Sri Lakshmi Narayana Institute of Medical Sciences

Osudu, Agaram Village, Kudapakkam post, Puducherry – 605 502

Department of Anatomy

Date:23.11.2019

From

Dr. Vijisha Phalgunan
Professor and Head,
Department of Anatomy,
Sri Lakshmi Narayana Institute of Medical Sciences
BIHER
Puducherry

To

The Dean,
Sri Lakshmi Narayana Institute of Medical sciences
BIHER
Puducherry

Sub: Permission to conduct value-added course: Cytogenetics

Dear sir,

With reference to the subject mentioned above, the department proposes to conduct a value-added course titled: **cytogenetics for 1st year MBBS students** in December 2019. We solicit your kind permission for the same.

Kind Regards

Dr. Vijisha Phalgunan

FOR THE USE OF DEANS OFFICE

Names of Committee members for evaluating the course:

The Dean: **Dr. Balagurunathan.S**

The HOD: **Dr. Vijisha Phalgunan**

The Expert: **Dr. Vijisha Phalgunan**

The committee has discussed about the course and is approved.

Dean

Subject Expert

HOD

OFFICE OF THE DEAN

Sri Lakshmi Narayana Institute of Medical Sciences

OSUDU, AGARAM VILLAGE, VILLIANUR COMMUNE, KUDAPAKKAM POST,
PUDUCHERRY - 605 502.
[Recognised by Medical Council of India, Ministry of Health letter No. U/12012/249/2005-ME (P -II) dt. 11/07/2011]
[Affiliated to Bharath University, Chennai - TN]

Circular

30.11.2019

Sub: Organising Value-added Course on Cytogenetics. reg

With reference to the above mentioned subject, it is to bring to your notice that Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry affiliated by Bharath Institute of Higher Education and Research is organizing a value added course on **"Cytogenetics" during Dec 2019 for 1st year MBBS students(2019-2020)**. The course content for the same is enclosed below."

Dean

(Dr.Balagurunathan.S)

Encl: Copy of Course content

COURSE CONTENT

Particulars	Description
Course Title	Cytogenetics
Course Code	ANA01
Topics and content of the course in the Hand book	1. Introduction to genetics 2. Cell & organelles 3. mitosis 4. meiosis 5. Modes of inheritance 6. Morphology of chromosomes 7. Classification of chromosomes 8. Karyotyping - I 9. Karyotyping -II 10.Karyotyping – skill training 11.Molecular cytogenetics techniques _I 12.Molecular cytogenetics techniques -II 13.Cytogenetic nomenclature 14.Pedigree analysis-I 15.Pedigree analysis - II 16.Structural chromosomal abnormalities

	17.Numerical chromosomal abnormalities 18.Prenatal diagnosis 19.Genetic counselling 20.Gene therapy 21.Recent advancements in Cytogenetics
Advantages of learning and evaluation	In-depth knowledge of genetics and its application
Further learning Opportunities	Advanced techniques cytogenetics
Key Competencies	On successful completion of the course the students will have skill in karyotyping
Target Student	1st MBBS
Duration	30 hours, Dec-Jan2020
Theory Session	28hrs
Practical Session	2 hrs
Assessment Procedure	Short answer questions

COURSE PROPOSAL

Course Title: CYTOGENETICS

Course Objective:

1. Introduce the students to different fields of research
2. To learn basic principles of genetics
3. To learn the basic skills involved in karyotyping

Course Outcome: knowledge on the various aspects of cytogenetics and the prospects of research

Course Audience: Medical undergraduates

Course Coordinator: Dr.Vijisha Phalgunan

Course Faculties with Qualification and Designation:

1.Dr.Vijisha Phalgunan

2.Dr.Rajesh.B

Course Curriculum/Topics with schedule (Min of 30 hours)

SlNo	Date	Topic	Time	Hours
1.	02.12.19	Introduction to genetics	4-5p.m	1
2.	03.12.19	Cell & organelles	4-5p.m	1
3.	04.12.19	mitosis	4-5p.m	1
4.	05.12.19	meiosis	4-5p.m	1
5.	06.12.19	Modes of inheritance	4-5p.m	1
6.	07.12.19	Morphology of chromosomes	4-5p.m	1
7.	09.12.19	Classification of chromosomes	4-5p.m	1
8.	10.12.19	Karyotyping - I	4-6p.m	2
9.	11.12.19	Karyotyping -II	4-6p.m	2
10.	12.12.19	Karyotyping – skill training	4-6p.m	2
11.	13.12.19	Molecular cytogenetics techniques _I	4-6p.m	2
12.	14.12.19	Molecular cytogenetics techniques -II	4-6p.m	2
13.	16.12.19	Cytogenetic nomenclature	4-5p.m	1
14.	17.12.19	Pedigree analysis-I	4-5p.m	1
15.	18.12.192	Pedigree analysis - II	4-5p.m	1
16.	19.12.19	Structural chromosomal abnormalities	4-6p.m	2
17.	20.12.19	Numerical chromosomal abnormalities	4-6p.m	2
18.	21.12.19	Prenatal diagnosis	4-5p.m	1
19.	23.12.19	Genetic counselling	4-6p.m	2
20.	03.01.20	Gene therapy	4-6p.m	2
21.	04.01.20	Recent advancements in Cytogenetics	4-5p.m	1
			Total Hours	30

REFERENCE BOOKS:

1.Emery's elements of medical genetics – 14th edition -elsivier publications

2.Human genetics by SD Gangane – 4th edition- elsivier publications

3.Thompson & Thompson genetics in medicine – 5th edition

4.yogesh Ashok Sontakke-Principles of clinical genetics

VALUE ADDED COURSE

1. Name of the programme & Code

Cytogenetics ANA01

2. Duration & Period

(30 hrs)from December 2019– Ist week January 2020

3. Information Brochure and Course Content of Value Added Courses

Enclosed as Annexure- I

4. List of students enrolled

Enclosed as Annexure- II

5. Assessment procedures:

SAQ's - *Enclosed as Annexure- III*

6. Certificate model

Enclosed as Annexure- IV

7. No. of times offered during the same year:

once– December 2019 – Ist week January2020

8. Year of discontinuation: 2020

9. Summary report of each program year-wise

Value Added Course					
Sl. No	**Course Code**	**Course Name**	**Resource Persons**	**Target Students**	**Strength & Year**
1	ANA01	**cytogenetics**	**Dr.Vijisha Phalgunan**	1st MBBS	20 (December – Jan 20)

10. Course Feed Back

Enclosed as Annexure- V

RESOURCE PERSON

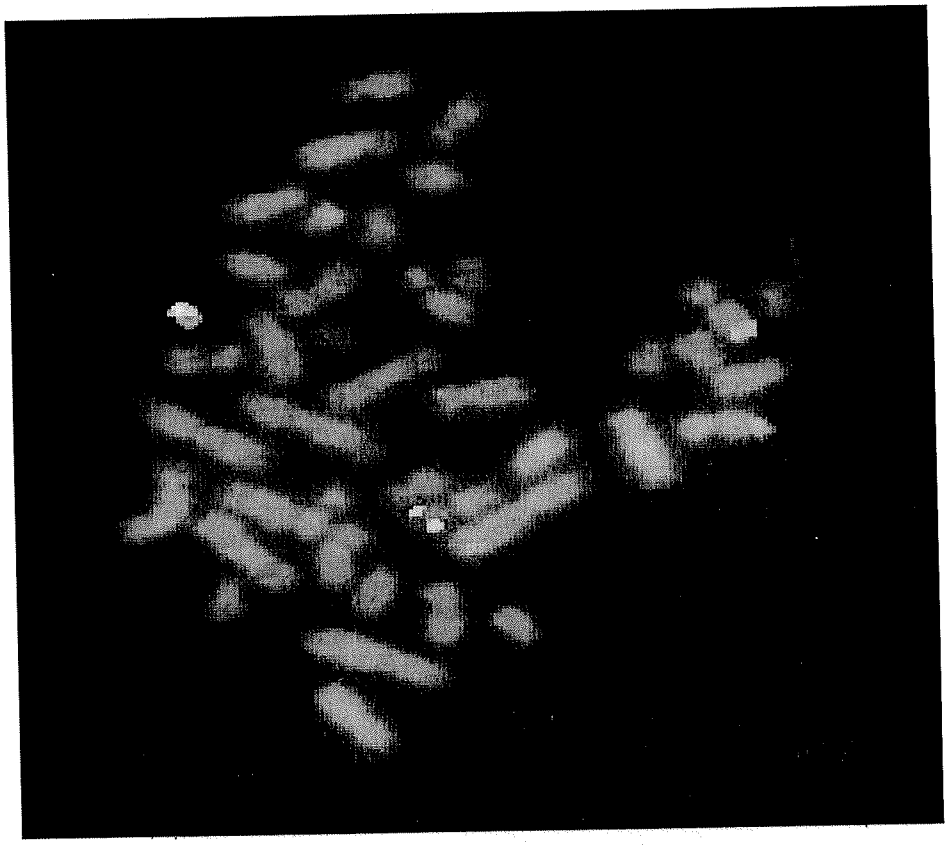
1.Dr.Vijisha P

2.Dr.Rajesh.B

COORDINATOR

Dr.Vijisha P

CYTOGENETICS



PARTICIPANT HAND BOOK

BIHER

SLIMS

COURSE DETAILS

Particulars	Description
Course Title	Cytogenetics
Course Code	ANA01
Objective	Introduction to genetics Cell & organelles mitosis meiosis Modes of inheritance Morphology of chromosomes Classification of chromosomes Karyotyping - I Karyotyping -II Karyotyping – skill training Molecular cytogenetics techniques _I Molecular cytogenetics techniques -II Cytogenetic nomenclature Pedigree analysis-I Pedigree analysis - II Structural chromosomal abnormalities Numerical chromosomal abnormalities Prenatal diagnosis Genetic counselling Gene therapy Recent advancements in Cytogenetics
Further learning opportunities	Molecular genetics
Key Competencies	Demonstration of karyotyping Pedigree analysis
Target Student	1st MBBS Students
Duration	30hrs Every December 2019– Ist week January 2020
Theory Session	20hrs
Practical Session	10hrs
Assessment Procedure	Short answer questions

Cytogenetics is essentially a branch of genetics, but is also a part of cell biology/cytology (a subdivision of human anatomy), that is concerned with how the chromosomes relate to cell behaviour, particularly to their behaviour during mitosis and meiosis.[1] Techniques used include karyotyping, analysis of G-banded chromosomes, other cytogenetic banding techniques, as well as molecular cytogenetics such as fluorescent *in situ* hybridization (FISH) and comparative genomic hybridization (CGH).

Chromosomes were first observed in plant cells by Karl Wilhelm von Nägeli in 1842. Their behavior in animal (salamander) cells was described by Walther Flemming, the discoverer of mitosis, in 1882. The name was coined by another German anatomist, von Waldeyer in 1888.

The next stage took place after the development of genetics in the early 20th century, when it was appreciated that the set of chromosomes (the karyotype) was the carrier of the genes. Levitsky seems to have been the first to define the karyotype as the phenotypic appearance of the somatic chromosomes, in contrast to their genic contents. Investigation into the human karyotype took many years to settle the most basic question: how many chromosomes does a normal diploid human cell contain?[4] In 1912, Hans von Winiwarter reported 47 chromosomes in spermatogonia and 48 in oogonia, concluding an XX/XO sex determination mechanism.[5] Painter in 1922 was not certain whether the diploid number of humans was 46 or 48, at first favoring 46.[6] He revised his opinion later from 46 to 48, and he correctly insisted on humans having an XX/XY system of sex-determination.[7] Considering their techniques, these results were quite remarkable. In science books, the number of human chromosomes remained at 48 for over thirty years. New techniques were needed to correct this error. Joe Hin Tjio working in Albert Levan's lab[8][9] was responsible for finding the approach:

1. Using cells in culture
2. Pre-treating cells in a hypotonic solution, which swells them and spreads the chromosomes
3. Arresting mitosis in metaphase by a solution of colchicine
4. Squashing the preparation on the slide forcing the chromosomes into a single plane
5. Cutting up a photomicrograph and arranging the result into an indisputable karyogram.

It took until 1956 for it to be generally accepted that the karyotype of man included only 46 chromosomes.[10][11][12] The great apes have 48 chromosomes. Human chromosome 2 was formed by a merger of ancestral chromosomes, reducing the number.

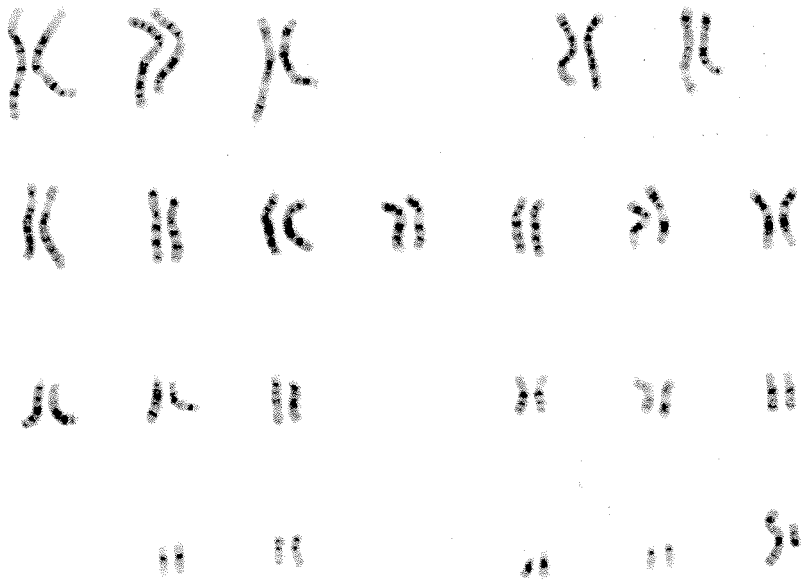
Karyotyping

The routine chromosome analysis (Karyotyping) refers to analysis of metaphase chromosomes which have been banded using trypsin followed by Giemsa, Leishmanns, or a mixture of the two. This creates unique banding patterns on the

chromosomes. The molecular mechanism and reason for these patterns is unknown, although it likely related to replication timing and chromatin packing.

Several chromosome-banding techniques are used in cytogenetics laboratories. Quinacrine banding (Q-banding) was the first staining method used to produce specific banding patterns. This method requires a fluorescence microscope and is no longer as widely used as Giemsa banding (G-banding). Reverse banding, or R-banding, requires heat treatment and reverses the usual black-and-white pattern that is seen in G-bands and Q-bands. This method is particularly helpful for staining the distal ends of chromosomes. Other staining techniques include C-banding and nucleolar organizing region stains (NOR stains). These latter methods specifically stain certain portions of the chromosome. C-banding stains the constitutive heterochromatin, which usually lies near the centromere, and NOR staining highlights the satellites and stalks of acrocentric chromosomes.

High-resolution banding involves the staining of chromosomes during prophase or early metaphase (prometaphase), before they reach maximal condensation. Because prophase and prometaphase chromosomes are more extended than metaphase chromosomes, the number of bands observable for all chromosomes increases from about 300 to 450 to as many as 800. This allows the detection of less obvious abnormalities usually not seen with conventional banding.



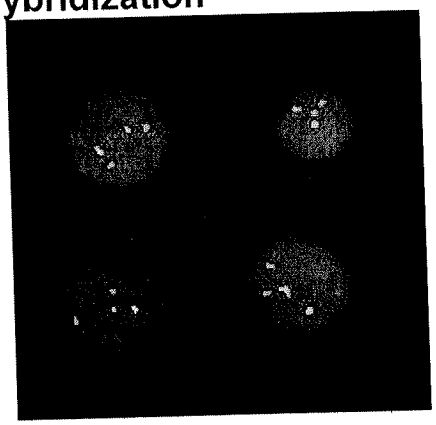
Slide preparation

Cells from bone marrow, blood, amniotic fluid, cord blood, tumor, and tissues (including skin, umbilical cord, chorionic villi, liver, and many other organs) can be cultured using standard cell culture techniques in order to increase their number. A mitotic inhibitor (colchicine, colcemid) is then added to the culture. This stops cell division at mitosis which allows an increased yield of mitotic cells for analysis. The cells are then centrifuged and media and mitotic inhibitor are removed, and replaced with a hypotonic solution. This causes the white blood cells or fibroblasts to swell so that the chromosomes will spread when added to a slide as well as lyses the red blood cells. After the cells have been allowed to sit in hypotonic solution, Carnoy's fixative (3:1 methanol to glacial acetic acid) is added. This kills the cells and hardens the nuclei of the remaining white blood cells. The cells are generally fixed repeatedly to remove any debris or remaining red blood cells. The cell suspension is then dropped onto specimen slides. After aging the slides in an oven or waiting a few days they are ready for banding and analysis.

Analysis

Analysis of banded chromosomes is done at a microscope by a clinical laboratory specialist in cytogenetics (CLSp(CG)). Generally 20 cells are analyzed which is enough to rule out mosaicism to an acceptable level. The results are summarized and given to a board-certified cytogeneticist for review, and to write an interpretation taking into account the patient's previous history and other clinical findings. The results are then given out reported in an *International System for Human Cytogenetic Nomenclature 2009* (ISCN2009).

Fluorescent in situ hybridization



Interphase cells positive for a t(9;22) rearrangement

Fluorescent in situ hybridization (FISH) refers to using fluorescently labeled probe to hybridize to cytogenetic cell preparations.

In addition to standard preparations FISH can also be performed on:

- bone marrow smears
- blood smears
- paraffin embedded tissue preparations
- enzymatically dissociated tissue samples
- uncultured bone marrow

- uncultured amniocytes
- Cytospin preparations

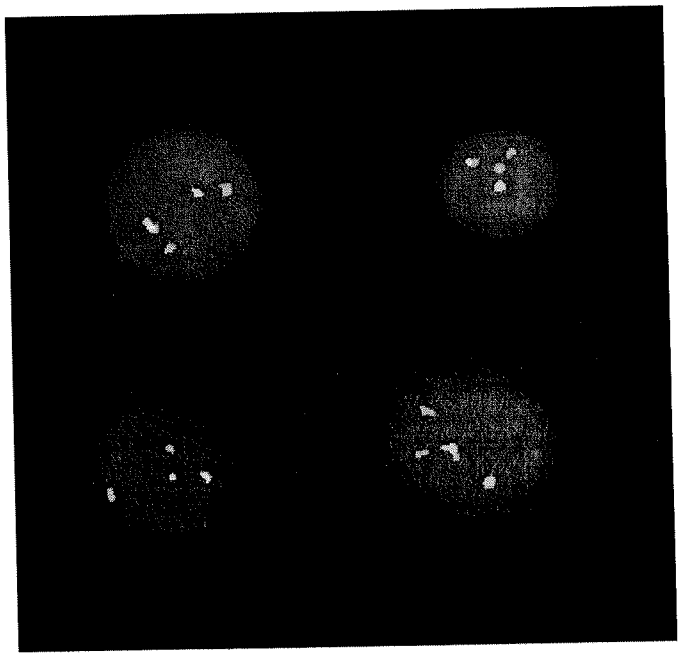
Slide preparation

This section refers to preparation of standard cytogenetic preparations

The slide is aged using a salt solution usually consisting of 2X SSC (salt, sodium citrate). The slides are then dehydrated in ethanol, and the probe mixture is added. The sample DNA and the probe DNA are then co-denatured using a heated plate and allowed to re-anneal for at least 4 hours. The slides are then washed to remove excess unbound probe, and counterstained with 4',6-Diamidino-2-phenylindole (DAPI) or propidium iodide.

Analysis

Analysis of FISH specimens is done by fluorescence microscopy by a clinical laboratory specialist in cytogenetics. For oncology generally a large number of interphase cells are scored in order to rule out low-level residual disease, generally between 200 and 1,000 cells are counted and scored. For congenital problems usually 20 metaphase cells are scored.



Future of cytogenetics

Advances now focus on molecular cytogenetics including automated systems for counting the results of standard FISH preparations and techniques for virtual karyotyping, such as comparative genomic hybridization arrays, CGH and Single nucleotide polymorphism arrays.

References:

1. Rieger, R.; Michaelis, A.; Green, M.M. (1968), A glossary of genetics and cytogenetics: Classical and molecular, New York: Springer-Verlag, ISBN 978-0-387-07668-3
2. ^ Levitsky, Grigorii Andreevich (1924). Material'nye osnovy nasledstvennosti [The Material Basis of Heredity] (in Russian). Kiev: Gosizdat Ukrainy.[page needed]
3. ^ Levitsky GA (1931). "The morphology of chromosomes". Bull. Applied Bot. Genet. Plant Breed. 27: 19–174.
4. ^ Kottler, Malcolm Jay (1974). "From 48 to 46: cytological technique, preconception, and the counting of human chromosomes". Bulletin of the History of Medicine. 48 (4): 465–502. JSTOR 44450164. PMID 4618149. ProQuest 1296285397.
5. ^ von Winiwarter H (1912). "Études sur la spermatogenese humaine" [Human spermatogenesis studies]. Arch. Biologie (in French). 27 (93): 147–149.
6. ^ Painter T.S. "The spermatogenesis of man" p. 129 in "Abstracts". The Anatomical Record. 23 (1): 89–132. January 1922. doi:10.1002/ar.1090230111.
7. ^ Painter, Theophilus S. (April 1923). "Studies in mammalian spermatogenesis. II. The spermatogenesis of man". Journal of Experimental Zoology. 37 (3): 291–336. doi:10.1002/jez.1400370303.
8. ^ Wright, Pearce (11 December 2001). "Joe Hin Tjio The man who cracked the chromosome count". The Guardian. Archived from the original on 25 August 2017.
9. ^ Saxon, Wolfgang (7 December 2001). "Joe Hin Tjio, 82; Research Biologist Counted Chromosomes". The New York Times. Archived from the original on 12 May 2013.
10. ^ Tjio, Joe Hin; Levan, Albert (9 July 2010). "The chromosome number of man". Hereditas. 42 (1–2): 723–4. doi:10.1111/j.1601-5223.1956.tb03010.x. PMID 345813.

Annexure- II

VALUE ADDED COURSE

Cytogenetics and ANA01

List of Students Enrolled – Dec-Jan 2020

2019	U19MB251	AAYESHA TAUHEED	Anatomy
2019	U19MB252	ABHIJITH A	Anatomy
2019	U19MB253	ABIHA SHERIN M	Anatomy
2019	U19MB254	ABINAYA SHANMUGAM	Anatomy
2019	U19MB255	ADHITI PRAKASH	Anatomy
2019	U19MB256	ADITHYA S KUMAR	Anatomy
2019	U19MB257	S M AISHMEKA SAIRA	Anatomy
2019	U19MB258	AISHU MUPPANENI	Anatomy
2019	U19MB259	AJETH R	Anatomy
2019	U19MB260	AKASH P	Anatomy
2019	U19MB261	AMIR FAJURA A	Anatomy
2019	U19MB262	AMLAN KUMAR KAR	Anatomy
2019	U19MB263	ANANDHA VIGNESHVAR A	Anatomy
2019	U19MB264	ANISHA C	Anatomy
2019	U19MB265	ANMOL KAUL	Anatomy
2019	U19MB266	ANNET GERIZIM	Anatomy
2019	U19MB267	ANUSHA MOL VINCENT VJP	Anatomy
2019	U19MB268	ARAVIND N	Anatomy
2019	U19MB269	ARNAB ADHIKARI	Anatomy
2019	U19MB270	ARNAB JYOTI DAS	Anatomy
2019	U19MB271	ARTHY M	Anatomy
2019	U19MB272	ARUNESHWARAN N	Anatomy

RESOURCE PERSON

1. Dr. Vijisha P

2. Dr. B. Rajesh

COORDINATOR

Dr. Vijisha P

SRI LAKSHMI NARAYANA INSTITUE OF HIGHER EDUCATON AND RESEARCH

Annexure - III

VALUE ADDED COURSES

CYTOGENETICS

Short answer questions

Course code:ANA01

Answer all the questions (10x2 = 20)

1. Define cytogenetics
2. Mitosis & meiosis
3. Modes of inheritance
4. Karyotyping
5. Pedigree analysis
6. Gene therapy
7. Recent trends in genetics
8. Prenatal diagnosis
9. genetic counselling
10. chromosomal aberrations

Value added exam

cytogenetics - branch of genetics that studies the structure of DNA within the cell nucleus

Mitosis - Process single cell divides into two identical daughter cells

Meiosis - Single cell divides twice to produce 4 cells containing half the original amount of genetic information

Modes of inheritance - Is the manner in which a genetic trait or disorder is passed from one generation to the next

Karyotyping skill training: The skill training we underwent was very useful The basics were clear.

Pedigree analysis - Its useful when studying species with a long generation time

6. Urine [illegible]
patient to test genetic disease

7. Recent trends
- Increased focus on neglect cancer treatment

8. Pre-natal diagnosis -
Amniocentesis and chorionic villous sampling

9. Genetic counselling
Process through which knowledge about genetic aspects of illness is shared by trained professionals

10. Chromosomal abnormalities
eg. Down syndrome, Trisomy 18, Trisomy
Klinefelter syndrome, XYY syndrome,
Turner syndrome, Triple X syndrome

Student Feedback Form

Course Name: cytogenetics
Subject Code: **ANA01**

Name of Student: Aayeesha J Roll No.: U19MB251

We are constantly looking to improve our classes and deliver the best training to you. Your evaluations, comments and suggestions will help us to improve our performance

Sl. NO	Particulars	1	2	3	4	5
1	Objective of the course is clear					✓
2	Course contents met with your expectations					✓
3	Lecturer sequence was well planned					✓
4	Lectures were clear and easy to understand					✓
5	Teaching aids were effective					✓
6	Instructors encourage interaction and were helpful					✓
7	The level of the course					✓
8	Overall rating of the course	1	2	3	4	5

** Rating: 5 – Outstanding; 4 - Excellent; 3 – Good; 2– Satisfactory; 1 - Not-Satisfactory*

Suggestions if any:

Signature

Date:

Date: 05.01.2020

From

Dr. Vijisha Phalgunan
Professor and Head,
Department of Anatomy,
Sri Lakshmi Narayana Institute of Medical Sciences
BIHER
Puducherry

To

The Dean,
Sri Lakshmi Narayana Institute of Medical Sciences
BIHER
Puducherry

Sub: Completion of value-added course: Cytogenetics

Dear Sir,

With reference to the subject mentioned above, the department of Anatomy has conducted the value-added course titled: : Cytogeneticsfor the 1st MBBS students during Dec-Jan 2020 . We solicit your kind action to send certificates for the participants, whose list is attached with this letter. Also I am attaching the photographs captured during the conduct of the course.

Kind Regards,

Dr. Vijisha P

Encl: Participants list

Photograph

VALUE ADDED COURSE

CYTOGENETICS

Participants list

2019	U19MB251	AAYESHA TAUHEED	Anatomy
2019	U19MB252	ABHIJITH A	Anatomy
2019	U19MB253	ABIHA SHERIN M	Anatomy
2019	U19MB254	ABINAYA SHANMUGAM	Anatomy
2019	U19MB255	ADHITI PRAKASH	Anatomy
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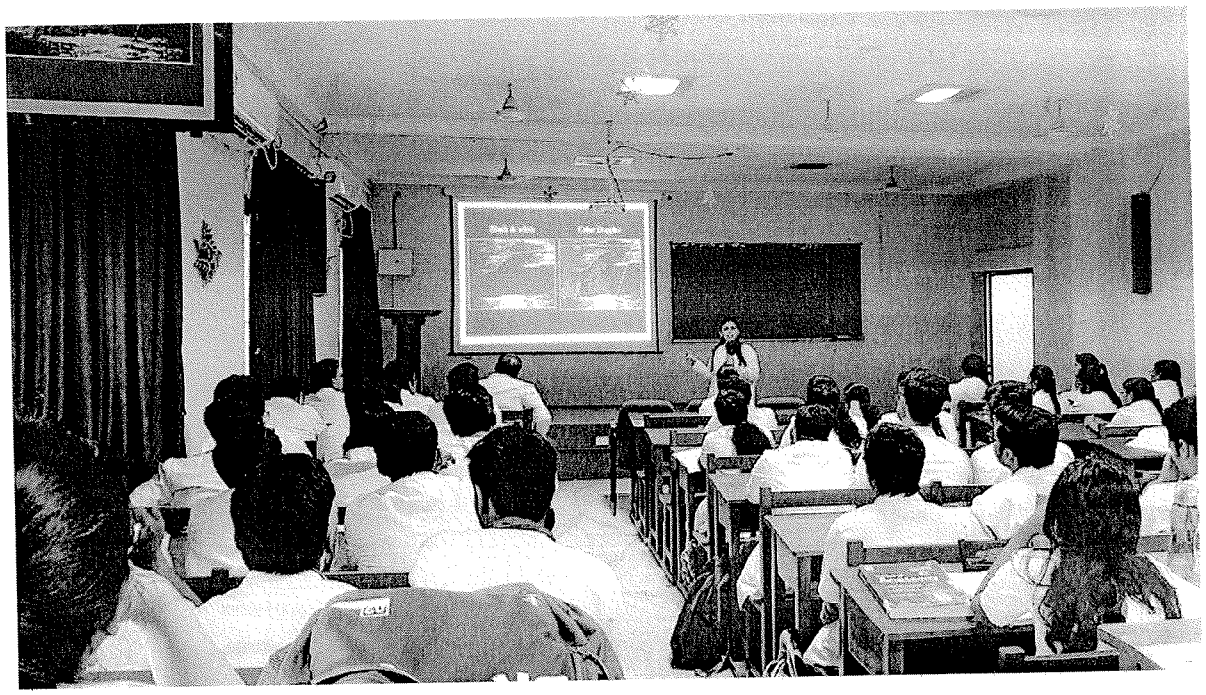
2019	U19MB271	ARTHY M	Anatomy
2019	U19MB272	ARUNESHWARAN N	Anatomy



Sri Lakshmi Narayana Institute of Medical Sciences

Affiliated to Bharath Institute of Higher Education & Research
(Deemed to be University under section 3 of the UGC Act 1956)

CERTIFICATE OF MERIT

This is to certify that Aayesha Tauheed has actively participated in the Value Added Course on Cytogenetics held during Dec-Jan 2020 Organized by Department of Anatomy, Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry- 605 502, India.

Dr. Vijisha P	Dr. B. Rajesh	Dr.Vijisha P	Dr. S.Balagurunathan
RESOURCE PERSON	**RESOURCE PERSON**	**COORDINATOR**	**DEAN**

Sri Lakshmi Narayana Institute of Medical Sciences

Affiliated to Bharath Institute of Higher Education & Research
(Deemed to be University under section 3 of the UGC Act 1956)

CERTIFICATE OF MERIT

This is to certify that ASHA J has actively participated in the Value Added Course on Cytogenetics held during Dec-Jan 2020 Organized by Department of Anatomy, Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry- 605 502, India.

Dr. Vijisha P	Dr. B. Rajesh	Dr.Vijisha P	Dr. S.Balagurunathan
RESOURCE PERSON	**RESOURCE PERSON**	**COORDINATOR**	**DEAN**