
YEARS (FOUR SEMESTERS) POST GRADUATE DEGREE PROGRAMME
in
Master of Science (AUDIOLOGY) –M.Sc. (AUD)
(Framed under Section 44(1) (c) of the KSU Act 2000)**

PREAMBLE:

The University Grants Commission, New Delhi, has directed all Universities in the country to implement the Choice Based Credit System (CBCS, Semester Scheme) in both the under and post-graduate programmes and has been issuing a series of guidelines with regard to this. The Higher Education Council, Government of Karnataka, has considered the implementation of CBCS and has organized workshops in this regard. The Choice Based Credit System enables the degrees of Mangalore University to be on par with the global standards. Given the present trend of globalization, it is all but fitting that Mangalore University should adopt the CBCS so that the acceptability of the programmes and degrees offered by the University becomes comparable and readily acceptable. After due consideration, thus, the following Regulations were drawn up.

1. TITLE and COMMENCEMENT:

The title of the programme shall be **Master of Science (AUDIOLOGY). M.Sc. (AUD)** shall be the short form. The course would be a 'Choice Based Credit System for 2 years (4 semesters)'. These regulations shall come into force from the academic year 2021-22.

2. DEFINITIONS:

- i) **Programme:** An educational programme leading to award of a Post Graduate Degree.
- ii) **Semester:** Each semester will consist of minimum of 16 weeks of academic actual teaching /instruction days. The odd semester is ordinarily scheduled from July to December and even semester from January to June.
- iii) **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week.
- iv) **Course:** A unit of study (earlier called a "paper") within a subject carrying a fixed number of credits.
- v) Core Course is related to the discipline of the programme. This is further divided into:

Hard Core: These courses are compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

Soft Core: These courses are electives and related to the discipline of the programme.

- vi) **Open Elective:** A course to be opted by the student from out of the choices offered by other programmes.
- vii) **Tutorial:** A period of teaching that involves discussion between an individual student or a small group of students and a teacher.
- viii) **Credit Point:** It is the product of grade point and number of credits for a course.
- ix) **Alpha-sign Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters and a sign + i.e., OO, OA+, AB, AB+, CC etc to indicate semester grades and O, A, B+, B, and C. to indicate programme grades.
- x) **Grade Point:** It is a numerical weight allotted to each alpha-sign grade on a 10-point scale.

3. ELIGIBILITY FOR ADMISSION

Candidates with B.A.S.L.P/B.ASLP/B.Sc. (Speech & Hearing) degree of any recognized university by the Rehabilitation Council of India or any other degree considered as equivalent thereto and having an average of not less than 45% (40% for SC/ST/Category-I candidates) are eligible for admission to M.Sc. (AUDIOLOGY).

'Average' refers to average of the aggregate marks obtained in all the years/semesters of the qualifying examination.

- a. Relaxation in the qualifying marks for designated categories of students shall be as per the rules and regulations of Mangalore University.
- b. No age bar for Applicants.

4. DURATION

The duration of Master Degree Programmes shall extend over 4 semesters each of a minimum of 16 weeks of instruction and 2 to 4 weeks for preparation and examination.

5. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMME:

The candidate shall complete the Master Degree programme within four years from the date of admission to the programme

6. MEDIUM OF INSTRUCTION: The medium of instruction shall be English.

7. ATTENDANCE:

a) Each course (theory, practical) shall be treated as an independent unit for the purpose of attendance. A student shall attend a minimum of 80% of the total instruction hours and 90% in clinical in each semester for students to be eligible to appear for examination at the end of each semester.

b) There shall be no provision for condonation of shortage of attendance and a student who fails to secure 80% attendance in a course shall be required to repeat that course to accrue the credit.

8. COURSE PATTERN:

8.1 Each postgraduate programme will comprise “core” and “elective” courses. The “Core course” will further consist of “hard” and “soft” core courses. Hard core courses can have 3-5 credits. Soft core courses can have 3-4 credits. Practical (Hard core) can have 2-5 credits. Open Electives have 3 credits each. Dissertation will carry 6 credit points with the total credit of 90 including open electives.

Course/credit pattern:

Semester Credits	Hard Core (Theory ×Credits)	Soft Core (Theory ×Credits)	Open Elective (OE)	Clinical Practicum(P) (Hard Core)	Total Credits
First	3 (4) = 12	2(4) = 8	-	5	25
Second	3(4) = 12	1(4) = 4	3	5	24
Third	2(4) = 8	1(4) = 4	3	4	19
Fourth	2(4) = 8 1(6) =6	1(4) = 4	-	4	22
Total	40	20	6*	18	90

Total Credits from all the Four Semesters (1st, 2nd, 3rd and 4th Semesters): 25+24+19+22 = 90

Total Hard Core credits = 40 (H) + 18 (P) = 58= 64.44%

Total Soft Core credits = 20(S) + 6 (D) = 26=28.88%

*** Open Elective Credits = 6 = 6.66%** (Not to be considered for calculating the CGPA)

H= Hard Core, S= Soft Core, P =Clinical Practicum, D = Dissertation

The following credits are defined by considering 16 weeks of each semester of 6 working days

a) **Theory papers:** 1 Credit = 1hour/week

[4 credits for Hard Core and 4 credits for Soft Core theory papers/week]

b) **Clinicals = Clinical practicum,** 1 credit = 3 hours of clinical practicum for 5 days of a week.

Special Note: As per the general guidelines of University of Mangalore, a total of **84 to 92 credits are allotted** for M.Sc. (AUD) post graduate programme. In this, the **hard core** will make up **50%-65%** of the total credits, **soft core 30%-45%**, while the open electives will have a **fixed 6 credits (3 credits x 2 courses)**. A student has to take **minimum of 18 credits and maximum of 26 credits** in any semester.

Detailed distribution of Course & Credits

Programme: Audiology:

First Semester

Course Code	Course Title	Examination		Teaching		Exam Hours	Credits
		Theory	IA	Hours/Week	Hours/Sem		
AH 101	Research Methods, Epidemiology and statistics	70	30	4	64	3	4
AH 102	Cochlear Physiology	70	30	4	64	3	4
AH103	Hearing Sciences	70	30			3	4
AS 104 AS 105	Auditory Disorders Or Pathologies of the ear	70	30	4	64	3	4
AS 106 AS 107	Technology in Audiology Or Learning and Behavior Analysis	70	30	4	64	3	4
ACP 108	Clinical Practicum in Audiology	-	100	15	-	-	5

Total credits = 25 (Hard Core-8+4=12, Soft Core-8, Clinical Practicum-5)

Second Semester

Course Code	Course Title	Evaluation		Teaching		Exam Hrs	Credits
		Exam	IA	Hours/Week	Hours/Sem		
AH 201	Neurophysiology of Hearing	70	30	4	64	3	4
AH 202	Electrophysiological Assessment	70	30	4	64	3	4
AH 203	Auditory Perception	70	30	4	64	3	4
AS 204	Genetics of Hearing and Pediatric Audiology	70	30	4	64	3	4
AS 205	Or Early Identification and Counseling			4	64	3	
ACP 206	Clinical Practicum in Audiology	70	30	15	-	-	5
Open Elective	The Auditory System Or Noise: Measurements	70	30	3	48	3	3

Total credits = 24 (Hard Core = 12, Soft Core-4, Clinical Practicum-5, Open Elective = 3)

Third Semester

Course Code	Course Title	Evaluation		Teaching		Exam Hrs	Credits
		Exam	IA	Hours/Week	Hours/Sem		
AH 301	Auditory Processing Disorders	70	30	4	64	3	4
AH 302	Speech Perception	70	30	4	64	3	4
AS 303 Or AS 304	Vestibular system and its disorders Or Noise and Hearing Conservation	70	30	4	64	3	4
ACP 305	Clinical Practicum in Audiology		100	15	-	-	4
Open Elective	Audiology as a Profession Or Acoustics	70	30	3	48		3

Total Credits = 19 (Hard Core-8, Soft Core-4, Clinical Practicum-4 and Open Elective-3).

Fourth Semester

Course Code	Course Title	Evaluation		Teaching		Exam Hrs	Credits
		Exam	IA	Hours/Week	Hours/Sem		
AH 401	Implantable Auditory Devices	70	30	4	64	3	4
AH 402	Advances in the Management of Hearing Loss	70	30	4	64	3	4
AS 403	Audiology in Practice	70	30	4	64	3	4
AS 404	Or Aging in Auditory System						
AS 405	Dissertation in Hearing Sciences/Auditory Disorders	70	30			3	6
AS 406	Or Dissertation in Diagnostic Audiology/ Rehabilitative Audiology						
ACP 407	Clinical Practicum in Audiology	70	30	15	-	-	4

Total Credits = 22 (Hard Core-8, Soft Core = 4+6 =10, Clinical Practicum-4).

8.2 Core Course is related to the discipline of the programme. This is further divided into Hard Core and Soft Core. Hard core courses are compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study. Soft Core courses are elective but related to the discipline of the programme. The Soft Core subjects are as per the subjects specified by Board of Studies. These Soft Core courses are offered in First, Second and Third Semester.

- 8.3 Out of the total of 90 credits of the programme, the hard core will make up 50%-65% of the total credits, soft core 30%-45% while the open electives will have a fixed 6 credits (3 credits x 2 courses). A student has to take minimum of 18 credits and maximum of 26 credits in any semester.
- 8.4 A credit is a unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching per week.
- 8.5 All courses need not carry the same weight (credit). The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/ laboratory work/outreach activities/ Dissertation.
- 8.6 In the case of subjects with practical there shall be minimum of 16 credits of practical in the programme.
- 8.7 A Dissertation is taken up in the third semester or at the beginning of the fourth semester. However, credit for the dissertation is counted for the fourth semester only.
- 8.8 A student can take the courses offered by the university as per the Rehabilitation Council of India syllabus which is speculated in the particular semester. Open electives are taken in 2nd and 3rd semesters from any courses offered by Mangalore university.
- 8.9 The performance of a student in a course is graded and the “grade” is an index of the performance of that student. The overall performance of a student over the whole programme is expressed as Cumulative Grade Point Average (CGPA).
- 8.10 The CGPA of a programme shall be declared on the basis of the total credits that a student secures in hard and soft core courses including Dissertation. Credits of the open electives shall not be considered in declaring the CGPA. However, a student has to compulsorily take one open elective each in the second and the third semesters (two open elective courses in all) and secure a minimum of 6 credits in the open elective courses to qualify to pass the programme.

8.11 The grade card is not a statement of Marks. However, the printed CGPA card issued by the university shall declare a formula to convert the CGPA to an overall percentage.

8.12 Boards of Studies shall exercise care in framing open elective courses and see that these courses are not general introduction to an area of study. The open electives offered by the departments will maintain the level and standards of other postgraduate courses offered by them. Care must also be exercised to see that open elective courses will not repeat undergraduate syllabi.

8.13 A student may take extra courses over and above the prescribed number in a programme. However, the credits so earned in excess shall not be considered in the declaration of the CGPA.

8.14 A student can earn credits in soft core courses by doing them in a department other than the one to which he is admitted, provided that such courses are considered as relevant to his discipline by the Board of Studies and provided, further, that the Councils of the departments concerned approve it.

8.15 Two or more open electives may be offered in the second and third semesters by every department.

9. THE SCHEME OF EXAMINATION:

There shall be examinations at the end of each semester ordinarily during November/ December for odd semesters and during May/June for even semesters. Each course shall be evaluated with 30% of marks shall be for continuous internal assessment and 70% of the marks for the end-semester examinations as per the guidelines of Mangalore University.

10. CONTINUOUS INTERNAL ASSESSMENT:

Marks for internal assessment shall be awarded on the basis of seminars, field work, tests, assignments etc. The internal assessment marks shall be notified on the department / college notice board for information of the students and it shall be communicated to the Registrar (Evaluation) before the commencement of the University examinations, and the Registrar (Evaluation) shall have access to the records of such internal assessment evaluations.

11. REGISTERING FOR THE EXAMINATIONS:

The candidate shall register for all the courses in the subject of a semester when he/she appears for the examination of that semester for the first time.

12. VALUATION OF ANSWER SCRIPTS:

12.1 a. Normally a course, including dissertation shall be evaluated by one internal and one external examiner.

b. Clinical Practicum examination of 1st and 3rd semester shall be evaluated by two designated internal faculty of the college/Department.

c. Clinical practicum examination shall be jointly conducted and evaluated by one internal examiner and one external examiner or two external examiners if there are no internal examiners.

d. Each written course on open elective has to be valued by one examiner

12.2 There will be viva-voce examination for Dissertation in the final year (Fourth Semester) along with the Clinical Practicum examination. A dissertation shall be evaluated by two examiners, one external and one internal from out of the panel of examiners prepared by the B.O.S. and approved by the University. Further, the internal guide, if he is not a member of the BOE, shall be co-opted as a member for the viva-voce examination.

12.3 If the difference in marks awarded by two evaluators is more than 20% of the maximum marks of the examination of the paper, the Registrar (Evaluation) shall check the entries and the total marks assigned by the two evaluators. If there is any mistake in totalling, it shall be rectified. While checking the total, if it is observed that any one or more of the answers is not valued by one of the evaluators, the Registrar (Evaluation) shall advise the internal members of the Board of Examiners to value that answer. After receiving the marks, the Registrar (Evaluation) shall make the necessary corrections. Despite all these corrections, if the difference between the two valuations is still more than 20%, the Registrar (Evaluation) shall refer such answer scripts to the Chairman of the BOE for arranging third valuation by the examiners from among the approved panel of examiners.

12.4 In case of two valuations, the average of the two valuations and if there are three valuations, the average of the nearest two valuations shall be taken for declaring results.

13. CHALLENGE VALUATION:

13.1 A Candidate who has appeared for an examination conducted by Mangalore University may apply through the Department/College for Challenge Valuation on payment of the prescribed fee, within 20 days after the publication of the results or 10 days from the date of dispatch of the marks cards by the Registrar (Evaluation) to the department / colleges whichever is later.

13.2 Procedure for challenge valuation shall be as per the guidelines framed by the University of Mangalore from time to time.

14. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

The results of successful candidates at the end of each semester shall be declared in terms of Grade Point Average (GPA) and alpha-sign grade. The results at the end of the programme shall be classified on the basis of the Cumulative Grade Point Average (CGPA) obtained in all the four semesters and the corresponding programme alpha-sign grade.

The Grade Point Average (GPA) in a Semester and the Cumulative Grade Point Average (CGPA) at the end of fourth semester shall be computed as follows:

14.1 Grade Point Average (GPA):

The grade points in a course shall be assigned on the basis of actual marks scored (end Semester examination and I.A.) in that course as per the table given below, they have secured a minimum of 35% marks in the end Semester examination. The candidate securing less than 35% marks in the end Semester examination in any unit/ theory/ practical/ project work/ dissertation/ internship shall be declared to have failed in that unit indicated with FF grade. A student obtaining grade FF or absent will be required to reappear in the examination of that course.

Table1: Grades (alpha sign) and grade points

Grade	Limits*	Grade point
OO+	95-100	10
OO	90-94	9.5
OA+	85-89	9
OA	80-84	8.5
AA+	75-79	8
AA	70-74	7.5
AB+	65-69	7
AB	60-64	6.5
BB+	55-59	6
BB	50-54	5.5
BC	45-49	5
CC	40-44	4.5
PP	35-39	4
FF	0-34	0

- Limits are considered after converting the marks out of 100 in that course.

14.2. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student (except open electives and extra courses) and the sum of the number of credits of all these courses undergone by a student during that semester. It shall be expressed up to two decimal places.

SGPA (S_i) = $\Sigma(C_i \times G_i) / \Sigma C_i$ where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

Grade Card: Based on the above recommendations on alpha-sign grades, grade points, SGPA, and CGPA, the University shall issue the Grade Card for each semester and a Programme Grade Card indicating the performance in all semesters. The Grade Card may also indicate that the grade points are in 10 point scale.

Table 2: An example of the Calculation of SGPA

Course Code	Credit	Grade awarded	Grade points	Credit Points
C1	4	OA	8.5	34
C2	4	AB+	7.0	28
C2	4	BC	5.0	20
C3	3	OA	8.5	25.5
C4	3	OO+	10.0	30
C5	4	AA	7.5	30
C6	2	PP	4.0	8
Total				175.5
SGPA	= sum of the credit points/Sum of the credits = 175.5/24=7.3125 ≈ 7.31			

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

CGPA = $\Sigma(C_i \times S_i) / \Sigma C_i$ where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

Table 3: Illustration for CGPA

	Semester I	Semester II	Semester III	Semester IV
Credit	20	18	20	24
SGPA	8.23	7.31	6.95	8.20

$$CGPA = \frac{20 \times 8.23 + 18 \times 7.31 + 20 \times 6.95 + 24 \times 8.20}{82} = 631.98 / 82 = 7.71$$

CGPA will not be declared in the case of such candidates who either secure grade F or absent in any one of the courses including open electives of the programme.

The alpha-sign grade of a programme is determined based on CGPA as given below

Table 4: Programme alpha-sign grade

Programme alpha-sign grade	CGPA
O+	More than or equal to 9 but less than 10
O	More than or equal to 8 but less than 9
A+	More than or equal to 7 but less than 8
A	More than or equal to 6 but less than 7
B +	More than or equal to 5.5 but less than 6
B	More than or equal to 5 but less than 5.5
C	More than or equal to 4 but less than 5

Grade Card: Based on the above recommendations on alpha-sign grades, grade points, SGPA, and CGPA, the University shall issue the Grade Card for each semester and a Programme Grade Card indicating the performance in all semesters. The Grade Card may also indicate that the grade points are in 10-point scale.

15. MINIMUM FOR A PASS:

- 15.1 A candidate shall be declared to have passed the PG programme if he/she secures at least a CGPA of 4.0 (Course Alpha-Sign Grade C).
- 15.2 The candidates who pass all the semester examinations in the first attempts in two years are eligible for ranks provided they secure at least a CGPA of 6.0 (at least Alpha-Sign Grade A).
- 15.3 The results of the candidates who have passed the fourth semester examination but not passed the lower semester examinations shall be declared as NCL (Not Completed Lower semester examinations). Such candidates shall be eligible for the degree only after completion of all the lower semester examinations.
- 15.4 A candidate who passes the semester examinations in parts is eligible for only CGPA and Alpha-Sign Grade but not for ranking.
- 15.5 There shall be no minimum in respect of internal assessment and viva-voce marks.
- 15.6 A Candidate who fails in any of the dissertation shall reappear in that dissertation and pass the examination subsequently.

16. CARRY OVER PROVISION: Candidates who fail in a lower semester examination may go to the higher semesters and take the examinations.

17. REJECTION OF RESULTS:

17.1 A candidate who fails in one or more courses of a semester may be permitted to reject the result of the whole examination of that semester. Rejection of result course wise shall not be permitted. A candidate who rejects the results shall appear for the whole examination of that semester in the subsequent schedule of examinations.

17.2 Rejection shall be exercised only once in each semester and the rejection once exercised shall not be revoked.

17.3 Application for rejection along with payment of the prescribed fee shall be submitted to the Registrar (Evaluation) through the department/college together with the original statement of marks 45 days in advance of the pertinent semester examination whenever held.

17.4 A candidate who rejects the result is eligible for class and not for ranking.

18. IMPROVEMENT OF RESULTS:

18.1 A candidate who passes all the courses of a semester may be permitted to improve the result by reappearing for the whole examination of that semester.

18.2 The reappearance could be permitted twice during double the period without restricting it to the subsequent examination only. The regulation governing maximum period for completing various degree/ diploma programme notified by the University from time to time shall be applicable for improvement of results also.

18.3 The student could be permitted to apply for the improvement examination 45 days in advance of the pertinent semester examination whenever held.

18.4 If the candidate passes in all the subjects in the reappearance, higher of the two aggregate marks secured by the candidate shall be awarded to the candidate for that semester. In case the candidate fails in the reappearance, candidate shall retain the first appearance result.

18.5 A candidate who appears for improvement is eligible for class and not for ranking.

19. Internal assessment marks shall be shown separately in the marks card. A candidate who has rejected the result or who, having failed, takes the examination again or who has appeared for improvement shall retain the internal assessment marks already obtained.
20. A candidate who fails in any of the semester examinations may be permitted to take the examinations again at a subsequent appearance as per the syllabus and scheme of examination in vogue at the time the candidate took the examination for the first time. This facility shall be limited to the following two years and this provision may also be extended to a candidate who rejects or improves the result.

A. BASIS FOR INTERNAL ASSESSMENT:

- i. Internal assessment marks in theory papers shall be based on two tests. The tests may be conducted in 8th and 14th week after the start of a semester. Average of two test marks will be considered as internal assessment marks.
- ii. Clinical examinations for odd semesters shall be conducted by the designated internal faculty of the department at the end of 1st and 3rd semester. IA marks shall be awarded by all the faculty of the department on the basis of the assessment of the candidates' work throughout the particular semester.
- iii. Clinical examinations for even semesters will be conducted by one internal and one external examiner at the end of the 2nd and 4th semester, respectively. The examiners shall also evaluate records of clinical and practical work of the students.

B. THEORY QUESTION PAPERS PATTERN:

The Syllabus of hard core and soft core course shall be grouped into 5 units of 16 teaching hours/ week. Open Elective shall be of 5 units of 3 teaching hours/ week. Each unit is compulsory and questions would be drawn from each unit of Hard/Soft core subjects. An equal weightage of 14 marks would be allotted for each unit. Every question may have 2 or 3 subdivisions.

C. CLINICAL EXAMINATION PATTERN:

Clinical practicum examination would be conducted after every semester for MSc Audiology. In odd semesters, clinical practicum examination will be conducted by two internal examiners. For even semesters, the clinical examination will be conducted by one internal and an external examiner.

D. BOARD OF EXAMINERS

There shall be a Board of Examiners for scrutinizing and approving the question papers as well as scheme of valuation. Fifty percent of the members in the Board of Examiners shall be from outside the institution.

E. AWARD OF DEGREE

The University shall award the degree and issue certificate only after the candidates successfully complete all the examinations stipulated.

OBJECTIVES OF THE SYLLABUS

The objectives of the M.Sc. (Audiology) programme are to equip the students with knowledge and skills to

1. Diagnose and manage disorders of hearing and balance across life span.
2. Counsel and guide persons with disorders of hearing and balance as well as their family members.
3. Implement rehabilitation programs for persons with hearing and balance disorders.
4. Liaise with professionals in allied fields and other stake holders.
5. To function as the disability certification authority in the field.
6. Implement prevention and public education programs.
7. Undertake advocacy measures on behalf of and for persons with Hearing and balance disorders.
8. Advise government and other institutions on legal and policy issues related to persons with Hearing and balance disorders.
9. Function as researchers in institutions of higher learning.
10. To establish and administer institutions of higher learning in the area.

PROGRAMME OUTCOMES

- a. Eligible to work as clinician, academician and researcher in hospitals, government/private sector and institutions.
- b. To work as an expert in diagnosis, management and counselling of Hearing disorders.
- c. Eligible to provide rehabilitation programs for persons with Hearing disorders.
- d. Equip themselves with up-to-date knowledge in the field of frontier areas of Hearing and balance.
- e. To take up research and development positions in the area of Audiology.
- f. To use knowledge for the betterment of persons with disabilities.

MASTER OF SCIENCE (Audiology)

Existing CBCS SCHEME (MODEL QUESTION PAPER PATTERN)
(All Units are Compulsory)

Paper Title:Max. Marks: 70

Paper Code:

Unit no.	Question Number	Question/s	Marks
I	1)	A x x x x x x x x x x x x x x x x x x x x OR	14
	2 (a)	B x x x x x x x x x x x x x x x x x x x x	8
	2 (b)	C x x x x x x x x x x x x x x x x x x x x	6
II	3 (a)	D x x x x x x x x x x x x x x x x x x x x	10
	3 (b)	E x x x x x x x x x x x x x x x x x x x x OR	4
	4)	F x x x x x x x x x x x x x x x x x x x x	14
III	5 (a)	G x x x x x x x x x x x x x x x x x x x x	6
	5 (b)	H x x x x x x x x x x x x x x x x x x x x	4
	5 (c)	I x x x x x x x x x x x x x x x x x x x x OR	4
	6 (a)	J x x x x x x x x x x x x x x x x x x x x	7
	6 (b)	K x x x x x x x x x x x x x x x x x x x x	7
IV	7 (a)	L x x x x x x x x x x x x x x x x x x x x	4
	7 (b)	M x x x x x x x x x x x x x x x x x x x x	4
	7 (c)	N x x x x x x x x x x x x x x x x x x x x OR	6
	8)	O x x x x x x x x x x x x x x x x x x x x	14
V	9 (a)	P x x x x x x x x x x x x x x x x x x x x	8
	9 (b)	Q x x x x x x x x x x x x x x x x x x x x OR	6
	10 (a)	R x x x x x x x x x x x x x x x x x x x x	8
	11 (b)	S x x x x x x x x x x x x x x x x x x x x	6

I Semester

AH 101: RESEARCH METHODS, STATISTICS & EPIDEMIOLOGY

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to understand

- a) clinical research designs and statistical methods,
- b) epidemiological issues and its relevance in hearing research,
- c) evidence based practice in Audiology, and
- d) ethical practices in research

Unit 1: Experimental Designs and Their Applicability in Hearing Research

- a) Types of research- post facto research, normative research, standard group comparison, experimental research, clinical and applied research, sample surveys, evaluation research
- b) Methods of observation and measurement, strategies and designs in research
- c) Experimental designs, single subject designs and group designs
- d) Critical analysis of the research methods employed in hearing research.
- e) Documentation and research writing
- f) Ethical considerations in research – National and international guidelines

Unit 2: Epidemiology

- a) Epidemiology: Definition, basic concepts – scope and function of epidemiology
- b) Study designs in epidemiology: Cohort studies, case-control studies, cross-sectional studies, clinical trials
- c) Measures in epidemiology – Ratios, proportions, rates, relative risk, odds ratio
- c) Identify biases and their consequences in published literature.
- d) Describe criteria for characterizing the causality of associations.
- e) Application of epidemiology in evaluation and screening procedures employed in Speech-language Pathology
- f) Application and impact of epidemiology on national and local policy; influence of epidemiology on ethical and professional issues

Unit 3: Statistical Measures and their Features

- a) Review of data description and exploratory data analysis (Numerical summaries and graphical summaries)
- b) Probability concepts and models
- c) Statistical Inference – Estimation Confidence Intervals
- d) Statistical Inference – Basic concepts related to hypothesis testing –null hypothesis, alternative hypothesis, significance level, statistically significant, critical value

acceptance / rejection region, p-value, power, types of errors: Type I , Type II ,one-sided (one-tailed) test, Two-sided (two-tailed) test

- e) Parametric and non-parametric approaches to hypothesis testing
- f) Categorical data analysis - contingency tables, Chi-square test for independence of attributes,
- g) Measures of association (Contingency coefficient, Cramer's V), Kappa coefficient

Unit 4: Regression, Univariate and Multivariate Analysis

- a) Correlation, regression analysis and prediction including multiple regression; logistic regression; path analysis
- b) Analysis of Variance (ANOVA)- Basic models, assumptions, one way and two-way ANOVA; Consequence of failure of assumptions underlying ANOVA; Tests for additivity, homogeneity, transformation; Post – hoc tests; Analysis of Covariance (ANOCOVA); Repeated measure ANOVA
- c) Multivariate analysis: Need for multivariate analysis, various methods including MANOVA, MANCOVA
- d) Introduction to principal component analysis, factor analysis, discriminant function, multidimensional scaling
- e) Evaluation of application of statistics to different research designs used in different publications
- f) Critical analysis of research articles in the field: Analysis of research designs in different areas of Speech-language Pathology

Unit 5: Evidence Based Practice

- a) Introduction to Evidence Based Practice (EBP) and Steps to EBP from formulating foreground question, finding best current evidence, critical appraisal of best current evidence, summarizing evidence, integrating evidence and tracking progress.
- b) Concepts related to practical significance (effect size) vs. statistical significance, precision of measurement (confidence intervals)
- c) Levels of evidence: For experimental and non-experimental designs; treatment efficacy- randomized control study, quasi experimental study, correlation and case study, single subject designs, expert committee report, consensus conference
- d) Measures of diagnostic accuracy – positive and negative likelihood ratios; positive predictive value, negative predictive value, diagnostic odds ratio
- e) Concepts related to randomized control trials: Comparative groups- allocation concealment/ random allocation; importance of participation and follow up in understanding, evaluating and applying randomized controlled trial results
- e) Methods of carrying out therapy trials; execution, indexing and reporting of therapy trial – efficacy studies; Conventions to study outcomes - i) Absolute risk reduction, ii) Absolute benefit increase, iii) Absolute risk increase, and iv) Absolute benefit reduction
- f) Systematic review and meta-analysis; importance of research publications in terms of systematic review, meta-analysis, clinical practice guidelines, health technology assessments.
- g) Challenges in implementation of EBP in Audiology in India and future directions

Recommended Reading

- Russell, C., & Jay, L. (2016). *Rehabilitation Research: Principles and Applications*. Elsevier
- Robert E. Owens Jr., Dale Evan Metz, Kimberly A. Farinella (2014). *Introduction to Communication Disorders: A Lifespan Evidence-Based Perspective*. Pearson Education
- Laura M. Justice, Erin Redle (2013). *Communication Sciences and Disorders: A Clinical Evidence-Based Approach*. Pearson Education.
- Robert F. Orlikoff, Nicholas E. Schiavetti, Dale Evan Metz (2014). *Evaluating Research in Communication Disorders*. Pearson Education
- David L. Irwin, Mary Pannbacker, Norman J. Lass (2013). *Clinical Research Methods in Speech-Language Pathology and Audiology*. Second Edition. Plural Publishing
- Timothy Meline (2009). *A Research Primer for Communication Sciences and Disorders*. Pearson Education
- David, L., Maxwell, Eiki Satake. (2006) *Research and Statistical Methods in Communication Sciences and Disorders*. Thomson/Delmar Learning.
- John C Reinard (2006). *Communication Research Statistics*. SAGE Publications
- Nicholas Schiavetti, Dale Evan Metz (2006). *Evaluating Research in Communicative Disorders*. Allyn & Bacon
- Tim Pring (2005). *Research Methods in Communication Disorders*. Wiley
- Donald G. Doehring (2002). *Research Strategies in Human Communication Disorders*. Pro-Ed
- Carole E. Johnson, Jeffrey L. Danhauer (2002). *Handbook of Outcomes Measurement in Audiology*. Singular
- David L. Maxwell, Eiki Satake (1997). *Research and Statistical Methods in Communication Disorders*. Williams & Wilkins

AH 102: COCHLEAR PHYSIOLOGY

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) describe the micro and macro structures of cochlea,
- b) explain the physiology of cochlea,
- c) explain the physiological basis for generation of OAE,
- d) use appropriate protocol for recording OAEs in clinics and for research,
- e) use appropriate protocol for recording ECochG in clinics and for research, and
- f) understand the research needs in physiological measurements of hearing

Unit 1: Cochlear Anatomy

- a) Macro & microanatomy of cochlea
- b) Homeostatic mechanisms in cochlea
- c) Blood supply to cochlea
- d) Innervations of cochlea
- e) Cochlear regeneration
- f) Evolution of human cochlea

Unit 2: Cochlear Physiology

- a) Techniques to study hair cell and basilar membrane physiology
- b) Basilar membrane mechanics and non-linearity
- c) Outer hair cell physiology – different mechanisms involved in hair cell motility
- d) Inner hair cell physiology
- e) Cochlear non-linearity

Unit 3: Development of cochlea and top-down control of sensory process

- a) Efferent control of cochlear hair cells
- b) Nutrients related to sensory cell physiology
- c) Ontogenetic development of cochlea
- d) Phylogenetic development of cochlea
- e) Developmental changes in the cochlea; effect of advancing age on cochlea
- f) Comparative physiology of auditory system in non-mammalian species

Unit 4: Otoacoustic Emissions

- a) Classifications of OAEs; mechanism-based taxonomy
- b) Characteristics of different types of OAEs
- c) Instrumentation and techniques for recording different types of OAEs
- d) Factors affecting different types of OAEs
- d) Fine structure DPOAEs
- e) Suppression of OAEs: ipsilateral, contralateral, and bilateral
- f) Clinical applications of OAEs

Unit 5: Cochlear Potentials

- a) Endo cochlear potentials.
- b) Electrocochleography: Instrumentation and technique
- b) Protocol for recording ECoChG
- c) Interpretation of ECoChG
- d) Clinical application of ECoChG

Recommended Reading

- Altschuler, R. A., & Hoffman, D. W. (1986). *Neurobiology of hearing: the cochlea*. New York: Raven Press.
- Berlin, C. I. (1996). *Hair cells and hearing aids*. San Diego: Singular Publishing Group.
- Dallos, P. (1973). *Auditory periphery: Biophysics & physiology*. New York: Academic Press.
- Dallos, P., Popper, A. N., & Fry, R. R. (1996). *The cochlea*. New York: Springer.
- De Reuck, A. V. S., & Knight, J. (1968). *Hearing mechanisms in vertebrates*. London: Churchill.
- Dhar, S and Hall, J.W. (2011). *Otoacoustic emissions: Principles, Procedures and Protocols*. San Diego: Plural Publishing Inc
- Drescher, D. G. (1985). *Auditory biochemistry*. Springfield: Charles C. Thomas.
- Flock, A., Ottoson, D., & Ulfendahi, M. (1995). *Active hearing*. Baltimore: Williams & Wilkins.
- Gelfand, S. A. (2004). *Hearing: Introduction to Psychological and Physiological Acoustics*. (4th Edn.). New York: Marcel Decker.
- Hall, J.W. (2007). *New Handbook of Auditory Evoked Responses*. Boston: Pearson.
- Jahn, A. F., & Santos-Sacchi, J. (1989). *Physiology of the Ear*. New York: Academic Press.
- Kemp, D. T. (1986). Otoacoustic emissions, travelling waves, and cochlear mechanisms. *Hearing Research*. 22, 95-104.
- Moller, A. R. (2000). *Hearing: Its physiology and pathology*. San Diego: Academic Press.
- Moore, B. C. J. (1995). *Hearing*. San Diego: Academic Press.
- Musiek, F.E. & Baran, J.A. (2016). *Auditory System: Anatomy, Physiology and Clinical Correlates*. San Diego: Plural Publishing Inc
- Robinette, M. S., & Glatke, T. J. (1997). *Otoacoustic emissions: clinical applications*. New York: Thieme Medical Publications.
- Zemlin, W. R. (2010). *Speech & Hearing Science: Anatomy & Physiology*. Boston: Allyn & Bacon.

AH 103: HEARING SCIENCES

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) understand psychophysical components of sound and their measurement,
- b) analyse and critically evaluate the different methods of estimation of thresholds, frequency analysis and application of masking, and
- c) conduct experiments to estimate thresholds, measure pitch.

Unit 1: Introduction to Psychoacoustics

- a) Physical description and parameters for generation of sounds: Sine wave and complex signals; Analysis of sound: Spectrum and spectrogram, LTASS; Filters and their properties
- b) Theory of signal detection: Basic concepts and applications of signal detection
- c) Psychophysical methods - Classical and adaptive methods

Unit 2: Thresholds and Loudness

- a) Overview of absolute and relative measures: Methods of measuring absolute and relative thresholds; thresholds of audibility (MAP & MAF); Models of loudness.
- b) Loudness perception in normal hearing persons
- c) Effect of hearing impairment on perception of loudness
- d) Dynamic range of hearing, equal loudness contours and loudness scaling.
- e) Recruitment and softness imperceptions
- f) Consequences of altered loudness perception
- g) Factors affecting loudness: Bandwidth, duration, adaptation and masking.
- h) DLI

Unit 3: Pitch

- a) Theories of pitch perception - simple and complex signals
- b) Pitch scales
- c) Factors affecting pitch perception
- d) Perception of pure-tones by persons with normal hearing and those with hearing impairment
- d) Perception of complex signals by persons with normal hearing and those with hearing impairment
- e) DLF

Unit 4: Peripheral Masking

- a) Critical band concept and power spectrum model
- b) Estimating the shape of auditory filter: Psycho-physical tuning curve; Notched noise; Non-simultaneous masking
- c) Auditory filter shapes in normal hearing and hearing impaired
- d) Masking patterns and excitation patterns in normal hearing and hearing impaired

Unit 5: Non-Peripheral Masking

- a) Central masking
- b) Informational masking
- c) Overshoot phenomena
- d) Co-modulation masking release
- e) Effect of hearing loss on non-peripheral masking

Recommended Reading

- Brain C.J., Moore (2007). Cochlear Hearing Loss: Physiological, Psychological and Technical Issues. England: John Wiley and Sons Ltd.
- Brain, C.J. Moore (1998). Cochlear Hearing Loss. (2nd and 3rd Editions). London: Whurr Publishers.
- Gelfand, S, A. (2005). Introduction to psychological and physiological acoustics. New York: Marcel Dekker.
- Gullick, W.L. (1971). Hearing physiology and psychophysics. New York: Oxford University Press.
- Howard, D and Angus, J (2013). Acoustics and Psychoacoustics. Oxford: Taylor & Francis
- Moore, B. C. J. (1995). Hearing. San Diego: Academic Press.
- Stanley, A. Gelfand (1998). Hearing. New York: Marcel Dekker Inc.
- Stuart Rosen & Deter Howell (1991). Signals and systems for speech and hearing. CA: Academic Press Inc.
- Stuart Rosen and Deter Howell (1991). Signals and systems for speech and hearing. CA: Academic Press Inc
- Yost, W. A. (1994). Fundamentals of hearing: An introduction. San Diego: Academic Press.
- Zwicker, E., & Fastl, H. (1999). Psychoacoustics-Facts and models. Springer Verlag: Berlin Heidelberg.

AS 104: AUDITORY DISORDERS

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) Explain the pathophysiology of auditory disorders,
- b) Diagnose and differentially diagnose auditory disorders, and
- c) Recommend appropriate management options for the clients with hearing loss.

Unit 1: Disorders of the External and Middle Ear

- a) Congenital malformations of external and middle ear
- b) Diseases of the external ear: otitis – externa, neoplasms of external ear, cerumen, keratosis obtains, injuries, sebaceous cysts, acquired atresia, stenosis of external auditory canal & malignant otitis externa
- c) Diseases of the middle ear cleft: otosclerosis otitis media, non-suppurative otitis media, complications of middle ear diseases, neoplasms.
- d) Assessment of middle ear functioning: multicomponent tympanometry, multifrequency tympanometry, wide band reflectance/absorbance, relaxometry
- e) Reconstruction of external and middle ear hearing mechanisms: reconstructive andrehabilitation procedures

Unit 2: Disorders of the Cochlea

- a) Pathophysiology of inner ear disorders: ototoxicity, Meniere's, Age related hearing loss, Sudden hearing loss, Auto immune conditions, hearing loss due to systemic diseases
- b) Audiological profile in persons with above inner ear disorders
- c) Non-audiological management options

Unit 3: Disorders of the Cochlea– NIHL & Traumatic Injury

- a) Pathophysiology inner ear disorders due to NIHL and other traumatic injuries
- b) Audiological profile in persons with NIHL and other traumatic injuries
- c) Hearing conservation: National and International guidelines
- d) Non-audiological management options

Unit 4: Auditory Nerve and Brainstem

- a) Pathophysiology of space occupying lesions of auditory nerve and brainstem
- b) Audiological profile in persons with space occupying lesions
- d) Radiological findings and its correlations with audiological findings
- d) Challenges in diagnosis of space occupying lesion
- e) Management options for space occupying lesion

Unit 5: Auditory Neuropathy Spectrum Disorders (ANSD)

- a) Pathophysiology of ANSD
- b) Etiology of ANSD
- c) Audiological profile of persons with ANSD and its correlations with pathophysiology

- d) Speech perception in persons with ANSD
- e) Management of persons with ANSD: Aids strategies

Recommended Reading

- Berlin, C. I., Hood, L. J., & Ricci, A. (2002). Hair Cell Micromechanics and Otoacoustic Emissions. New York: Thomson Learning Inc.
- Chasin, M (2009) Hearing Loss in Musicians: Prevention and Management. San Diego: Plural Publishers
- Hall, J. W. (2000). Handbook of Otoacoustic Emissions. San Diego: Singular Publishing Company.
- Hall, J.W. (2007). New Handbook of Auditory Evoked Responses. Boston: Pearson.
- Hood, L.J. (1998). Clinical applications of auditory brainstem response. San Diego:Singular Publishing Group Inc.
- Moller, A. R. (2000). Hearing: Its physiology and pathology. San Diego: Academic Press.
- Rintleman, W.F. (1991). Hearing Assessment. Boston: Allyn and Bacon.
- Roeser, R. J., Valente, M., & Hosford-Dunn, H. (2007). Audiology: Diagnosis. New York: Thieme Medical Publishers.
- Sanbridge, S.A. (2009). Ear Disorders. San Diego: Plural Publishers
- Sininger, Y& Starr, A (2001). Auditory Neuropathy: A new perspective in hearingdisorders
- Standring, S. (2008). Gray's Anatomy: The Anatomical Basis of Clinical Practice, Expert Consult. Livigstone: Churchill publishers.
- Wiley, T.L., & Fowler, C.G. (1997). Acoustic immittance measures in clinical audiology:A primer. San Diego: Singular Publishing Group Inc.

AS 105: PATHOLOGIES OF THE EAR

Marks -100

64 Hours

Objective:

On successful completion of the course students are expected to appreciate the|

1. Anatomical Structures related to ear
2. Physiological aspects of ear functioning
3. Various pathologies affecting the ear in children
4. Various pathologies affecting the ear in adults
5. Diagnosis and treatment of pathologies of the ear.

Unit I: Anatomy of the auditory path way

- a. External Ear
- b. Middle Ear
- c. The Eustachian Tube
- d. Inner ear
- e. Auditory Neural Pathway and Auditory cortex

Unit II: Physiological aspects of auditory pathway

- a. Physiology of outer ear
- b. Physiology of middle ear and Eustachian tube
- c. Physiological aspects of inner ear
- d. Neurophysiology of auditory system

Unit III: Pathologies of External and Middle Ear

- a. Congenital disorders
- b. Acquired disorders
- c. Foreign bodies
- d. Inflammatory conditions,
- e. Infections of the ear
- f. Tympanic membrane perforations
- g. Tumours, Trauma
- h. Facial nerve and its disorders

Unit IV: Pathologies of Inner Ear and higher auditory centres

- a. Congenital disorders
- b. Meniere's Disease
- c. Ototoxicity
- d. Presbycusis
- e. Disorders of Vestibular system
- f. Vestibular Schwannoma
- g. Auditory Neuropathy Spectrum Disorders (ANSD)

Unit V: Diagnosis, treatment of ear for children and adults

- a. Surgical approaches for External and middle ear disorders
- b. Surgical technique for restoration and preservation of hearing.
- c. Treatment options for Sudden hearing loss
- d. Pre- and post-operative Counselling
- e. Evaluation of success and evidence-based practices

Reference:

- Ballenger, J. J. & Snow, J. B., Jr. (Eds.). (1996). Otorhinolaryngology: Head and Neck Surgery (15th ed.). Philadelphia: Williams and Wilkins.
- Bhargava KB, (2017) A Short Book Of ENT Diseases (10th Edition) by BHARGAVA KB, THE NATIONAL BOOK DEPOT
- Brackmann,D.,Shelton, C.,Arriaga,M.A.,(2010).Otologic Surgery:Expert Consult (3rd ed) Saunders.
- Chan, Y. and Goddard, J.C. (2015). K J Lee's Essential otolaryngology: head and neck surgery. (11th edition). New Delhi: Atlantic Publisher and Distributers
- Dhingra, P. L. (2013). Diseases of Ear, Nose and Throat (Sixth edition). Elsevier.
- Hazarika,Textbook Of Ear, Nose, Throat And Head- Neck Surgery: Clinical And Practical,(4th Edition),(2018) CBS Publishers & Distributors

AS 106: TECHNOLOGY IN AUDIOLOGY

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to understand

- a) advanced aspects of signal acquisition and processing,
- b) development and application of software-based tools,
- c) development and application of tele-technology, and
- d) technology of amplification devices

Unit 1: Fundamentals of Digital Signal Processing & Communication Systems

- a) Digitization of data and digital systems; Principles and methods of digital signal processing
- b) Fundamentals of communication systems – (i) AM & FM transmission & reception (ii) Digital modulation techniques, (iii) Satellite communication
- c) Transducers and signal generation
- c) Biomedical signals & signal processing: Principles of generation of acoustic stimuli
- d) Signal acquisition and processing techniques
- e) Working principles of EEG / Magnetoencephalography, event related potentials/ evoked potential.
- f) High-fidelity sound reproducing systems: Auditorium acoustics

Unit 2: Techniques of Speech Processing and Analysis

- a) Artificial neural networks
- b) Speech processing and synthesis models and techniques (linear predictive coding, linear prediction model, LPC-based synthesis) and applications, review of signal processing, Fourier transform and short-time speech analysis (energy, zero-crossing rate, autocorrelation function).
- c) Voice response system, speaker recognition system and speech recognition system: Speech synthesis methods, speech recognition, speaker recognition, speech coding, and speech enhancement.
- d) Basic principles of cepstral analysis, filtering low-time filtering for formant estimation, high-time filtering for pitch estimation, complex cepstrum

Unit 3: Neuro Imaging

- a) Principles of neuro imaging techniques - MRI, fMRI, NIRS, CT, PET, SPECT, TMS and MEG and their technology (working principles, interpretation and implications).
- b) Synching various speech stimuli and events for fMRI acquisition and speech perception in fMRI
- c) Technology available for intra-operative monitoring of sensory and motor functions

Unit 4: Tele-technology

- a) Tele-technology: Definition, applications, technology, resources
- b) Transmission of information: transmission of patient images, reports, etc.
- c) Remote consultations and databases
- d) Distance learning- multimedia meeting room / videoconferencing

Unit 5: Software for Analysis

- a) Software packages and applications in hearing diagnostics and research - MATLAB, Adobe audition, Audacity, PRAAT
- b) Basics features, vectors and matrices, built-in functions and plotting
- c) Editing audio files, applying effects in waveform editor, amplitude compression and modulation effects, filter and equalizer effects, noise reduction/ restoration effects, basic multi track controls, saving and exporting
- d) Computer based assessment and intervention programs relating to hearing
- e) Calibration and maintenance of equipment

Recommended Reading

- Moser, P. (2015). Electronics and Instrumentation for Audiologists. Psychology Press.
- Villchur, E. (1999). Acoustics for Audiologists (1 edition.). San Diego, Calif: Delmar Cengage Learning.
- Baber, C. & Noyes, J.M. (1993). Interactive Speech Technology: Human Factors Issues in the Application of Speech Input Output to Computers. London: Taylor and Francis.
- Daniloff, R.G (1985). Speech Sciences: Recent advances. London: Taylor and Francis.
- Gottingen, M.R.S. (Ed.) (1985). Speech and Speaker Recognition. Basel: Kager.
- Haton, J.P. (Eds) (1981). Automatic speech analysis & Recognition. USA, D. Reidel Publishing Company.
- Keller, E. (ed.) (1994). Fundamentals of Speech Synthesis and Speech Recognition: Basic Concepts, State of the art and Future challenges. New York: John Wiley & sons.
- Morgan, D.P. & Scofield, C.L (1991). Neural Networks and Speech Processing. Boston, Kluwer Academic Publishers.
- Nakagawa, S. &etal. (1995). Speech, Hearing and Neural Network Models. Oxford: IOS, Press
- Oppenheim & Schafer (1989). Digital signal processing. New Delhi: Prentice Hall of India.
- Boulston, F. R. & Dvorak, J.D (2015). Matlab Primer for Speech Language Pathology and Audiology. San Diego: Plural Publishing Inc
- Silman, S & Emmer, M.B. (2011). Instrumentation in Audiology and Hearing Science: Theory and Practice. San Diego: Plural Publishing Inc

AS 107: LEARNING AND BEHAVIOUR ANALYSIS

Marks -100

64 Hours

Objectives After successful completion of the course student will be:

1. Prepared in the specific area of clinical behaviour analysis, therapy or change programs for affected individuals with communication disorders.
2. Trained in the practical skills and competences needed to grasp the fundamentals of clinical behaviour analysis in order to identify and manage people with communication difficulties in their practise.
3. Sensitized on the ethical aspects of clinical behaviour analysis when dealing with individuals or their families with communication disorders.
4. Able to integrate clinical behaviour analysis and counselling-based aspects in the field of research in communication disorders
- 5.

Unit 1: Introduction

- a) Definition and types of learning
- b) Behavioral Perspectives: From the Past to the Present in Behaviour Medicine
- c) Behavioral Theories by Pavlov, Skinner and Watson
- d) Concepts related to Behaviour Therapy
- e) Behaviour Modification and its application in therapeutic settings

Unit 2: Assessment

- a) Meaning & Characteristics of Behavioral Assessment - Behavioral Perspective
- b) Recent advances in behavioural therapy: Applied Behaviour Analysis and Dialectical Behavioral Counselling – ABC Model
- c) Various Behaviour Assessment Scales such as Western and Indian-AAMD Adaptive Behaviour Scale, PBCL, BASIC-MR, ACPC-DD, MDPS, etc
- d) Steps involved in Behaviour Assessment & Management: Skills, Steps, Strategies Skill Training and Problem Behaviour Remediation
- e) Shaping, Chaining, Prompting, Fading, Modelling, Contingency Contracting, Reward Training, Token Economy, Activity Scheduling, Systematic Desensitization, Flooding, Aversion Techniques

Unit 3: Management- I

- a) Self-Management Techniques: Correspondence Training
- b) Techniques: Shaping, Chaining, Prompting, Compliance training, Stress Management/ Relaxation Techniques: JPMR, Yoga – Habit Reversal Techniques – Paradoxical Intention – Negative Practice

Unit 4: Management- II

- a) Operant Procedures and Techniques include Counter-Conditioning, Desensitization, Aversive Conditioning Procedures
- b) Self-control and Cognitive Procedures
- c) Time Out
- d) Over-correction

Unit 5: Application in allied science

- a) Biofeedback: EEG, EMG, GSR, EKG and Thermal – Polygraph
- b) Cognitive Behaviour Techniques: Beck and Ellis – Reality Therapy and Transactional Technique.

Recommended reading

1. Feldman, M.P., & Broadhurst, A. (1976). Theoretical and experimental bases of the behaviour therapy. London: Wiley.
2. Housten, R.V., & Axelrod, S. (1993). Behaviour analysis and treatment. New York: Springer.

3. Kearney, A.J. (2007). *Understanding Applied Behaviour Analysis: An Introduction*. London: Jessica Kingsley.
4. Malott, R., Tillema, M., & Glenn, S. (1978). *Behaviour analysis and behaviour modification: an introduction*. Kalamazoo, MI: Behaviordelia.
5. Hersen, M. (2005). *Encyclopedia of behavior modification and Cognitive behavior therapy*. California: Sage Publications.
6. Bellack, S. (1985). *International handbook of behaviour modification and therapy*. New York: Plenum Press.
7. Venkatesan, S. (2004). *Children with Developmental Disabilities: a training guide for parents, teachers and caregivers*. New Delhi: Sage.
8. Peshawaria, R., & Venkatesan, S. (1992). *Behavior approach in teaching mentally retarded children: a manual for teachers*. Secunderabad: NIMH
9. Ramnero, J., & Törneke, N. (2008). *ABCs of human behavior: Behavioral principles for the practicing clinician*. Oakland, CA: New Harbinger & Reno, NV: Context Press.
10. Miltenberger, R.G., (2008). *Behavior modification: Principles and procedures (4th Ed.)*. Pacific Grove, CA: Thomson/Wadsworth.
11. Woods, D. W., & Kanter, J. W. (Eds.). (2007). *Understanding behavior disorders: A contemporary behavioral perspective*. Reno, NV: Context Press.
12. Cooper, J.O., Heron, T.E. & Heward, W.L. (2007). *Applied Behavior Analysis (2nd Edition)*. Prentice Hall.
13. Baum, W. M. (2004). *Understanding Behaviorism: Behavior, Culture, and Evolution (2nd edition)*. Wiley-Blackwell
14. Pierce, W.D. & Cheney, C.D. (2003). *Behavior Analysis and Learning, 3rd edition*. Lawrence Erlbaum
15. Baldwin, J.D., & Baldwin, J.I. (2000). *Behavior Principles in Everyday Life (4th Edition)*. Prentice Hall.

SEMESTER II

AH 201: NEUROPHYSIOLOGY OF HEARING

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) explain the anatomy afferent system,
- b) describe the neurophysiology of hearing,
- c) explain the efferent auditory system,
- d) describe the functioning and role of efferent system,
- e) understand the neurophysiological basis of the disorders affecting the auditory nervous system, and
- f) understand the basis of electrophysiological assessment

Unit 1: Ascending Auditory Pathway: Anatomy

- a) Auditory nerve
- b) Cochlear nucleus
- c) Superior olivary complex
- d) Lateral lemniscus
- e) Inferior colliculus
- f) Medial geniculate body

Unit 2: Functioning of the Auditory Nerve

- a) Stimulus coding
 - i. Frequency, intensity and temporal coding
 - ii. Coding of complex signals
- b) Non linearity
- c) Action potentials
- d) Neurotransmitters and neuromodulators

Unit 3: Physiology of Auditory Brainstem

- a) Tonotopic organization of auditory brainstem
 - i. Cochlear nucleus
 - ii. Superior olivary complex
 - iii. Lateral lemniscus
 - iv. Inferior colliculus
 - v. Medial Geniculate body
- b) Coding of simple and complex acoustic signals at auditory brainstem
 - i. Cochlear nucleus
 - ii. Superior olivary complex
 - iii. Lateral lemniscus
 - iv. Inferior colliculus
 - v. Medial Geniculate body
- c) Role of subcortical structures in sound localization

Unit 4: Anatomy and Physiology of Auditory Cortex

- a) Anatomy of primary and secondary auditory cortex
- b) Tonotopic organization in auditory cortex
- c) Coding of signals in the auditory cortex
 - i. Simple and complex signals
 - ii. Speech
- d) Association of auditory cortex with other structures
- e) Role of auditory cortex in sound localization
- f) Plasticity of auditory cortex

Unit 5: Efferent Auditory System

- a) Efferent auditory pathway: medial and lateral Olivary cochlear bundle
- b) Functioning of the auditory efferent system
- c) Role of auditory efferent system in hearing
- d) Protective function of auditory efferent system

Recommended Reading

- Aitkin, L. (1990). *The auditory cortex: structural and functional bases of auditory perception*. University of Michigan: Chapman and Hall.
- Berlin, C.E. (1999). *The efferent auditory system: basic science and clinical applications*. USA: Singular Publishing Group.
- Enrique A. & Lopez-Poveda, S. (2010). *The neurophysiological bases of auditory perception*. New York: Springer-Verlag.
- Gelfand, S.A. (2004). *Hearing: An introduction to psychological and physiological acoustics*. USA: Marcel Dekker Inc.
- Günter, E., & Romand, R. (1997). *The central auditory system*. United Kingdom: Oxford University Press.
- Jahn, A.F., & Santos-Sacchi J. (2001). *Physiology of the ear*. San Diego: Singular/Thomson Learning.
- Jeffery, A., & Schreiner, C. (2005). *The inferior Colliculus*. USA: Springer-Verlag.
- Lambert, M.S., Miriam T. T., & Susan F. M (2010). *Superior Olivary Complex*. USA: Betascript Publishers.
- Meddis, R. (2010). *Computational Models of the Auditory System*. USA: Springer-Verlag
- Moore, D., Rees, A. & Palmer, A.R. (2010). *Oxford handbook of auditory science the ear*. United Kingdom: Oxford University Press.
- Musiek, F.E., & Baran, J.A. (2006). *The auditory system: anatomy, physiology and clinical correlates*. USA: Indiana University Press.
- Musiek, F.E., Baran, J.A., Shinn, J., & Raleigh, J. (2012). *Disorders of the Auditory System*. San Diego: Plural Publishers.
- Pickels, J.O. (2012). *An introduction to the physiology of hearing*. United Kingdom: Emerald Group Publishing Inc.
- Richard, A. (1991). *Neurobiology of Hearing*. USA: Raven Press.
- Ryugo, D.K. (2010). *Auditory and Vestibular Efferents*. USA: Springer-Verlag
- Schnupp, J., Nelken, I., & Ahissar, E. (2011). *Auditory Neuroscience: Making Sense of Sound*. USA: Library of Congress.
- Steven, G., & William, A.A. (2006).
- *Listening to Speech: auditory perspectives*. New Jersey: Lawrence Erlbaum Associates Inc. Syka, J. (1997).
- *Acoustical signal processing in the central auditory system*. USA: Springer Science. Syka, J., & Merzenich, M.M. (2003). *Plasticity and signal representation in the auditory system*.
- *Efferent auditory system: structure and function*. USA: Singular Publishing Group. , Richard, H. N., & Musiek, F.E. (1997).
- Webster, D.B., Popper A.N., & Fay R.R. (1992). *The Mammalian auditory pathway: neuroanatomy*. New York: Springer-Verlag.

AH 202: Electrophysiological Assessment

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) describe and classify auditory evoked potentials,
- b) understand the technology for recording auditory evoked potentials,
- c) record and interpret exogenous and endogenous potentials,
- d) use appropriate protocols for recording exogenous and endogenous potentials for clinical and research purposes, and
- e) understand research needs in auditory evoked potentials

Unit 1: Foundations of Auditory Evoked Potentials (AEPs)

- a) Introduction and Classification of AEPs
- b) Neuroanatomy and neurophysiology related to AEPs; dipole orientation and scalp distribution of AEPs
- c) Stimuli for recording AEPs- generation, characteristics and types
- d) Electrodes for recording AEPs
- e) General principles of recording AEPs
- f) Overview to advanced analyses techniques such as independent component and time frequency analyses
- g) Maintenance and Calibration of instrumentation

Unit 2: Auditory Brainstem Responses

- a) Acquisition and analysis responses for different stimuli -clicks, tone bursts, chirps, complex stimuli such as speech
- b) New trends in ABR such as Cochlear Hydrops Analysis Masker Procedure (CHAMP) and stacked ABRs, and ABR for chained stimuli,
- c) Factors influencing ABR: Stimuli related, acquisition related, subject related
- d) Clinical applications

Unit 3: Middle Latency Auditory Evoked Potentials and Auditory Steady State Responses

- a) Acquisition and analysis of middle latency responses,
- b) Factors influencing middle latency responses: Stimuli related, acquisition related, subject related
- c) Acquisition and analysis of auditory steady state responses (ASSR)
- d) Factors influencing ASSR: Stimuli related, acquisition related, subject related
- e) Post auricular muscle responses
- f) Clinical applications

Unit 4: Cortical Auditory Evoked Potentials

- a) Overview of exogenous and endogenous cortical evoked potentials
- b) Acquisition and analysis of obligatory cortical auditory evoked potentials, acoustic change complex, T-complex, mismatch negativity, P300, N400, P640, CNV and other endogenous potentials
- c) Factors affecting exogenous and endogenous evoked potentials Stimuli related, acquisition related, subject related
- d) Clinical applications

Unit 5: Intraoperative monitoring

- a) Physiological tests useful in intraoperative monitoring of auditory function
- b) Effect of anaesthetic agents on electrophysiological responses of the auditory system
- c) Recording auditory evoked potentials during surgery; requirements, patient preparation
- d) Guidelines for intraoperative monitoring
- e) Electroneuronography

Recommended Reading

- Burkard, R.F., Don, M., & Eggermont, J.J. (Eds.) (2007). Auditory Evoked Potentials: Basic Principles & Applications. Baltimore: Lippincott Williams & Wilkins.
- Ferraro, J.A. (1997). Laboratory exercises in auditory evoked potentials. San Diego: Singular Publishing Group Inc.
- Hall, J.W. (1992). Handbook of Auditory Evoked Responses. Massachusetts: Allyn and Bacon.
- Hall, J.W. (2007). New Handbook of Auditory Evoked Responses. Boston: Pearson.
- Hall, J.W., & Mueller, H.G. (1997) Audiologists' Desk Reference. Volume 1: Diagnostic Audiology Principles, Procedures and Protocols. San Diego: Singular Publishing Group.
- Hood, L.J. (1998). Clinical applications of auditory brainstem response. San Diego: Singular Publishing Group Inc.
- Katz, J. (Ed.). (1994). Handbook of Clinical Audiology. Baltimore: Williams and Wilkins.
- Kilney, P.R. (2017). Audiologists' handbook of intraoperative neurophysiological monitoring. San Diego: Plural Publishing Group
- McPherson, L.D. (1995). Late potentials of the auditory system. London: Singular Publishing Group.
- Picton, T. (2010). Human Auditory Evoked Potentials. San Diego: Plural Publishing Group.
- Rance, G (2008). Auditory Steady State Responses. San Diego: Plural Publishing Group

AH 203: Auditory Perception

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) understand the processes involved in the perception of speech by persons with normal and impaired hearing, and
- b) apply principles of speech perception in therapy and research.

Unit 1: Temporal processing

- a) Overview of temporal processing: temporal resolution; temporal integration; models of temporal processing
- b) Detection and discrimination of gaps in normals and individuals with hearing impairment
- c) Temporal modulation transfer function in normals and individuals with hearing impairment
- d) Temporal integration in persons with normal hearing and those with hearing impairment
- e) Models of temporal processing in persons with normal hearing and those with hearing impairment

Unit 2: Auditory object and pattern perception

- a) Basic concepts in auditory object perception
- b) Spectral cues for object perception
- c) Temporal cues for object perception
- d) Auditory pattern perception in individuals with normal hearing and those with hearing impairment
- e) Timber perception
- f) Time invariant-pattern and time varying pattern perception

Unit 3: Adaptation

- a) Adaptation vs. fatigue
- b) Methods of studying adaptation
- c) Adaptation in persons with normal hearing and those with hearing impairment
- d) Neurophysiological basis of adaptation
- e) Factors affecting adaptation

Unit 4: Perception in Space

- a) Perception of distance: Localization Vs. Lateralization; localization of puretone; localization of complex signals
- b) Effect of hearing loss on lateralization
- c) Monaural localization
- d) Factors affecting localization
- e) Neurophysiology of localization

Unit 5: Binaural hearing and Perception of Music

- a) Binaural hearing - overview
- b) Models of binaural hearing

- c) Masking level difference
- d) Musical scales/Musical notes
- e) Factors affecting perception of music

Recommended Reading

- Brain, C.J. Moore (1986). Frequency selectivity in Hearing. CA: Academic Press Inc.
- Diana Deutsch (2013). The Psychology of Music, Third Edition (Cognition and Perception) 3rd Edition. Academic Press
- Gelfand, S, A. (2005). Introduction to psychological and physiological acoustics. New York: Marcel Dekker.
- Howard, D and Angus, J (2013). Acoustics and Psychacoustics. Oxford: Taylor & Francis
- M. Riess Jones, R.R. Fay, A.N. Popper (2010). Music Perception. Springer
- Oxenham, A., & Bacon, S. (2003). Cochlear Compression: Perceptual Measures and Implications for Normal and Impaired Hearing. Ear and Hearing, 24, 350-366.
- Plack, C.J., Oxenham, A.J., & Fay, R.R. (2005). Pitch: Neural Coding and Perception. New York: Springer.
- Stanley, A. Gelfand (1998). Hearing. New York: Marcel Dekker Inc.
- Warren, R. M. (2008). Auditory Perception: An Analysis and Synthesis. Cambridge: Cambridge University Press.
- Yost, W. A. (1994). Fundamentals of hearing: An introduction. San Diego: Academic Press.
- Zwicker, E., & Fastl, H. (1999). Psychoacoustics-Facts and models. Springer: Verlag Berlin Heidelberg.

AS 204: GENETICS OF HEARING AND PEDIATRIC HEARING EVALUATION

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to

- a) understand the genetic basis for hearing loss
- b) understand the tests/procedures for identifying genes for hearing loss
- c) counsel parents or caregivers of children with genetic and non-genetic hearing loss
- d) carry out screening programs to identify hearing loss using appropriate protocols, and
- e) diagnose and manage hearing loss in children using appropriate tests/protocols and aural management procedures

Unit 1: Molecular Genetics for Audiologists

- a) Basic concepts of genetics
- b) Genes involved in hearing
- c) Gene localization methods, gene mapping

Unit 2: Genetic Hearing Loss

- a) Genetics of hearing impairment, gene database for hearing loss
- b) Genetic evaluation of persons/families with hearing loss, genetic screening
- c) Genotypes and phenotypes of non-syndromic hearing loss
- d) Genotypes and phenotypes of syndromic hearing loss
- e) Genetic counselling

Unit 3: Hearing Screening

- a) Neonatal and infant hearing screening, international and national Protocols to identify middle ear disorders; sensory and neural hearing loss
- b) Screening for hearing loss in school children
- c) Screening for central auditory processing disorders in school children
- d) Issues related to hearing screening

Unit 4: Pediatric Hearing Evaluation

- a) Etiology of hearing loss in children
- b) Behavioral tests of hearing evaluation for children
- c) Physiological tests of hearing evaluation for children
- d) Assessing hearing in children with associated problems
- e) Speech audiometry in children
- f) Development of tests for speech audiometry in children
- g) Issues related to assessment and diagnosis of hearing loss in children

Unit 5: Team Approach in diagnosis of hearing loss in children

- a) Integration of results of behavioural and electrophysiological assessment of hearing
- b) Correlating results of Audiological evaluation with those of otolaryngological, paediatric, psychological and speech-language evaluation
- c) Problems faced by children with hearing loss in preschool and school setup
- d) Challenges/problems faced by children with conductive hearing loss and auditory processing problems
- e) Counselling parents/caregivers regarding hearing impairment, sequel and management
- f) Counselling and management of children with unilateral hearing loss and mild hearing loss

Recommended Reading

- Bess, F.H. & Gravel, J.S. (2006). Foundations of Pediatric Audiology. San Diego: Plural Publishing Inc
- Driscoll, C. & McPherson, B (2010). Newborn Screening Systems: The complete perspective. San Diego: Plural Publishing Inc
- Martini, A, et al.(1996) Genetics and Hearing impairment, London: Whurr Publishers.
- McCreery, R.W. & Walker, E.A. (2017). Pediatric Amplification: Enhancing Auditory Access. San Diego: Plural Publishing Inc
- Northern, J. L. & Downs, M. P. (2014). Hearing in Children. San Diego: Plural Publishing Inc
- Shprintzen, R.J. (1997). Genetic, Syndromes and communication disorders. San Diego: Singular Publishing Group Inc.
- Willems P J. (2004). Genetic Hearing loss. USA: Marcel Decker Inc.
- Tharpe, A.M. & Seewald, R. (2016). Comprehensive Handbook of Pediatric Audiology. San Diego: Plural Publishing Inc
- Toriello H V., & Smith S D. (2013). Hereditary Hearing Loss and Its Syndromes. United Kingdom: Oxford University Press.
- Flexer C A (2008). Pediatric Audiology: Diagnosis, Technology, and Management. New York: Thieme Medical Publishers.

AS 205: EARLY IDENTIFICATION AND COUNSELLING

Marks -100

64 Hours

Objectives

After completing this course, the students are expected to realize the following:

- Need and recent developments for early identification and its methods
- Types of early interventions and its applications
- To prepare students in the specific area of clinical counselling as a discipline seeking to understand counsellor-client relationships in the context of training and rehabilitation of individuals with disorders in human communication.
- To train students into practical skills and competencies required for mastering basics of clinical counselling in their practice for identification and management of persons with communication disorders
- To sensitize pupils on the ethical aspects of clinical counselling when dealing with individuals or their families with communication disorders.
- To develop ability for integrating counselling-based aspects in the field of research in communication disorders.

Unit 1: Identification of hearing loss and its methods

- a. Need for identifying; mild hearing loss, conductive hearing loss, sloping hearing loss, fluctuating hearing loss
- b. High risk register
 - Recommendations of the joint committee on infant screening
 - Universal hearing screening vs high risk register
 - High risk register usage in India
- c. Protocols for school screening (CHL, SNHL, APD), pseudo hypoacusis

Unit 2: Methods of Identification and its applications

- a. Methods used to screen for conductive hearing losses and sensori-neural hearing losses
 - Behavioral tests (awakening tests, bottle feeding test, behavioral observation audiometer)
 - Objective methods (Immittance audiometry, reflexometry, reflex Inhibition audiometry, evoked response audiometry, Automated ABR otoacoustic emissions,)
- b. Hearing testing in neonates and infants
 - Behavior observation audiometry
 - Conditioning techniques:
 - Visual reinforcement audiometry and its modifications including CORA
 - PIWI and peep show audiometry
 - TROCA
 - Play audiometry and others
 - Modifications required while testing multiply handicapped children

Unit 3: Speech audiometry and its applications

- a. Speech audiometry in children
 - Modifications required while carrying out speech audiometry in children
 - Speech detection threshold
 - Speech recognition threshold
 - Speech recognition scores-PBK, WIPI, NU Chip, Early speech perception test, Ling's six sound tests, auditory number test, tests available in Indian languages
 - BC speech audiometry

Unit 4: General concepts pertaining to Clinical Counselling

- a. Guidance and counselling:
 - Meaning, Nature & Scope of counselling, Principles and goals of counselling
 - Types and Techniques: Individual, Group counselling and clinical counselling, importance and need of clinical counselling
 - Counselling strategies across the life span, and across different relationships

Unit 5: Professional and clinical Counselling and its application

- a) Qualifications and qualities for effective counselling, Micro and macro skills and competencies,
- b) Do and Don'ts in professional counselling-Tips for improvement and Ethical issues
- c) Different Stages of Clinical Counselling, and its principles in clinical practice (Directive and non-directive)
- d) Approaches/strategies and tools used for clinical counselling, Alternate/holistic forms of counselling.
- e) Expectations and limitations of clinical counselling, Human rights, enablement and empowerment through counselling
- f) Counselling approaches based on scientific basis, and their cultural constraints
- g) Ethical issues in counselling
- h) Brief summary on conditions requiring clinical counselling
- i) Organic brain syndromes, Functional disorders, Psychotic and neurotic disorders Disabilities & impairments: Personality & conduct disorders Special populations: HIV/AIDS, school dropouts, chronic or terminally ill

Recommended reading

1. Bess F.H (1988). Hearing impairment in children. Maryland: York press Inc.
2. Bess, F.H (1977). Childhood deafness. New York: Grune & Stratton
3. Dale, D.M.C (1970). Applied audiology for children. 2nd Ed Springfield; C.C. Thomas
4. Eagles, E.L (1963). Hearing Sensitivity and related factors in children. Pennsylvania: University of Pittsburgh.
5. Hayes, D& Northern, J.L (1996). Infants and Hearing. San Diego: Singular Publishing Group Inc,
6. Martin, F.N (1978). Paediatric audiology. New Jersey: Prentice Hall
7. Martin, F.N. (1994). Introduction to audiology. 5th Edn. New Jersey: Prentice Hall
8. Martin, F.N. (Ed) (1987). Hearing disorder in children: Paediatric audiology. Austin: Pro. Ed.
9. Moog, J.S & Geers, A.E (1990). Early Speech Perception test for the profoundly hearing-impaired children. St. Louis: central institute for the deaf.
10. Northern, J & Downs, M.P (1991). Hearing in children. 4th edn. Baltimore: Williams & Wilkins

ACP 108 & ACP 206: CLINICAL PRACTICUM IN AUDIOLOGY

General considerations:

- a) The student should be able to carry out complete audiological evaluation and management of persons with hearing impairment.
- b) After completion of clinical postings, the student will have the ability to apply, show (in a clinical diary/log book), and perform the following on patients/clients:

Know-how

- a) Make appropriate changes in OAE protocols depending on the clinical / research needs
- b) Develop protocol for recording exogenous and endogenous auditory evoked potentials
- d) Integrate the results of audiological evaluation and correlate it to the possible pathophysiological/radiological findings
- e) Apply the latest technological advances available for persons with hearing impairment.
- f) Make appropriate modifications in hearing devices depending on the listening needs.
- g) Recommend appropriate aural rehabilitation program for persons with hearing impairment

Demonstrate

- a) Recording of exogenous and endogenous potentials
- b) Generation of stimuli for recording AEPs
- c) Analyze auditory evoked potential waveforms
- d) Electroacoustic measurement of different types of hearing aids
- e) Carry out ear mold modifications

Do

- a) Record OAEs, ABR for different stimuli and cortical auditory potentials on 5 persons with hearing loss
- b) Complete audiological evaluation on 5 persons with hearing loss and prepare a detailed report with appropriate recommendations
- c) Select and fit appropriate hearing devices to 10 individuals with different degree, configuration and type of hearing loss.
- d) Plan and carry out appropriate aural rehabilitation program for five children
- e) Evaluate and counsel/carry out appropriate audiological management for 5 persons with tinnitus.
- f) Carry out aided AEPs

Evaluation

- a) Internal evaluation shall be based on attendance, clinical diary, log book and learning conference.
- b) External evaluation: Spot test, OSCE, Record, Viva-voce, case work

SEMESTER III

AH 301: AUDITORY PROCESSING DISORDERS

Marks -100

64 Hours

Objectives: At the end of the course, the students should be able to

- a) diagnose and differentially diagnose auditory processing disorders (APDs) and explain their physiological bases,
- b) administer different tests for diagnosis and interpret the findings including correlation with findings from imaging and cognitive studies,
- c) institute screening and public education programs in different setups on APDs,
- d) identify and explain factors influencing assessment of APDs,
- e) advise clinical clientele on management of APDS including guidance on aids and appliances, and
- f) advise and liaise with members of the management team like neurologists, neurosurgeons on the diagnosis as well as management of APDs.

Unit 1: Introduction to Auditory Processing Disorders (APDs)

- a) Terminologies and definitions of APD
- b) Underlying neurobiological and neurochemical (genetic) correlates
- c) Relationship between neural maturation - degeneration and auditory processing
- d) Models to explain auditory and spoken language processing: Relationship between the two
- d) Methods of studying auditory processing - Animal studies
- e) Various disorders that lead to APDs (Syndromes, TBI): Signs, symptoms and classification
- f) Developmental communication disorders and APDs

Unit 2: Assessment of APDs (Behavioral)

- a) Overview of behavioural assessment in APDs
- b) Screening for APDs: questionnaires, checklists and tests
- c) Dichotic test (linguistic and non-linguistic)
- d) Monaural tests (linguistic and non-linguistic)
- e) Psychoacoustic tests for assessment of APDs

Unit 3: Assessment of APDs (Electrophysiological)

- a) Electrophysiological measures and their clinical applications in diagnosing APDs
 - i. Endogenous potentials
 - ii. Exogenous potentials
- b) Correlation between behavioural and electrophysiological measures: implications for diagnosis
- c) Factors influencing assessment of APDs: behavioural and electrophysiological

Unit 4: Management of APDs

- a) Management of APDs in children and adults
- b) Direct remediation techniques and meta-cognitive and meta-linguistic approaches
- c) Auditory perceptual training and its methods, applicability and outcome.
- d) Evidence based approach and treatment efficacy

- e) Multidisciplinary approach
- f) Signal enhancement and room acoustics
- g) Aids and appliances - indication and outcome
- h) Factors affecting management of APDs

Unit 5: Team work in the diagnosis and management of APDs

- a) Electrophysiological and radiological correlates for APDs: implications in management
- b) Imaging and cognitive studies in APDs
- c) Diagnosis and differential diagnosis
- d) Development of APD test materials (linguistic and non-linguistic)
- e) Open-source software for developing diagnostic tests and intervention modules

Recommended Reading

- American Speech-Language-Hearing Association. (2005). (Central) auditory processing disorder (technical report) Retrieved from <http://www.asha.org/members/derfjournals/deskref/default>.
- Geffner, D., & Ross-Swain, D. (2013). Auditory Processing Disorders: Assessment, Management, and Treatment. 2nd Edn. San Diego, Plural Publishing Inc.
- Musiek, F. E., Baran, J. A., Shinn, J. B., & Jones, R. O. (2012). Disorders of the Auditory System. San Diego: Plural Publishing Inc.
- Katz J., ndE ht7 .ygoIoiduA lacinilC fo koobdnaH .(2014) .K ,hsilgnE & ,M nisahC snikliW & smailliW ,ttocnippiL :aihpledalihP.
- Musiek, F. E., &Chermak, G. D. (2014). Handbook Of Central Auditory Processing Disorder: Auditory Neuroscience And Diagnosis. 2nd Edn, Vol: 1. San Diego: Plural Publishing Group Inc.
- Chermak, G. D., &Musiek, F. E. (2006). Handbook of (Central) Auditory Processing Disorders – Comprehensive Intervention. Vol. II. San Diego: Singular Publishing Group Inc.
- Chermak, G. D., &Musiek, F. E. (2002). Auditory Training: Principles and Approaches for Remediating and Managing Auditory Processing Disorders. Seminars In Hearing, 23(4), 297-308.

AH 302: SPEECH PERCEPTION

Marks -100

64 Hours

Objectives: At the end of the course, the student should be able to

- a) explain coding of speech in the auditory pathway in normal hearing- and hearing-impaired individuals,
- b) critically evaluate theories of speech perception and methods to synthesis speech,
- c) explain speech perception in relation to short term memory,
- d) describe aspects of dichotic speech perception.

Unit 1: Theories of Speech Perception

- a) Basic concepts of speech perception; hearing, listening, perception and comprehension; acoustic cues of different classes of speech sounds
- b) Definition and concept of categorical and continuous speech perception
- b) Normalization in speech perception: Definition and methods used for normalization of vowels and consonants
- c) Coding of speech in the auditory pathway - cochlea, auditory nerve and the central auditory pathway
- d) Theories of speech perception (acoustic, neurological, auditory, motor, analysis-by-synthesis, dual stream, reverse hierarchy theory)

Unit 2: Perceptual Cues for Vowels and Consonants

- a) Perception of vowels and diphthongs in normal - major and minor cues
- b) Perception of consonants in normals: Major and minor cues to identify place, manner and voicing features of stops, fricatives, affricates, nasals
- c) Perception of vowels and consonants in the persons with hearing impairment
- d) Perception of vowels and consonants through amplification and implantable devices.

Unit 3: Speech Perception of Segmental and Suprasegmental Features

- a) Effects of co-articulation on speech perception:
- b) Perception of segmental features in normal hearing individuals
- c) Perception of suprasegmental cues in normal hearing individuals
- d) Perception of segmental and suprasegmental cues in persons with hearing impairment

Unit 4: Factors related to Speech Perception

- a) Memory and speech perception: Stages of memory, coding and capacity at the different stages; Models of short term memory: Dual coding Model, Modal model, A model for auditory memory and contrast, Working memory model; Role of short term memory in the perception of consonants and vowels
- b) Dichotic listening: Theories and physiological bases: Testing of dichotic listening and the clinical significance of the results; Factors influencing dichotic perception
- c) Music perception: Methods of study of perception of music; Perception of music through amplification and implantable devices.

Unit 5: General issues related to speech perception

- a) Infant perception: theories of infant speech perception (universal theory, attunement theory, perceptual learning theory, maturational theory, perceptual magnetic theory); methods of studying infant speech perception; perception of consonants and vowels in infants, and comparison with adults
- b) Speech perception in animals: methods of study of speech perception in animals; perception of consonants and vowels; categorical perception and normalization; animal vs. human perception; need for study of speech perception in animals
- c) Methods to study speech perception: EEG/electrophysiological and behavioral methods to study speech perception; study designs; role of cognition in speech perception.

Recommended Reading

- Raphael, L. J., Borden, G. J., & Harris, K. S. (2011). *Speech Science Primer: Physiology, Acoustics, and Perception of Speech* (Sixth edition). Baltimore, MD: LWW.
- Greenberg, S., Ainsworth, W. A., & Fay, R. R. (Eds.). (2004). *Speech Processing in the Auditory System*. New York: Springer.
- Mildner, V. (2007). *The Cognitive Neuroscience of Human Communication* (1 edition). New York: Psychology Press.
- Pickett, J. M. (1998). *The Acoustics of Speech Communication: Fundamentals, Speech Perception Theory, and Technology* (1 edition). Boston: Pearson
- Pisoni, D. B., & Remez, R. E. (Eds.). (2005). *The Handbook of Speech Perception*. Blackwell Publishing Ltd.
- Studdert-Kennedy, M., & Mattingly, I. G. (Eds.). (1990). *Modularity and the Motor theory of Speech Perception: Proceedings of A Conference To Honor Alvin M. Liberman* (1 edition). Hillsdale, N.J: Psychology Press.
- Sanders, D.A (1977). *Auditory perception of speech - an introduction to principle and problems*. New Jersey: Prentice Hall
- Tatham, M., & Morton, K. (2011). *A Guide to Speech Production and Perception* (1 edition). Edinburgh: Edinburgh University Press
- Kent, R. D. (2002). *Acoustic Analysis of Speech* (2nd Revised edition edition). Australia ;United States: Delmar Cengage Learning.

AS 303: Vestibular System and its Disorders

Marks -100

64 Hours

Objectives: After completing this course, the student should be able to

- a) describe the functioning of the balance and vestibular system
- b) explain the disorders of the vestibular system
- c) assess vestibular system using appropriate tests/protocols
- d) recommend appropriate management option for persons with vestibular dysfunction
- e) counsel and guide the clinical clientele with vestibular disorders on quality of life etc.

Unit 1: Anatomy and Physiology of the Vestibular System

- a) Peripheral vestibular system including semi circular canals, utricle, saccule and vestibular nerve
- b) Central vestibular pathway (brainstem, cerebellum, cortex)
- c) Reflexes involving vestibular system like vestibulocochlear reflex, vestibulo spinal reflex and vestibulocochlear reflex advise
- d) Other systems involved in maintenance of balance like proprioceptive system, visual system etc.

Unit 2: Assessment of the Vestibular System

- a) Techniques and Principles of electronystagmography / videonystagmography, Rotatory chair test, Video Head Impulse test, Sclera Coil search test, Vestibular Evoked Myogenic Potentials: cVEMP, oVEMP, Dynamic Posturography, Craniocorpography, Subjective visual vertical horizontal tests, Vestibular autorotation tests
- b) Screening for vestibular disorders
- c) Questionnaires to assess quality of life in persons with vertigo

Unit 3: Pathophysiology of Vestibular Disorders

- a) Peripheral Vestibular Disorders like Benign paroxysmal positional vertigo, Meniere's disease, Vestibular neuritis, Labyrinthitis, Ototoxicity, vestibular neuropathy
- b) Perilymph fistula, Superior semicircular canal dehiscence, Auditory neuropathy spectrum disorders, Vestibular schwannomas
- c) Central Vestibular disorders like Generalized neuropathy involving multiple systems, Multiple sclerosis, Cranial tumour's, Cerebro-vascular accidents involving vestibular cortex and cerebellum, Vertebro-basilar insufficiency, Migraine, Meningitis and encephalitis
- d) Vestibular disorders in children
- e) Age related changes in vestibular system

Unit 4: Profiling Vestibular Disorders using Audio Vestibular Test Battery

- a) Benign paroxysmal positional vertigo, Meniere's disease, Vestibular neuritis, Labyrinthitis, Ototoxicity, Perilymph fistula, Superior semicircular canal dehiscence, Auditory neuropathy spectrum disorders, Vestibular schwannomas, Multiple sclerosis, Cranial tumors, vestibular neuropathy
- b) Quality of life in persons with vestibular disorders

Unit 5: Management of Persons with Vestibular Disorders

- a) Medical management
- b) Surgical management
- c) Vestibular rehabilitation:
 - i. Repositioning Manoeuvre's
 - ii. Adaptation Exercises
 - iii. Habituation Exercises
 - iv. Imbalance Exercises
- d) Special considerations for rehabilitation of children with vestibular problems
- e) Vestibular implants

Recommended Reading

- Ackley, R. S., Decker, T. N., & Limb, C. J. (2007). An essential guide to hearing and balance disorders. New Jersey: Lawrence Erlbaum Associates Inc.
- Biswas, A. (2009). Clinical audio-vestibulometry for otologists and neurologists. 4th Ed. Mumbai, India: Bhalani Publishing House.
- Desmond, A. L. (2004). Vestibular function: evaluation and treatment. New York: Thieme Medical Publishers Inc.
- Hughes, G. B., & Pensak, M. L. (2007). Clinical Otology. New York: Thieme Publishers, Inc.
- Jackler, R. K., & Brackmann, D. E. (2005). Neurotology. 2nd Ed. Philadelphia: Elsevier Mosby.
- Jacobson, G. P., & Shepard, N. T. (2014). Balance function assessment and management. San Diego: CA: Plural Publishing Inc.
- Kaga, K. (2014). Vertigo and balance disorders in children. Tokyo, Japan: Springer.
- McCaslin, D. L. (2013). Electronystagmography and videonystagmography ENG / VNG. San Diego: Plural Publishing Inc.
- Murofushi, T., & Kaga, K. (2009). Vestibular evoked myogenic potential- its basics and clinical applications. Tokyo, Japan: Springer.
- Myers, B.L. (2011). Vestibular Learning Manual. San Diego: Plural Publishing Inc.
- O'Reille, R.C., Morlet, T. & Kushing, S.L (2013). Manual of pediatric balance disorders. San Diego: Plural Publishing Inc.
- Ruckienstien, M & Davis, S. (2014). Rapid interpretation of balance function tests. San Diego: Plural Publishing Inc.
- Shepard, N. T., & Telian, S. A. (1997). Practical management of the balance disorders patient. New York: Thomson Delmar Learning.

AS 304: NOISE AND HEARING CONSERVATION

Marks -100

64 Hours

Objectives:

After completing the course, the student will be able to

- Develop good understanding of noise and its measurements
- Learn hearing testing and importance of monitoring of hearing loss.
- Appreciate the noise and its detrimental effects on mental health.
- Develop knowledge on importance of hearing protection and hearing conservation program.
- List and describe the highlights of legislations relating to hearing impairment and other disabilities

Unit 1: Auditory and non-auditory effects of noise (12 hrs)

a) Noise in the environment and its effects:

- Definition and Sources – community, industrial, music, traffic and others
- Types – steady & non-steady.

b) Auditory effects of noise exposure

- Historical aspects in noise measurement techniques and auditory effects of noise exposure
- Recent developments in noise measurement techniques and auditory effects of noise exposure
- TTS and recovery patterns and PTS
- Histopathological changes due to noise exposure.
- Effect of noise on communication, Speech Interference Level (SIL), Articulation Index (AI) Perceived Noise in dB (PN dB), Perceived Noise Level (PNL), Effective Perceived Noise Level (EPNL), Noise Criteria (NC) curves, Noise Reduction Rating (NRR), Signal to Noise Ratio (SNR)

c) Contemporary aspects in non-auditory effects of noise exposure

- Recent developments in Physiological/Somatic & psychological responses, stress and health, sleep,
- Annoyance and Distraction Factors
- Brain response in relation to Loudness, Annoyance.
- Audio-analgesia effects on CNS and other senses
- Effects of noise on work efficiency and performance

Unit 2: Audiological assessment and noise exposure (12 hrs)

- a. Audiometry in NIHL and Music induced hearing loss.
- b. Hearing evaluation: PTA- Baseline and periodic monitoring of hearing, High frequency audiometry, Correction for Presbycusis.
- c. Speech audiometry:
- d. Speech discrimination tests with and without the presence of noise
- e. Filtered speech tests and time compressed speech tests
- f. Social Adequacy Index
- g. Other Audiological evaluations: Impedance audiometry, ERA, OAE, Tests for susceptibility

Unit 3: Noise and its measurements (12 hrs)

- a. Recent trends in Noise & vibration measurement: Noise Measurement Techniques
 - Selection of Instrument and Measurement Locations
 - Travel and On-Site Preparation Procedures
 - Annoyance and its measurement
- b. Recent developments in instrumentation and procedure for indoor and outdoor measurement of ambient noise traffic noise, aircraft noise, community noise and industrial noise.

Unit 4: Contemporary aspects of hearing conservation (12 hrs)

- a. Need for hearing conservation program, steps in hearing conservation program
- b. Recent developments in Ear protective devices: (EPDs)
 - Types: Ear plugs, ear muffs, helmets, special hearing protectors
 - Properties of EPDs: Attenuation, comfort, durability, stability, temperature, tolerance
 - Current trends in Evaluation of attenuation characteristics of EPDs.
 - Toughening

Unit 5: Noise and recent developments in noise control regulations (12 hrs)

- a. Legislations related to noise:
 - Damage Risk Criteria (DRC) – definition, historical aspects,
 - use of TTS and PTS, information in establishing DRC,
- b. Committee on Hearing Bioacoustics & Biomechanics (CHABA), Air Force Regulation (AFR 160-3), American Academy of Ophthalmology & Otolaryngology (AAOO), ASA-Z 24.5, Damage risk contours, Walsh – Healey Act, Occupational Safety & Health Act (OSHA), Environmental Protection Agency (EPA),
- c. Indian noise standards.
 - Indian studies/acts/regulations, American acts.
 - National Program of Prevention of Hearing Impairment in Operation

References

1. Bruel, and Kjaer, (1982), Noise Control - Principles and practices.
2. Harris, C.M. (Ed.2), Handbook of Noise Control New York: McGraw-Hill.
3. Kryter, K.D. (1970). The effects of noise on Man. New York: Academic Press.
4. Tempest, N (1985). The Noise Handbook. London: Assessment Press.
5. Sataloff, R.T. (1987). Occupational hearing loss. Marcel Dekker, Inc.
6. Trivedi, P.R. and Gurudeep Raj (1992). Noise Pollution, 1st Ed. New Delhi: Akashdeep Publishing House.
7. BIS Specifications - List attached
 - IS Specifications - Noise Measurements.
 - IS:7194-1973 Specification for assessment of noise exposure during work for hearing conservation purposes.
 - IS:9167-1979 Specification for ear protectors.
 - IS:6229-1980 Method for measurement of real-ear protection of hearing protectors any physical attenuation of earmuffs.
 - IS:9876-1981 Guide to the measurement of airborne acoustical noise and evaluation of its effects on man.
 - IS:7970-1981 Specification for sound level meters.
 - IS:9989-1981 Assessment of noise with respect to community response.
 - IS:10399-1982 Methods for measurement of noise emitted by Stationary road vehicles.

SEMESTER IV

AH 401: IMPLANTABLE AUDITORY DEVICES

Marks -100

64 Hours

Objectives: At the end of the course, the student should be able to

- a) identify and describe the types of implantable hearing devices,
- b) describe the purpose of different components of implantable hearing devices,
- c) determine candidacy for implantable hearing devices,
- d) assess benefits from implantable hearing devices and guide the clinical population, and
- e) understand and contribute to formulation Government policies and schemes relating to implantable hearing devices

Unit 1: Development of Technology, Criteria/ Candidacy and Program

- a) Candidacy for bone conduction implantable devices (BCID), middle ear implants (MEI), cochlear implant (CI), auditory brainstem implant (ABI) and mid brain implant (MBI): evidence from research
- b) Comprehensive Candidacy Assessment for implantable hearing devices (IHD- Audiological and non-audiological).
- c) Safety standards and regulation for IHD.
- d) State and central Government schemes for cochlear implants and other implantable devices.
- e) Pre-requisite to start a IHD program
- f) Comprehensive policy issues relating to IHD

Unit2: Bone Conduction Implantable Devices (BCID) and Middle Ear Implants(MEI)

- a) Types of BCID and components (per-cutaneous, trans-cutaneous and intra-oral)
- b) Types of MEI and components
- c) Intra-operative and post-operative measurements/assessment for device function (troubleshooting) and performance outcomes
- d) Programming BCID and MEI
- e) Contra indications and management of device failures and poor performance.
- f) Limitations and future development/requirement

Unit 3: Cochlear Implants (CI)

- a) Concepts and types of CI: external components (sound processor- body worn, BTE, off the ear); internal component (electrode type/design, MRI compatibility & reliability); totally implantable cochlear implants.
- b) Expanding criteria- audiological and non-audiological assessment: single sided deafness, sloping SN hearing loss, bilateral asymmetric HL; cochlea/nerve anomaly(classification), auditory neuropathy spectrum disorder (ANSD) and multiple disabilities.
- c) Speech/Sound Coding Strategies: Within and across devices; Evidences from research and critical analysis of each strategy; Features for Enhancing Speech and Music perception.
- d) Surgical procedures: posterior tympanotomy, varia technique, hearing preservation technique; surgical complications and management
- e) Intra-operative measurement: device function (impedance/ voltage/ compliance telemetry); patient function (eCAP, eSRT, eABR and facial nerve monitoring); Special consideration in anomalous cochlear/nerve, ANSD and multiple disabilities.

Unit 4: Programming Cochlear Implants

- a) Psychophysics of programming: parameters (pulse width, rate of stimulation, frequency allocation/ re-allocation, map law); pre-requisites for mapping: pre-implant radiological report, post-implant radiological report; discharge report of surgeon; non- physiological objective measures (electrode impedance, compliance, electrode voltage); special considerations in cochlea/nerve anomaly, ANSD, multiple disabilities and SSD; Effect of map parameters on perception of loudness, pitch perception, gap,
- b) Programming technique: evidences from research: behavioral maps; objective maps (eCAP, eSRT& eABR based programming); evidence and target based programming (artificial intelligence); self-programming.
- c) Measuring performance and MAP optimization: assessment of benefit: speech and non- speech; electrophysiological measures (EABR and other evoked potentials); optimization of: hearing aid in the contralateral ear for bimodal implants; bilateral cochlear implants; electroacoustic stimulation and SSD.
- d) Complications: identifying and managing device failures; identifying and managing infection, magnet migration, electrode extrusion; identifying and managing poor performance; decision making in subjects with poor performance; special consideration in revision implantation; outcome audit.
- e) Limitations and future developments/requirements (device, techniques and procedures)

Unit 5: Auditory Brainstem Implant (ABI) and Auditory Midbrain Implant (MBI)

- a) Pre-op (ABI and MBI): candidacy for children and adult; audiological and non- audiological assessment; evidences from research for predicting outcome; counselling and expectations; device type and components
- b) Intra-op (ABI and MBI): Surgical procedures – overview; eABR, cranial nerve monitoring; decision making.
- c) Post-op: programming ABI (subjective and objective methods) and technique for pitch ranking, identifying auditory and non-auditory electrodes); MAP optimization (pitch, loudness, auditory and non-auditory sensation); techniques to identify auditory and non- auditory sensation; assessment of benefit: speech and non-speech; role of eABR, aided cortical potentials, PET and f-MRI in programming and monitoring outcomes.
- d) Managing and monitoring subject with ABI: rehabilitation strategy; identifying and managing complications (device failure, infection, trauma, device migration, radio imaging); identify poor performance- auditing outcome; decision making in complications and poor performance

Recommended Reading

- Boheim, K. (2010). Active middle ear implants. Basel: Karger.
- Clark, G., (2003). Cochlear implants - fundamentals & Applications. New York: Springer – AIP Press.
- Cooper, H. (1995). Cochlear Implants –A practical guide. Delhi: AITBS Publishers.
- Hughes, M. L. (2013). Objective measures in cochlear implants. San Diego: Plural Publishing Inc.

- Kirwin, S.H. (2014). Cochlear Implants: Technological advances, psychological/social impacts and long-term effectiveness. New York: Nova Biomedical.
- Kompis, M., & Caversaccio, M.D. (Eds.). (2011). Implantable Bone Conduction Hearing Aids. (New Delhi) Switzerland: Karger.
- Lim, H. H., Lenarz, M., & Lenarz, T., (2009). Auditory midbrain implant: A review. Trends in Amplification, Sept. 13(3), 149–180.
- Manenkar, G. (2014). Implantable hearing devices other than cochlear implants. New D Suzuki, J.I, Tokyo (1988). Advances in audiology-Middle ear implant: Implantable hearing aids. Switzerland: Karger. Delhi: Springer-Verlag.
- Niparko, J. K. (2009). Cochlear Implants: Principles and practices. 2nd Edn. Philadelphia: Lippincott: Williams & Wilkins.
- Wolfe, J., & Schafer, E. C. (2010). Programming Cochlear Implants. San Diego: Plural Publishing Inc.

AH 402: ADVANCES IN THE MANAGEMENT OF HEARING LOSS

Marks -100

64 Hours

Objectives: At the end of the course, the students should be able to

- a) understand the different amplification/assistive devices and their changing technology
- b) explain the strategies of device selection and optimization
- c) develop need-based programs and intervention strategies for persons with different types of hearing impairment across age groups, and
- d) to list specific needs and know psychosocial and communicative demands and strategies to solve these

Unit 1: Advances in Hearing Aid and Hearing Assistive Technology

- a) Application of recent advances in hearing aids and hearing assistive technology: Compression and expansion, directionality, advanced signal processing techniques including noise reduction algorithms, wireless technology, data logging, trainable hearing aids, occlusion reduction, application of nanotechnology in hearing aids, Personal amplification systems
- b) Techniques to control acoustic feedback, distortion, circuit noise: Electromagnetic interference – measurement, solutions; techniques to improve compatibility of hearing aids with mobile phones
- c) Application of LASER technology in ear mould production, ear mould modifications for enhancing listening comfort – physical and acoustic modifications
- d) Electroacoustic measurement of hearing aids: Variables affecting electroacoustic measurements and its implications
- f) International and Indian standards/legislations for hearing aids and ALDs.

Unit 2: Selection and Fitting of Hearing Aid and Hearing Assistive Devices

- a) Selection, verification and validation of hearing aids and hearing assistive devices: Pre-selection, selection and assessment of listening needs
- b) Objective procedures for hearing aid fitting (ABR, ALLR, ASSR and others):
- c) Hearing aid programming, optimization, verification and validation
- d) Hearing aid fitting for children: pre-selection, selection, verification and validation:

Different protocols used

- e) Hearing aid fitting for persons with different types of hearing loss (Sudden hearing loss, unilateral hearing loss, High frequency hearing loss, Cochlear dead region)
- f) Future trends in hearing aids and HATs: Technology and fitting strategies

Unit 3: Speech Perception Through Hearing Aids

- a) Factors affecting speech perception through hearing aids and hearing devices: Auditory plasticity
- b) Methods to improve speech perception through hearing aids and hearing devices: Speech cue enhancement – spectral shape, duration, intensity, enhancement of CVR, speech simplification, re-synthesis, enhancement of perception of telephone speech
- c) Emerging technology for better speech perception
- d) Noise reduction algorithms and nanotechnology in hearing aids

Unit 4: Rehabilitation of Individuals with Hearing Impairment

- a) Counselling of users of hearing aid and hearing assistive devices: techniques: Realistic expectations, adjusting to hearing device, other management options
- b) Care and maintenance of hearing aid and hearing assistive devices
- c) Trouble shooting and fine tuning/optimization of hearing aids and assistive devices
- d) Management of children with hearing impairment: Criteria for selecting different auditorylistening programs; criteria for transition from one method to the other as a child grows: Adapting AVT techniques for Indian languages and late identified children
- e) Providing group listening training activities for children having different listening skills
- f) Rehabilitation of adults and older adults: auditory listening / speech reading training for older adults: variables that affect the communication and the role of the communication partner: auditory plasticity: Planning training activities; assertiveness training
- g) Quality of life of hearing impaired and its enhancement: Outcomes of different management strategies across age groups: Methods and measures

Unit 5: Management of the children/adult with Multiple Disabilities and other HearingRelated Disorders

- a) Management of children and adults with multiply disability: hearing aid fitting considerations, strategies used and the outcome with different strategies for individuals with hearing impairment with visual problems; cognitive problems; neuro-motor problems: educational and vocational placement, role of caregivers and outcome measures
- b) Audiological management of tinnitus: characteristics, assessment of tinnitus, basis and theories of tinnitus, models related to tinnitus management: patho-physiological and neurophysiological model: overview to non-audiological management techniques for tinnitus
- c) Audiological management techniques for those with normal hearing and different degrees of hearing loss (TRT, counselling, others) and their outcomes
- d) Audiological management of persons with hyperacusis: Models related to hyperacusis management; overview to non-audiological management techniques for hyperacusis Audiological management techniques for normal hearing and different degrees of hearingloss and their outcomes

Recommended Reading

- Atcherson, S. R., Franklin, C. A., & Smith-Olinde, L. (2015). Hearing assistive and access technology. San Diego: Plural Publishing Inc.
- Dillon, H. (2012). Hearing Aids. 2nd Edn. Australia: Boomerang Press.
- Martini, A., Mazzoli, M., Read, A., & Stephens, D. (2001). Definitions, Protocols and Guidelines in Genetic Hearing Impairment. England: Whurr Publishers Ltd.
- Metz, M. J. (2014). Sandlin's textbook of hearing aid amplification. 3rd Edn. San Diego: Plural publishing Inc.
- Schaub, A. (2008). Digital hearing aids. New York: Thieme Medical publishers.
- Mueller, H. G., Rickettes, T. A., & Bentler, R. (2014). Modern hearing aids: Pre-fitting Testing and selection considerations. San Diego: Plural Publishing Inc.

- Sandlin, R.E. (1995). Handbook of Hearing aid amplification – clinical consideration and fitting practices. London: Singular Publishing Group.
- Tyler, R.S., & Schum, J. (1995). Assistive devices for persons with hearing impairment. United States of America: Allyn & Bacon.
- Cole, E.B., & Carol, F. (2007). Children with hearing loss- Developing Listening & Talking. United States of America: Plural Publishing Inc.
- Estabrooks, W. (2006). Auditory Verbal Therapy & Practice. United States: Alexander Graham Bell Association for the Deaf and Hard of Hearing Inc.
- Hull, R. H. (2014). Introduction to aural rehabilitation. 2nd edn. San Diego: Plural publishing Inc.
- Tye-Murray, N. (2015). Foundations of aural rehabilitation-Children, Adults & Their family members. 4th Edn. United States of America: Stamford, Cengage Learning.
- Baguley, D. M., & Andersson, G. (2007). Hyperacusis: Mechanisms, Diagnosis and Therapies. San Diego: Plural Publishing Inc.
- Hersh, M. A., & Johnson, M. A. (2003). Assistive Technology for the hearing-impaired, Deaf and Deaf-blind. Nottingham: Springer-Verlag London Ltd.
- Jastreboff, P.J., & Hazell, J.W.P. (2004). Tinnitus retraining therapy- implementing the Neurophysiological model. United Kingdom: Cambridge University Press.
- Johnson, C. E. (2012). Introduction to auditory rehabilitation: A contemporary issues approach. New Jersey: Pearson Education, Inc.
- Wong, L., & Hickson, L. (2012). Evidence-based practice in audiology: Evaluating interventions for children and adults with hearing impairment. San Diego: Plural Publishing Inc.

AS 403: AUDIOLOGY IN PRACTICE

Marks -100

64 Hours

Objectives: At the end of the course, the students should be able

- a) know the role of an audiologist in different set-ups.
- b) liaise with other professionals in setting-up an audiology clinic.
- c) audit audiology practices in existing set-ups.
- d) implement acts and legislations relating to persons with hearing impairment,
- e) advise Governments and other agencies on the formulation of policies and legislative acts relating to hearing disability
- f) understand the legal implications of practice in audiology.

Unit 1: Scope of Practice, Laws, Regulations and Professional Ethics

- a) Scope of practice in global and Indian scenario
- b) Professional ethics
- c) Existing acts, legislations, policies related to persons with communication impairment
- d) Role of audiologist in the formulation of acts, regulations and policies
- e) Implementation of acts, legislations, policies and welfare measures relating to persons with hearing impairment
- f) Advocacy groups and rights of citizens
- g) National and international standards related to audiology
- h) Welfare measures provided by State and Central Government for persons with hearing impairment

Unit 2: Specialized Programs in Audiology

- a) Need for specialized programs in audiology: Geriatric and persons with multiple disability
- b) Forensic audiology
- c) Health, wellness, and health care - Health promotion and disease prevention, quality of life and healthcare finances
- d) Disability-friendly environment including public education
- e) Prevention and early identification programs including societal participation

Unit 3: Service Delivery Models in Audiology

- a) Services in different medical / rehabilitation/ research /educational set ups
- b) School based services pertaining to regular and special schools
- c) Community based practice in rural and urban areas
- d) Family empowerment programs
- e) Home based delivery of services
- f) Autonomous practice in audiology
- g) Apps for hearing screening/assessment

Unit 4: Tele-practice in Audiology

- a) Information and communication technology in Audiology practice
- b) Infrastructure for video-conferencing and tele-practice in audiology
- c) Techniques/principles of remote testing for screening and diagnostic assessment for hearing, intervention and counselling
- d) Challenges and limitations of tele-practice in audiology in screening, assessment and evaluation, selection of aids and appliances, therapeutics and counselling.

Unit 5: Issues in Audiology Practice

- a) Medico-legal issues,
- b) Entrepreneurship and planning to set up private practice/clinic for audiology practice: Clinical ethics
- c) Documentation in audiology practice: clinical / demographic data, database management and storage
- d) ICF framework for documentation / reports
- e) Quality control and auditing in audiology practice
- f) Documenting and implementing evidence-based practice in audiology
- g) Understanding team approach: Work in cohesion with other professionals
- h) Information resources in audiology including books and journals, both electronic and print - Databases

Recommended Reading

- College of Audiologists and Speech-Language Pathologists of Ontario.(2004). Use of Telepractice Approaches in Providing Services to Patients/Clients.
- Dobie, R.A (2015). Medico legal evaluation of hearing loss. San Diego: Plural Publishing Inc
- Dunn, H.H., Roeser, R.J., & Valente, M. (2000). Audiology- practice management. New York: Thieme Medical Publishers Inc.
- King, P.F. et al., (1993). Assessment of hearing disability- guidelines for medico-legal practice, London: Whurr Publishers.
- Ramachandran, V & Stach, B.A. (2013). Professional Communication Audiology.
- Resource Guide for Educational/Pediatric Audiologists. Retrieved
- Rizzo, S.R., & Trudeau, M.D. (1994). Clinical administration in audiology and speech language pathology. San Diego: Singular Publishing Group Inc.
- Rushbrooks, E & Houston, K.T. (2015). Telepractice in Audiology. San Diego: Plural Publishing
- Stephen, R.R., Jr., Trudeau, D.M. (Eds.) (1994). Clinical administration in audiology & speech language pathology. San Diego: Singular Publishing Group Inc.
- Taylor, B. (2015). Marketing in an Audiology practice. San Diego: CA: Plural Publishing Inc.
- www.rehabcouncil.nic.in (website of Rehabilitation Council of India)
- www.disabilityaffairs.gov.in (website of Department of Empowerment with Disabilities)
- Acts relating to disability, particularly hearing, enacted by the Indian Parliament.

AS 404: AGING IN AUDITORY SYSTEM

Marks -100

64 Hours

Objectives: After completing this course, the student will be able to understand

1. Age-related changes in peripheral, central auditory and vestibular systems.
2. Should be able to modify tests and interpret their outcomes taking into account an individual's age

Unit 1: Auditory-vestibular system: Anatomical and physiological changes

- a) Neuro-anatomy and physiology related to hearing
- b) Conductive mechanism: External ear (pinna, external auditory meatus and tympanic membrane)
- c) Middle ear
- d) Cochlea: Hair cells, Stria vascularis, Basilar membrane properties, Transduction properties, other structures
- e) Peripheral vestibular system: Semi-circular canals, Otolith organs (Utricle & Saccule)
- f) Age at which maturation is attained and age at which decline commences for: Conductive mechanism, Cochlea, Peripheral vestibular system

Unit 2: Auditory-vestibular nervous system: Anatomical and physiological changes

- a) Auditory nervous system: Auditory nerve, other structures such as cochlear nucleus, SOC, lateral lemniscus, inferior colliculus, auditory thalamus and auditory cortex
- b) Vestibular nervous system: Vestibular nerve, Vestibular nucleus, other structures: cerebellum, vestibular cortex
- c) VOR and VSR reflex pathways
- d) Neurotransmitter properties and changes in various neuro-transmitters due to ageing
- e) Age at which maturation is attained and age at which decline commences for: • Auditory nervous system: Vestibular nervous system.
- f) Presbycusis and types

Unit 3: Behavioural Auditory and Vestibular responses

- a) Tests of auditory function: **Psychophysical measures:** Absolute thresholds, Difference limens for intensity, frequency and duration; Loudness, Pitch
- b) Central auditory processes: Temporal processing, Binaural integration, Binaural interaction, Localization/Lateralization, Binaural separation, Auditory closure
- c) Tests for vestibular function: Romberg test, Fukuda stepping test, Tandem gait test, Doom and foam test, Past pointing test (finger-to-noise test), Subjective visual vertical
- d) Assessment of presbycusis

Unit 4: Physiological responses of Auditory systems & its Effect on age

- a) Physiological assessment of auditory system: Tympanometry and relaxometry, Otoacoustic emissions (TEOAE, DPOAE and fine structure)
- b) Electrophysiological assessment of auditory system: Auditory brainstem responses to speech and non-speech stimuli, Auditory middle latency responses, Auditory late latency responses to speech and on-speech stimuli, other event related potentials – MMN, P₃₀₀.

Unit 5: Physiological responses of Vestibular Systems & its Effect on age

- a) Vestibular electrophysiological changes: Vestibular evoked myogenic potentials: Cervical VEMP, Ocular VEMP
- b) Oculomotor evaluation: Gaze test, Optokinetic test, Smooth pursuit test, Saccade test, Positional and positioning test, Video head impulse test, Biothermal caloric test, Computerized dynamic posturography, Rotary chair test

References:

1. Armstrong, D., Stoney, P., Hawke, M., & Farkashidy, J. (1992). Presbycusis: correlations of clinical audiology with morphological changes in the cochlea and the ventral cochlear nucleus. *Journal of Otolaryngology*, 21(5), 343-349.
2. Goldberg, J., Buettner-Ennever, J. A., & Fukushima, K. (2007). *The vestibular system*. Oxford: Oxford University Press.
3. Hughes, G. B., & Pensak, M. L. (2007). *Clinical otology*. New York: Thieme Medical Publishers.
4. Nelson, E. G., & Hinojosa, R. (2003). Presbycusis: A human temporal bone study of individuals with flat audiometric patterns of hearing loss using a new method to quantify stria vascularis volume. *The Laryngoscope*, 113(10), 1672-1686.
5. Poeppel, D., Overath, T., & Popper, A. N. (2012). *The Human Auditory Cortex*. New York: Springer Publishers.
6. Rubel, E. W., & Fay, R. R. (2012). *The development of the auditory system*. New York: Springer Publishers.
7. Musiek, F. E., & Chermak, G. D. (2014). *Handbook of central auditory processing disorders*. Volume I: Auditory neuroscience and diagnosis. 2nd Ed. San Diego, CA: Plural Publishing Inc.
8. Northern, J. L., & Downs, M. P. (2007). *Hearing in children*. Philadelphia: Lippincott: Williams and Wilkins.
9. Swartz, K. P., Walton, J. P., Hantz, E. C., Goldhammer, E., Crummer, G. C., & Frisina, R. D. (1994). P₃ event-related potentials and performance of young and old subjects for music perception tasks. *International Journal of Neuroscience*, 78(3-4), 223-239.
10. Tremblay, K. L., Piskosz, M., & Souza, P. (2003). Effects of age and age-related hearing loss on the neural representation of speech cues. *Clinical Neurophysiology*, 114(7), 1332-1343.

AS 405: Dissertation in Hearing Sciences/Auditory Disorders

Or

AS 406: / Dissertation in Diagnostic Audiology /Rehabilitative Audiology

ACP 305 & ACP 407 CLINICAL PRACTICUM IN AUDIOLOGY

General considerations

- a) The student should be able to carry out complete audiological evaluation and management of persons with hearing impairment.
- b) After completion of clinical postings, the student will have the ability to apply, show (in a clinical diary/log book), and perform the following on patients/clients:

Know-how to:

- a) Identify, manage and counsel persons with genetic hearing loss
- b) Choose/modify appropriate tests/protocols for evaluating children and multiply disabled
- c) Choose appropriate tests/protocols for evaluation and management of persons with giddiness
- d) Develop language / culture sensitive APD tests
- e) Advise clinical clientele on the latest implantable devices available for persons with hearing impairment.
- f) Set up audiology clinics / centers in different set ups
- g) Procedure for certification of persons with disability
- h) Financial planning and insurance policies

Demonstrate:

- a) Administration of different tests for APD
- b) Plan management for 5 persons with APD/at risk for APD
- c) Administration of different tests for vestibular assessment
- d) Troubleshoot cochlear implants

Do:

- a) Administer complete audiological test battery, behavioral and electrophysiological tests on 10 children with hearing loss and prepare a report explaining the results of the test and make appropriate recommendations
- b) Administer APD test battery on 5 persons with APD symptoms and prepare a report
- c) Administer complete vestibular test battery on 5 persons with giddiness
- d) Carry out pre-implant counseling for 5 persons with hearing loss
- e) Carry out mapping for 5 persons using cochlear implants
- f) Counsel 5 persons regarding use and maintenance of cochlear implants

Evaluation:

- a) Internal evaluation shall be based on attendance, clinical diary, log book and learning conference.
- b) External evaluation: Clinical Record, Viva-voce, case work

