Annexure-40.6

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category A by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with A++ Grade by NAAC. Recognised by UGC Under Section 12 B
Coimbatore - 641 043, Tamil Nadu, India

Conceptual Framework of Curriculum
PG Programme (M.Sc., Clinical Embryology)
Two year programme (with practical)
For students admitted from 2022-2023 & onwards

Part	Semester	Course/Components	Instruction Hrs/Week/ Course	No. of Courses	Credit/ Course	Total Credits
I	1-3	**Part I** **Core Courses** Theory	4-6	* 8-12 Courses per Semester *13-17 Courses totally	3-5	24-60
	1-4	Practical	3-6 / Practicals	* (2-4 per semester) * 8-12 (4 Semesters)	3-5	24-60
	3	Self-Study Course	1	1	4	4
	2	Mini Project (May be groups of 4-5)	1 (For discussion)	1	2	2
	4	Research Project	One Semester	1	8	8
	2	*** Interdisciplinary Course**	4 hours (With or Without Practicals)	1	4	4
	3	**** Multi-disciplinary Course** Theory	2	1	2	2
						95
II	Summer vacation of I year	**Part II** Internship/Training	1/6 months	1	2	2 (Credits may be increased for 6 months Internship)
	Any semester except 1st or out of class hours	Choices of Certification or Other Professional Courses (Choice from atleast 3)	-	1	2	2
	1-2 Semester	Medical Camp	2	1	1	1
						5
		Total				**100**

* Other course to be undergone by the students.

MOOC Course (Any Semester before 4th Semester) - 2 to 4 Credits

Minimum 100+2 to 4 credits to earn the degree

Avinashilingam Institute for Home Science and Higher Education for Women
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Coimbatore - 641 043, Tamil Nadu, India

Department of Clinical Embryology
M.Sc. Clinical Embryology

Programme Outcomes:

1. Acquiring enhanced knowledge on the theoretical and practical aspects of embryology.
2. Learning all theoretical aspects of human development from gamete formation, ovulation, fertilization, pre-and post- implantation events.
3. Acquiring hands on skills of the diagnostic sperm tests and procedures performed in an ART unit ranging from sperm preparation to oocyte aspiration to ICSI.
4. Understanding the working, maintenance and calibration of equipments in an IVF unit.
5. Enhancing analytical and trouble shooting skills required for the successful functioning of an ART unit.
6. Learning the nuances of setting up and working in an ART laboratory.
7. Understanding the government regulations required for running an IVF unit – level 1 and 2/ART bank.
8. Analyzing the KPI's and maintaining records/documents as per government norms.
9. Applying advanced professional ethics in clinical and laboratory practices.
10. Understanding about embryology counselling and acquiring communication skills.
11. To learn experientially and use the theoretical knowledge acquired.

Programme Specific Outcomes:

1. Developing hands-on skills in the various procedures performed in an IVF unit.
2. Ability to relate and connect concepts of professional ethics and values in clinical embryology and its application.
3. Complete understanding about all the laboratory aspects required for an ART unit.

Scheme of Instruction and Examinations
(For students admitted from 2022-2023 & onwards)

Part	Subject Code	Title of the Paper/Component	Hrs of Instruction /Week		Scheme of Examination				
			T	P	Duration of Exam	CIA	CE	Total	Credits
First Semester									
I	22MCEC01	Cell Biology and Reproductive Genetics	5	-	3	40	60	100	3
I	22MCEC02	Fertility and Infertility - Basics	5	-	3	40	60	100	3
I	22MCEC03	Examination and Processing of Human Semen	5	-	3	40	60	100	4
I	22MCEC04	Andrology Laboratory and IUI (Intrauterine Insemination)	5	-	3	40	60	100	5
I	22MCEC05	Practical I – Semen Analysis	-	3	3	40	60	100	5
I	22MCEC06	Practical II – Sperm Processing Techniques	-	3	3	40	60	100	4
II		Medical Camp	2	-	-	-	-	-	-
		Library	2	-	-	-	-	-	-
Second Semester									
I	22MCEC07	Laboratory Insights	5	-	3	40	60	100	4
I	22MCEC08	Embryo Culture Systems	6	-	3	40	60	100	4
I	22MCEC09	Clinical Applications for In Vitro Procedures	6	-	3	40	60	100	5
I	22MCEC10	Practical III - Cryopreservation of Sperm	-	3	3	40	60	100	5
I	22MCEC11	Practical IV- Media Aliquoting	-	3	3	40	60	100	5
I	22MCEC12	Mini Project	-	1	-	100	-	100	2
I		Interdisciplinary Course	4	-	3	40	60	100	4
II	22MSXMC1	Medical Camp	2	-	-	-	-	100	1
Internship during Summer Vacation for One Month									
Third Semester									
I	22MCEC13	Micromanipulation, Fertilization, Zygote and Embryo Assessment	6	-	3	40	60	100	5
I	22MCEC14	Choosing the Right Embryo and Chromosomal Abnormalities (Self study)	6	-	3	40	60	100	4
I	22MCEC15	Practical V – Oocyte Handling	-	4	3	40	60	100	5
I	22MCEC16	Practical VI – Intracytoplasmic Sperm Injection (ICSI) and In Vitro Fertilization (IVF) Insemination	-	4	3	40	60	100	5
I	22MCEC17	Practical VII – Intracytoplasmic Sperm Injection (ICSI) and In Vitro Fertilization (IVF) Insemination	-	4	3	40	60	100	5
I	22MCEC18	Practical VIII – Embryo and Oocyte Cryopreservation	-	4	3	40	60	100	5

I		Multidisciplinary Course	2	-	3	100	-	100	2
II		Professional Certificate Course	-	-	-	-	-	-	2
II	22MCEC19	Internship	-	-	-	100	-	100	2
Fourth Semester									
I	22MCEC20	Practical XI – Laser Hatching and Embryo Biopsy	-	5	3	40	60	100	3
I	22MCEC21	Research Project	-	25	-	100	100	200	8
Total Credits									100

Other course to be undergone by the students:
MOOC course – 2 to 4 credits
Note: Minimum 100+2 to 4 credits to earn the degree

Cell Biology and Reproductive Genetics

Semester – I
22MCEC01

Hours of Instruction/Week: 5
No. of Credits: 3

Course Objectives: To enable students to

1. Understand the basics of cells and reproductive cells
2. Application of genetics in the field of reproductive medicine
3. Complete understanding of the basics of reproduction

Unit 1: Basic Cell Biology — 15 hours

Nature and function of cells – Cell membrane – Internal membranes – Nucleus – Mitochondrion and chloroplast – Cytoskeleton – Cell matrix and cell to cell communication – Mitosis and meiosis – Evolution of cells – Cell theory

Unit 2: Reproductive Cell Biology — 15 hours

Anatomy of male reproductive system – Anatomy of female reproductive system - Development of testis – Development of ovary - Hormonal regulation of testicular function – Hormonal regulation of ovarian function – Oogenesis and spermatogenesis

Unit 3: Molecular Genetics — 15 hours

DNA structure – Genes – Genetic code – Gene transcription – tRNA, rRNA, mRNA – Translation – DNA replication – Regulation of gene expression in prokaryotes and eukaryotes

Unit 4: Mechanisms of Inheritance — 15 hours

Mendelian genetics – Mendelian's Law of Inheritance – Linkage - Sex determination – Sex and inheritance – Inbreeding – Probabilities

Unit 5: Genetics in Infertility — 15 hours

Genetics of male infertility – Genetics of female infertility – Genes and recurrent pregnancy losses – Preimplantation genetic diagnosis and preimplantation genetic screening in infertility

Total hours: 75

Reference Books:

1. Thomas d. Pollard (2017), Cell biology, 3rd edition
2. Rastogi (2019) Genetics, 4th edition
3. P. Vogt (2017), Genetics of Human infertility
4. Richard.E. Jones and Kristin.H. Lopez, Human Reproductive Biology, 4th edition, 2014

Course Outcomes:

1. Learn the basics of cell biology.
2. Understand cell biology and its relevance in the reproduction field.
3. Acquire knowledge on the basics of genetics.
4. Understand molecular genetics with relevance to sex and inheritance.
5. Recognize the relevance of genetics in infertility.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	H	M						M		L		M	M
CO 2	M	H	H		M				M	L	M	L	M	L
CO 3	L	H	H		M				L	M	H	M	L	M
CO 4	M	H	H	L	M	L	L		M	M	M	M	M	L
CO 5	M	H	H		M	H	M	M	M	M	M	M	H	H

Fertility and Infertility - Basics

Semester – I **Hours of Instruction/Week: 5**
22MCEC02 **No. of Credits: 3**

Course Objectives: To enable students to

1. Understand the biology of in vivo fertilization and implantation
2. Learn the basics of the causes and diagnosis of male and female infertility
3. Acquire knowledge about the prognosis of diagnostic procedures

Unit 1: In Vivo Fertilization and Implantation– An Overview **15 hours**

Genetics of fertilization – Sperm and oocyte structure - Stages of fertilization – Gamete interaction (1^{st} cleavage) – Embryo development (1^{st} cleavage to implantation) – Implantation – Post implantation embryology – Early pregnancy

Unit 2: Causes of Infertility **15 hours**

Female fertility causes – Male fertility causes – Unexplained infertility - Prognostic factors involved in infertility

Unit 3: Male Examination and Diagnostic Procedures **15 hours**

Physical examination of the male – Basic examination of the sperm sample – Testicular sperm – Pre and post examination procedures – WHO norms and basic examination of sperm

Unit 4: Female Examination and Diagnosis **15 hours**

Physical examination of the female – Ovulation – Pelvic ultrasonography – Tubal function – Endometrium and receptivity

Unit 5: Reproductive Immunology **15 hours**

Antigens tolerance for testis and ovary – autoimmune disease in testis and ovary – Antisperm antibodies – Pathogenesis of immunological infertility – Laboratory assays for immunological infertility – Treatment of immunological infertility

Total hours: 75

Reference Books:

1. Larsen's Human Embryology, 6^{th} edition, 2021, Schoenwolf
2. The infertility manual by Dr. Kamini.A.Rao
3. Walter K.H.Krause and Rajesh K Naz, 2^{nd} edition, Immune infertility: Impact of immune reactions on human fertility
4. John Aitken, David Mortimer, Gabor Kovacs, Male and sperm factors that maximize IVF success

Course Outcomes:

1. Obtain knowledge about the sequence of events in vivo.
2. Understand the causes of infertility, both male and female.
3. Thorough understanding of the physical examination of male and diagnosis.
4. Acquire knowledge about the female examination and diagnosis.
5. Understand the basics of immunological infertility.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	L						L	L	L	L	M	M
CO 2		M	H	L					L	M	M		L	
CO 3		M	H	H	M	M	M	H			L	H	L	H
CO 4		M	H	H	M	M	M	H			L	H	L	H
CO 5	L	L	M						M		L			H

Examination and Processing of Human Semen

Semester – I **Hours of Instruction/Week: 5**
22MCEC03 **No. of Credits: 4**

Course Objectives: To enable students to

1. Understand the structure of sperm
2. To teach the sperm defects leading to infertility
3. Acquire knowledge about the prognosis of diagnostic procedures and quality control

Unit 1: Extended Examination of the Human Sperm **15 hours**

Sperm defects – Interpretation of sperm examination results - Sperm DNA fragmentation causes and tests - Immature germ cells – Biochemical assays for accessory sex gland function – Assessment of sequence of ejaculation – Template of semen analysis form

Unit 2: Advanced Examination of the Human Sperm **15 hours**

Seminal oxidative stress and reactive oxygen species testing – Assessment of the acrosome reaction and sperm chromatin – Transmembrane ion influx and transport of sperm – Effect of environmental factors on sperm parameters - CASA – Emerging technologies

Unit 3: Sperm Processing of Ejaculate Samples **15 hours**

General principles – Simple washing – Direct Swim-up – Discontinuous density gradient – Magnetic cell sorting techniques – HIV infected sperm samples – Testicular and epididymal spermatozoa – Retrograde ejaculation samples – Assisted ejaculation samples

Unit 4: Quality Control and Quality Assurance **15 hours**

Nature of errors in ejaculate examination – QA programmes – Statistical procedures for analysing and reporting between technician variability – external quality control – National external quality control programs for semen analysis

Unit 5: Accreditation for IUI Laboratories **15 hours**

Indian laws for level 1 clinics – Personnel and equipment requirements – Consent forms for IUI procedures – Ethical requirement for IUI procedures

Total hours: 75

Reference Book:

1. WHO laboratory manual for the examination and processing of human semen, 6th edition, 2021.

Course Outcomes:

1. Obtain knowledge about thorough examination of the sperm.
2. Understand about the advanced examinations required for sperm.
3. Theoretical knowledge about the various sperm processing techniques.
4. Acquire knowledge about the quality control in the procedures.
5. Knowledge on the latest Indian regulations for an IUI center.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	L	H	M	L	L	M		M		L	H	M	H
CO 2	M	L	H	M	L	L	M		M		L	H	M	H
CO 3	M		H	M	M	M	M		H		M	H	L	H
CO 4		M	H	H	M	L		L	H		M	H	L	H
CO 5			M	H	M	M	H	H	H	L	L	H	M	M

Andrology Laboratory and IUI (Intrauterine Insemination)

Semester – I **Hours of Instruction/Week: 5**
22MCEC04 **No. of Credits: 5**

Course Objectives: To enable students to

1. Acquire knowledge on the setting up of an andrology laboratory
2. To understand about the equipments, consumables and disposables required
3. Understand the clinical aspects of an IUI procedure, cryopreservation and fertility preservation

Unit 1: Andrology Laboratory — 15 hours

Ideal laboratory design with various rooms – Air filtering systems - Workstations – Equipment, supplies and reagents – Safety guidelines for an IUI laboratory

Unit 2: Clinical Aspects of IUI Procedure — 15 hours

Indications for IUI – Pre procedure work up – Ovulation induction protocols – Ultrasound monitoring – IUI technique – Insemination catheters - Luteal phase support – IUI complications – Statistics and trouble shooting

Unit 3: Cryopreservation of Sperm — 15 hours

Technical considerations for sperm freezing – Sperm freezing and thawing protocols – Vitrification methods – cryobiology of sperm - Autologous and donor sperm banking for infertility – Sperm banking for other indications – Funding challenges for sperm freezing – ethical challenges in sperm freezing – future avenues for sperm preservation

Unit 4: Oncofertility in Male — 15 hours

Fertility preservation in adult male cancer patients – Managing fertility in childhood cancer patients – Fertility risk in paediatric and adolescent cancers – cryopreservation techniques and limitations

Unit 5: Transgender Males — 15 hours

Factors that affect reproduction – Fertility preservation options – International transgender parenting rights – Limitations of Indian laws

Total hours: 75

Reference Books:

1. Chaitanya Nagori, Practical guide to Intrauterine Insemination.
2. Narendra Malhotra, Manual on IUI: What, when and why.
3. Teresa.K.Woodruff, Textbook of oncofertility research and practice: a multidisciplinary approach.

Course Outcomes:

1. Obtain thorough knowledge about the setting of an IUI laboratory.
2. Understand the clinical female perspectives for an insemination procedure.
3. Theoretical knowledge about the cryobiology and cryopreservation of sperm.
4. Acquire the know-how of fertility preservation in onco patients.
5. Understanding the current need for transgenders in the reproductive medicine field.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1			H	H	H	H	M	H	M			H	L	H
CO 2	M	M	H	H	H	L	M	M	H	M		H	M	H
CO 3			H	H	M	M	H	M	H		L	H	L	H
CO 4	M	H	H		L			L	M	H	M	L	H	L
CO 5	M	M							H	M	H		M	H

Practical I – Semen Analysis

Semester – I **Hours of Instruction/Week: 3**
22MCEC05 **No. of Credits: 5**

Course Objectives:

1. To learn about the examination of the semen sample and differentiate between the normal and abnormal parameters
2. To learn motility grading
3. To learn the morphology grading and identify the sperm defects
4. To learn to generate a sperm analysis report based on the findings

• Examination of the semen sample – appearance, liquefaction time, volume, pH • Abnormality in the semen parameters	**8 hours**
• Sperm concentration using the Makler chamber • Sperm concentration using the slide • Sperm concentration using the Neubauer chamber	**15 hours**
• Sperm viability assessment using the eosin and nigrosine staining method	**7 hours**
• Sperm morphology assessment using the eosin-nigrosin staining method o Normal sperm o Acrosome defect o Head defect o Neck defect o Tail defect o Neck defect o ERC o Fructose test o Leukocyte test	**15 hours**

Total hours: 45

Reference Books:

1. WHO laboratory manual for the examination and processing of human semen, 2021, 6th edition
2. David Mortimer, Practical laboratory andrology

Course Outcomes:

1. Thorough understanding about the semen parameters and the abnormalities
2. Acquire knowledge about the calculation of sperm concentration using various methods
3. Understanding about the staining methods and its principles
4. Learn about the assessment of the live and dead sperm based on the staining methods
5. Learn to assess the normal and abnormal sperm

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	H	L			M	L	H	M	L	M		M
CO 2	L	M	H	L				H			M	M		L
CO 3	L	L	H	L					H		M	M		L
CO 4	L	L	H	L					H		M	M		L
CO 5	L	L	H	L			M	L	H	M	L	H		L

Practical II – Sperm Processing Techniques

Semester – I **Hours of Instruction/Week: 3**
22MCEC06 **No. of Credits: 4**

Course Objectives:

1. To learn various methods of sperm processing methods
2. To learn to chose the specific processing method based on the sperm analysis
3. To dilute the sperm samples for IUI, IVF and ICSI procedures
4. To calculate the sperm DNA fragmentation index using a kit

• Simple centrifugation method • Swim-up method • Density gradient centrifugation method	**19 hours**
• Dilution of sperm sample for IUI, IVF and ICSI procedures	**13 hours**
• Sperm DNA fragmentation testing using the kit	**13 hours**

Total hours: 45

Reference Books:

1. WHO laboratory manual for the examination and processing of human semen, 2021, 6th edition
2. David Mortimer, Practical laboratory andrology

Course Outcomes:

1. Assessment of the kind of processing method to be used based on the sperm parameters.
2. Understanding of the use of a combination of one or two techniques to maximize sperm concentration.
3. Learn the different dilution methods for the various procedures used in the IVF laboratory.
4. Understanding of handling the Sperm DNA fragmentation kit and calculating the SDF index.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L	L	H	M	L			L	H		L	H	L	L
CO 2	L	L	H	M	L			L	H		L	H	L	L
CO 3	L	L	H	M	M	M	M	L	M			M		H
CO 4	L	L	H	M					M			M		H

Laboratory Insights

Semester – II **Hours of Instruction/Week: 5**
22MCEC07 **No. of Credits: 4**

Course Objectives: To enable students to

1. Acquire knowledge on the morphological and handling aspects of the oocyte
2. Understand the nuances of setting up of an ART laboratory
3. To understand about the equipments and maintenance of IVF unit

Unit 1: Handling of Oocytes **15 hours**

Pioneers of IVF – History of the first IVF procedure - Early IVF lab – Emergence of IVF industry – International regulations for IVF practices – Processes and procedures

Unit 2: Establishment of an ART Clinic **20 hours**

Location – Design – Facilities – Construction, renovation and building materials – Designing and operation of andrology, cryopreservation and PGD facilities – 'Burning In' of finished facility - Staff requirements

Unit 3: IVF Culture Systems: An Overview **20 hours**

Incubators and working – Workstations and working – Microscopes and basic microscopy – Micromanipulators and working – Other equipments – Consumables, gases and culture media – New age equipments and their functioning

Unit 4: Air Quality Control in Reproductive Laboratories **20 hours**

Design and implementation of air quality control – Air handling unit – Control of particles – Control of volatile organic products -VOC testing – pH testing – Co2 analyser – Cleaning and maintenance of a functioning IVF unit

Total hours: 75

Reference Books:

1. Alex Varghese, A practical guide for setting up an IVF lab, Assessment of embryo culture systems and running the unit
2. Gautam Nand Allahbadia, Textbook of Assisted Reproduction

Course Outcomes:

1. Obtain thorough knowledge about the historical perspectives of early IVF.
2. Understand the intricacies involved in the setting of an IVF unit.
3. Theoretical knowledge about the various equipments and their functioning.
4. Acquire the know-how of air quality control in a reproductive laboratory.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	M	H	L	L	L	M	H	M		M	M	H
CO 2	M		H	H	M	H	L	L	L			M		H
CO 3	M	H	H	H	M	L	L	L			M		M	L
CO 4			M	M	H	M	L	L	H		L	H		H

Embryo Culture Systems

Semester – II **Hours of Instruction/Week: 6**
22MCEC08 **No. of Credits: 4**

Course Objectives: To enable students to

1. Understand the background of gamete and embryo culture
2. Acquire knowledge about the media culture
3. Obtain the know-how of the various aspects of the culture systems

Unit 1: Historical Background of Gamete and Embryo Culture **25 hours**

Development of culture media based on oviduct and uterine fluids composition and simplex optimization – Physiology of embryo culture based on temperature, pH regulation, cellular volume and density regulation, effects of environmental pollution/infection – Development of embryology using animal models

Unit 2: Media Composition **25 hours**

Salts and osmolality – Energy sources and metabolism – Amino acids and cellular homeostasis – Macromolecules and embryo growth – Antioxidants/chelators and cellular function – pH and buffers – Growth factors

Unit 3: Culture Systems **20 hours**

Single step – Sequential – Embryo co-culture – Low oxygen culture – Embryo density – Air quality – Mineral oil overlay – Physiological and environmental factors that can affect the outcome of human ART – Microfluidics

Unit 4: Culture Medium **20 hours**

Media comparisons – Monozygotic twinning due to culture systems – Epigenetic effects of embryo culture, culture media, serum, oxygen tension, multiple ART's

Total hours: 90

Reference Books:

1. Gary D.Smith, Embryo culture
2. Patrick Quinn, Culture media, Solutions and Systems in Human ART

Course Outcomes:

1. Understand the basics and historical aspects of embryo culture.
2. Acquire the knowledge about the various factors involved in media composition.
3. Theoretical knowledge about the different kinds of culture systems involved.
4. Understand about the external factor effects that are caused by extended embryo culture.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	L	L	L	M	L	M		M	H	M	M
CO 2	M			M			M		H	L	H	H	M	H
CO 3	H	H	H	L	M	H	M	L	M		M	H	M	M
CO 4	H	H	H	L	M	H	M	L	M	L	M	H	M	M

Clinical Applications for In Vitro Procedures

Semester – II **Hours of Instruction/Week: 6**
22MCEC09 **No. of Credits: 5**

Course Objectives: To enable students to

1. Understand the indications for IVF treatment and the initial investigations
2. Acquire knowledge about the use of stimulation protocols
3. Obtain the know-how of the classification of oocyte and sperm selection

Unit 1: Patient Investigation and the Use of Drugs **15 hours**

Diagnosis for IVF indication – IVF outcomes for the various causes – Diagnosis to prognosis and the prognostic factors – Prediction models for individualizing the treatment protocols – Overview of the male and female investigations

Unit 2: Stimulation Protocols for IVF **15 hours**

Basics of follicular development – Monitoring ovarian stimulation – Roles of LH and HCG in protocols - Use of recombinants - Agonists and antogonists in COH – Ovarian stimulation for PCOS and poor responders – Luteal phase support

Unit 3: Oocyte Aspiration **20 hours**

Stereo zoom microscope and its basics - Monitoring follicular development – Trigger and oocyte aspiration clinical aspect – Identification of oocyte and culture – Assessment of cumulus complex – Biology of stripping of cumulus complex

Unit 4: Oocyte Classification **20 hours**

Inverted microscopy and basics - Morphological characteristics of the oocyte (cytoplasm, vacuole, SER, refractile body, perivitelline space, zona pellucida, polar body) – Identification of nuclear maturity – Abnormal oocytes

Unit 5: Non-invasive Sperm Selection **20 hours**

Novel sperm tests – Sperm selection based on surface electrical charge – Microfluidics for sperm selection – Sperm binding to the zona pellucida, hyaluronic acid binding assay and PICSI – Non apoptotic sperm selection – MSOME – IMSI

Total hours: 90

Reference Books:

1. Gautam Nand Allahbadia, 2015, Ovarian stimulation protocols
2. Pasquale Patrizio, A color atlas for Human Assisted Reproduction
3. Ashok Agarwal, Non-invasive sperm selection for in vitro fertilization

Course Outcomes:

1. Understand the investigation process and prognosis.
2. Acquire knowledge about the various stimulation protocols.
3. Theoretical knowledge about the classification of oocytes.
4. Understand about the handling of oocytes in the laboratory.
5. Thorough knowledge about the sperm selection tests.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1			H				L	M	M	H	L	M	L	
CO 2	M	H			L	M	L	M	M		L	H	L	H
CO 3	L	M	M	H	M	M			L		L	H	M	M
CO 4			H	H	M	M	M	M	L			M	M	H
CO 5	L		H	L	L		M	M	H		M	H		M

Practical III – Cryopreservation of Sperm

Semester – II
22MCEC10

Hours of Instruction/Week: 3
No. of Credits: 5

Course Objectives:

1. To learn about the vitrification cryopreservation methods
2. To learn the freezing methods for ejaculate, testicular sperm samples

- Sperm cryopreservation methods for ejaculate samples
  - Sperm freezing methods for ejaculate samples
  - Sperm thawing methods for ejaculate samples
- Sperm cryopreservation methods for testicular samples
  - Sperm freezing methods for testicular samples
  - Sperm thawing methods for testicular samples
- Recovery rate for the freezing -thawing methods

45 hours

Total hours: 45

Reference Books:

1. WHO laboratory manual for examination and processing of human semen, 6th edition, 2022
2. In vitro fertilization, 4th edition, Kay Elder and Brian Dale

Course Outcomes:

1. Understanding of the appropriate processing method for sperm cryopreservation based on the sperm parameters.
2. Acquire knowledge about the appropriate sperm processing method for ejaculate samples.
3. Learn the appropriate method for thawing with maximum sperm survival.
4. Acquire knowledge about the appropriate sperm processing method for testicular tissue sample.
5. Learn the appropriate method for thawing testicular sperm samples with maximum sperm survival.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	H	L			M	L	H	M	L	M		M
CO 2	L	M	H	L				H			M	M		L
CO 3	L	L	H	L					H		M	M		L
CO 4	L	L	H	L					H		M	M		L
CO 5	L	L	H	L			M	L	H	M	L	H		L

Practical IV – Media Aliquoting

Semester – II
22MCEC11

Hours of Instruction/Week: 3
No. of Credits: 5

Course Objectives:

1. To learn about media aliquoting for the various procedures
2. To learn about the cold storage maintenance of media
3. To learn about the temperature and pH maintenance of media prior to procedures

- Media aliquoting for oocyte aspiration
- Media aliquoting for oocyte screening
- Media aliquoting for sperm processing
- Media aliquoting for hyasing
- Media aliquoting for ICSI
- Media aliquoting for IVF
- Media aliquoting for IVF fertilization check
- Media aliquoting for embryo culture
- Media aliquoting for embryo transfer

45 hours

Total hours: 45

Course Outcomes:

1. Learn about the various media required for the necessary procedure.
2. Understand the calibration required for media prior to the procedures.
3. Acquire knowledge about the various consumables used for media aliquoting.
4. Acquire knowledge about the good laboratory practices to follow while aliquoting media.
5. Obtain the know-how of aliquoting media for the processes.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	M	M	L	M	L	M		L	H	L	H
CO 2			H	L	L	L			M		L	H		H
CO 3			H	M	L				M			H	L	H
CO 4	L	L	M	M	H	H	H	H	M	M		M		H
CO 5			M	L		L	L	L	L			H		H

Mini Project

Semester – II
22MCEC12

Hours of Instruction/Week: 1
No. of Credits: 2

Course Objectives: To enable students to

1. Apply Research Methodology to practice.
2. Emphasize on action research.
3. Spread scientific knowledge through presentations and publication

Course Outcomes:

1. Apply the concepts of research and its methodologies identify appropriate research topics.
2. Practice select and define appropriate research problem and parameters.
3. Compose a project proposal.
4. Organize and conduct research.
5. Write a project report with good APA style for scholarly writing.

Cell Biology and Reproductive Genetics

Semester – I **Hours of Instruction/Week: 5**
22MCEC01 **No. of Credits: 3**

Course Objectives: To enable students to
1. Understand the basics of cells and reproductive cells
2. Application of genetics in the field of reproductive medicine
3. Complete understanding of the basics of reproduction

Unit 1: Basic Cell Biology **15 hours**

Nature and function of cells – Cell membrane – Internal membranes – Nucleus – Mitochondrion and chloroplast – Cytoskeleton –Cell matrix and cell to cell communication –Mitosis and meiosis – Evolution of cells – Cell theory

Unit 2: Reproductive CellBiology **15 hours**

Anatomy of male reproductive system – Anatomy of female reproductive system - Development of testis – Development of ovary - Hormonal regulation of testicular function – Hormonal regulation of ovarian function – Oogenesis and spermatogenesis

Unit 3:Molecular Genetics **15 hours**

DNA structure – Genes – Genetic code –Gene transcription – tRNA,rRNA,mRNA – Translation – DNA replication – Regulation of gene expression in prokaryotes and eukaryotes

Unit 4: Mechanisms of Inheritance **15 hours**

Mendelian genetics – Mendelian's Law of Inheritance –Linkage - Sex determination –Sex and inheritance –Inbreeding – Probabilities

Unit 5: Genetics in Infertility **15 hours**

Genetics of male infertility –Genetics of female infertility –Genes and recurrent pregnancy losses – Preimplantation genetic diagnosis and preimplantation genetic screening in infertility

Total hours: 75

Reference Books:

1. Thomas d. Pollard (2017), Cell biology, 3rd edition
2. Rastogi (2019) Genetics, 4th edition
3. P. Vogt (2017), Genetics of Human infertility
4. Richard.E.Jones and Kristin.H.Lopez, Human Reproductive Biology, 4th edition, 2014

Course Outcomes:

1. Learn the basics of cell biology.
2. Understand cell biology and its relevance in the reproduction field.
3. Acquire knowledge on the basics of genetics.
4. Understand molecular genetics with relevance to sex and inheritance.
5. Recognize the relevance of genetics in infertility.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	H	M						M		L		M	M
CO 2	M	H	H		M				M	L	M	L	M	L
CO 3	L	H	H		M				L	M	H	M	L	M
CO 4	M	H	H	L	M	L	L		M	M	M	M	M	L
CO 5	M	H	H		M	H	M	M	M	M	M	M	H	H

Fertility and Infertility - Basics

Semester – I **Hours of Instruction/Week: 5**
22MCEC02 **No. of Credits: 3**

Course Objectives: To enable students to

1. Understand the biology of in vivo fertilization and implantation
2. Learn the basics of the causes and diagnosis of male and female infertility
3. Acquire knowledge about the prognosis of diagnostic procedures

Unit 1:In Vivo Fertilization and Implantation– An Overview **15 hours**

Genetics of fertilization –Sperm and oocyte structure - Stages of fertilization –Gamete interaction (1st cleavage) – Embryo development (1st cleavage to implantation) – Implantation – Post implantation embryology – Early pregnancy

Unit 2: Causes of Infertility **15 hours**

Female fertility causes – Male fertility causes –Unexplained infertility - Prognostic factors involved in infertility

Unit 3: Male Examination and Diagnostic Procedures **15 hours**

Physical examination of the male –Basic examination of the sperm sample –Testicular sperm – Pre and post examination procedures – WHO norms and basic examination of sperm

Unit 4:Female Examination and Diagnosis **15 hours**

Physical examination of the female – Ovulation –Pelvic ultrasonography –Tubal function – Endometrium and receptivity

Unit 5: Reproductive Immunology **15 hours**

Antigens tolerance for testis and ovary –autoimmune disease in testis and ovary –Antisperm antibodies –Pathogenesis of immunological infertility –Laboratory assays for immunological infertility –Treatment of immunological infertility

Total hours: 75

Reference Books:

1. Larsen's Human Embryology, 6th edition, 2021, Schoenwolf
2. The infertility manual by Dr. Kamini.A.Rao
3. WalterK.H.Krause and Rajesh K Naz, 2nd edition, Immune infertility: Impact of immune reactions on human fertility
4. John Aitken, David Mortimer, Gabor Kovacs, Male and sperm factors that maximize IVF success

Course Outcomes:

1. Obtain knowledge about the sequence of events in vivo.
2. Understand the causes of infertility, both male and female.
3. Thorough understanding of the physical examination of male and diagnosis.
4. Acquire knowledge about the female examination and diagnosis.
5. Understand the basics of immunological infertility.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	L						L	L	L	L	M	M
CO 2		M	H	L					L	M	M		L	
CO 3		M	H	H	M	M	M	H			L	H	L	H
CO 4		M	H	H	M	M	M	H			L	H	L	H
CO 5	L	L	M						M		L			H

Examination and Processing of Human Semen

Semester – I **Hours of Instruction/Week: 5**
22MCEC03 **No. of Credits: 4**

Course Objectives: To enable students to

1. Understand the structure of sperm
2. To teach the sperm defects leading to infertility
3. Acquire knowledge about the prognosis of diagnostic procedures and quality control

Unit 1: Extended Examination of the Human Sperm **15 hours**

Sperm defects –Interpretation of sperm examination results - Sperm DNA fragmentation causes and tests - Immature germ cells–Biochemical assays for accessory sex gland function – Assessment of sequence of ejaculation – Template of semen analysis form

Unit 2: Advanced Examination of the Human Sperm **15 hours**

Seminal oxidative stress and reactive oxygen species testing – Assessment of the acrosome reaction and sperm chromatin –Transmembrane ion influx and transport of sperm –Effect of environmental factors on sperm parameters - CASA – Emerging technologies

Unit 3: Sperm Processing of Ejaculate Samples **15 hours**

General principles – Simple washing – Direct Swim-up – Discontinuous density gradient – Magnetic cell sorting techniques – HIV infected sperm samples – Testicular and epididymal spermatozoa –Retrograde ejaculation samples – Assisted ejaculation samples

Unit 4:Quality Control and Quality Assurance **15 hours**

Nature of errors in ejaculate examination –QA programmes – Statistical procedures for analysing and reporting between technician variability – external quality control –National external quality control programs for semen analysis

Unit 5: Accreditation for IUI Laboratories **15 hours**

Indian laws for level 1 clinics –Personnel and equipment requirements – Consent forms for IUI procedures –Ethical requirement for IUI procedures

Total hours: 75

Reference Book:

1. WHO laboratory manual for the examination and processing of human semen, 6th edition, 2021.

Course Outcomes:

1. Obtain knowledge about thorough examination of the sperm.
2. Understand about the advanced examinations required for sperm.
3. Theoretical knowledge about the various sperm processing techniques.
4. Acquire knowledge about the quality control in the procedures.
5. Knowledge on the latest Indian regulations for an IUI center.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	L	H	M	L	L	M		M		L	H	M	H
CO 2	M	L	H	M	L	L	M		M		L	H	M	H
CO 3	M		H	M	M	M	M		H		M	H	L	H
CO 4		M	H	H	M	L		L	H		M	H	L	H
CO 5			M	H	M	M	H	H	H	L	L	H	M	M

Andrology Laboratory and IUI (Intrauterine Insemination)

Semester – I **Hours of Instruction/Week: 5**
22MCEC04 **No. of Credits: 5**

Course Objectives: To enable students to
1. Acquire knowledge on the setting up of an andrology laboratory
2.To understand about the equipments, consumables and disposables required
3. Understand the clinical aspects of an IUI procedure, cryopreservation and fertility preservation

Unit 1: Andrology Laboratory **15 hours**

Ideal laboratory design with various rooms – Air filtering systems - Workstations –Equipment, supplies and reagents –Safety guidelines for an IUI laboratory

Unit 2: Clinical Aspects of IUI Procedure **15 hours**

Indications for IUI – Pre procedure work up –Ovulation induction protocols – Ultrasound monitoring –IUI technique – Insemination catheters - Luteal phase support –IUI complications– Statistics and trouble shooting

Unit 3: Cryopreservation of Sperm **15 hours**

Technical considerations for sperm freezing –Sperm freezing and thawing protocols – Vitrification methods–cryobiology of sperm - Autologous and donor sperm banking for infertility – Sperm banking for other indications –Funding challenges for sperm freezing – ethical challenges in sperm freezing – future avenues for sperm preservation

Unit 4:Oncofertility in Male **15 hours**

Fertility preservation in adult male cancer patients –Managing fertility in childhood cancer patients –Fertility risk in paediatric and adolescent cancers – cryopreservation techniques and limitations

Unit 5: Transgender Males **15 hours**

Factors that affect reproduction –Fertility preservation options – International transgender parenting rights –Limitations of Indian laws

Total hours: 75

Reference Books:

1. Chaitanya Nagori, Practical guide to Intrauterine Insemination.
2. Narendra Malhotra, Manual on IUI: What, when and why.
3. Teresa.K.Woodruff, Textbook of oncofertility research and practice: a multidisciplinary approach.

Course Outcomes:

1. Obtain thorough knowledge about the setting of an IUI laboratory.
2. Understand the clinical female perspectives for an insemination procedure.
3. Theoretical knowledge about the cryobiology and cryopreservation of sperm.
4. Acquire the know-how of fertility preservation in onco patients.
5. Understanding the current need for transgenders in the reproductive medicine field.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1			H	H	H	H	M	H	M			H	L	H
CO 2	M	M	H	H	H	L	M	M	H	M		H	M	H
CO 3			H	H	M	M	H	M	H		L	H	L	H
CO 4	M	H	H		L			L	M	H	M	L	H	L
CO 5	M	M							H	M	H		M	H

Practical I – Semen Analysis

Semester – I **Hours of Instruction/Week: 3**
22MCEC05 **No. ofCredits:5**

Course Objectives:

1. To learn about the examination of the semen sample and differentiate between the normal and abnormal parameters
2. To learn motility grading
3. To learn the morphology grading and identify the sperm defects
4. To learn to generate a sperm analysis report based on the findings

- Examination of the semen sample – appearance, liquefaction time, volume, pH
- Abnormality in the semen parameters **8hours**

- Sperm concentration using the Makler chamber
- Sperm concentration using the slide **15 hours**
- Sperm concentration using the Neubauer chamber

- Sperm viability assessment using the eosin and nigrosine staining method **7 hours**

- Sperm morphology assessment using the eosin-nigrosin staining method
  - oNormal sperm
  - oAcrosome defect
  - oHead defect
  - oNeck defect **15 hours**
  - oTail defect
  - oERC
  - oFructose test
  - oLeukocyte test

Total hours: 45

Reference Books:

1. WHO laboratory manual for the examination and processing of human semen, 2021, 6th edition
2. David Mortimer, Practical laboratory andrology

Course Outcomes:

1. Thorough understanding about the semen parameters and the abnormalities.
2. Acquire knowledge about the calculation of sperm concentration using various methods.
3. Understanding about the staining methods and its principles.
4. Learn about the assessment of the live and dead sperm based on the staining methods.
5. Learn to assess the normal and abnormal sperm.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	H	L			M	L	H	M	L	M		M
CO 2	L	M	H	L				H			M	M		L
CO 3	L	L	H	L					H		M	M		L
CO 4	L	L	H	L					H		M	M		L
CO 5	L	L	H	L			M	L	H	M	L	H		L

Practical II – Sperm Processing Techniques

Semester – I **Hours of Instruction/Week: 3**
22MCEC06 **No. of Credits: 4**

Course Objectives:

1. To learn various methods of sperm processing methods
2. To learn to chose the specific processing method based on the sperm analysis
3. To dilute the sperm samples for IUI, IVF and ICSI procedures
4. To calculate the sperm DNA fragmentation index using a kit

- Simple centrifugation method
- Swim-up method **19 hours**
- Density gradient centrifugation method

- Dilution of sperm sample for IUI, IVF and ICSI procedures **13 hours**

- Sperm DNA fragmentation testing using the kit **13 hours**

Total hours: 45

Reference Books:

1. WHO laboratory manual for the examination and processing of human semen, 2021, 6th edition
2. David Mortimer, Practical laboratory andrology

Course Outcomes:

1. Assessment of the kind of processing method to be used based on the sperm parameters.
2. Understanding of the use of a combination of one or two techniques to maximize sperm concentration.
3. Learn the different dilution methods for the various procedures used in the IVF laboratory.
4. Understanding of handling the Sperm DNA fragmentation kit.
5. Understanding the SDF index and be able to give an interpretation.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L	L	H	M	L			L	H		L	H	L	L
CO 2	L	L	H	M	L			L	H		L	H	L	L
CO 3	L	L	H	M	M	M	M	L	M			M		H
CO 4	L	L	H	M					M			M		H
CO 5	M			M							L		M	

Laboratory Insights

Semester – II
22MCEC07

Hours of Instruction/Week: 5
No. of Credits: 4

Course Objectives: To enable students to

1. Acquire knowledge on the morphological and handling aspects of the oocyte
2. Understand the nuancesof setting up of an ART laboratory
3. To understand about the equipments and maintenance of IVF unit

Unit 1: Handling of Oocytes **15 hours**

Pioneers of IVF – History of the first IVF procedure - Early IVF lab – Emergence of IVF industry – International regulations for IVF practices – Processes and procedures

Unit 2: Establishment of an ART Clinic **15 hours**

Location – Design – Facilities – Construction, renovation and building materials – Designing and operation of andrology, cryopreservation and PGD facilities – 'Burning In' of finished facility - Staff requirements

Unit 3: IVF Culture Systems: An Overview **15 hours**

Incubators and working – Workstations and working – Microscopes and basic microscopy – Micromanipulators and working – Other equipment's – Consumables, gases and culture media – New age equipment's and their functioning

Unit 4:Air Quality Control in Reproductive Laboratories **15 hours**

Design and implementation of air quality control – Air handling unit – Control of particles – Control of volatile organic products -VOC testing – pH testing – Co2 analyser – Cleaning and maintenance of a functioning IVF unit

Unit 5: Quality Control Procedures **15 hours**

Sperm survival test – Culture of surplus oocytes/embryos/multipronucleate embryoculture – Risk assessment and SOP's – Housekeeping procedures in the IVF laboratory – Microbiological testing and contamination in the laboratory

Total hours: 75

Reference Books:

1. Alex Varghese, A practical guide for setting up an IVF lab, Assessment of embryo culture systems and running the unit
2. Gautam Nand Allahbadia, Textbook of Assisted Reproduction
3. In-vitro fertilization, 4th edition, Kay Elder and Brian Dale

Course Outcomes:

1. Obtain thorough knowledge about the historical perspectives of early IVF.
2. Understand the intricacies involved in the setting of an IVF unit.
3. Theoretical knowledge about the various equipments and their functioning.
4. Acquire the know-how of air quality control in a reproductive laboratory.
5. Understand the know-how of the quality control procedures that is usedin the laboratory.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	M	H	L	L	L	M	H	M		M	M	H
CO 2	M		H	H	M	H	L	L	L			M		H
CO 3	M	H	H	H	M	L	L	L			M		M	L
CO 4			M	M	H	M	L	L	H		L	H		H
CO5			H	H	M	M	H	M	H			H		H

Embryo Culture Systems

Semester – II **Hours of Instruction/Week: 6**
22MCEC08 **No. of Credits: 4**

Course Objectives: To enable students to

1. Understand the background of gamete and embryo culture
2. Acquire knowledge about the media culture
3. Obtain the know-how of the various aspects of the culture systems

Unit 1: Historical Background of Gamete and Embryo Culture **20 hours**

Development of culture media based on oviduct and uterine fluids composition and simplex optimization – Physiology of embryo culture based on temperature, pH regulation, cellular volume and density regulation, effects of environmental pollution/infection – Development of embryology using animal models

Unit 2: Media Composition **20 hours**

Salts and osmolality – Energy sources and metabolism – Amino acids and cellular homeostasis – Macromolecules and embryo growth

Unit 3: Growth Factors in Media **10 hours**

Antioxidants/chelators and cellular function – pH and buffers – Growth factors

Unit 4: Culture Systems **20 hours**

Single step – Sequential – Embryo co-culture – Low oxygen culture – Embryo density – Air quality – Mineral oil overlay – Physiological and environmental factors that can affect the outcome of human ART – Microfluidics

Unit 5: Culture Medium **20 hours**

Media comparisons – Monozygotic twinning due to culture systems – Epigenetic effects of embryo culture, culture media, serum, oxygen tension, multiple ART's

Total hours: 90

Reference Books:

1. Gary D.Smith, Embryo culture
2. Patrick Quinn, Culture media, Solutions and Systems in Human ART

Course Outcomes:

1. Understand the basics and historical aspects of embryo culture.
2. Acquire the knowledge about the various factors involved in media composition.
3. Acquire knowledge about the various growth factors required for embryo culture.
4. Theoretical knowledge about the different kinds of culture systems involved.
5. Understand about the external factor effects that are caused by extended embryo culture.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	L	L	L	M	L	M		M	H	M	M
CO 2	M			M			M		H	L	H	H	M	H
CO 3	M	L	M	L		L			M			H		H
CO4	H	H	H	L	M	H	M	L	M		M	H	M	M
CO5	H	H	H	L	M	H	M	L	M	L	M	H	M	M

Clinical Applications for InVitro Procedures

Semester – II
22MCEC09

Hours of Instruction/Week: 6
No. of Credits: 5

Course Objectives: To enable students to

1. Understand the indications for IVF treatment and the initial investigations
2. Acquire knowledge about the use of stimulation protocols
3. Obtain the know-how of the classification of oocyte and sperm selection

Unit 1: Patient Investigation and the Use of Drugs — 15 hours

Diagnosis for IVF indication – IVF outcomes for the various causes – Diagnosis to prognosis and the prognostic factors – Prediction models for individualizing the treatment protocols – Overview of the male and female investigations

Unit 2: Stimulation Protocols for IVF — 15 hours

Basics of follicular development – Monitoring ovarian stimulation – Roles of LH and HCG in protocols - Use of recombinants - Agonists and antogonists in COH – Ovarian stimulation for PCOS and poor responders – Luteal phase support

Unit 3: Oocyte Aspiration — 20 hours

Stereo zoom microscope and its basics - Monitoring follicular development – Trigger and oocyte aspiration clinical aspect – Identification of oocyte and culture – Assessment of cumulus complex – Biology of stripping of cumulus complex

Unit 4:Oocyte Classification — 20 hours

Inverted microscopy and basics - Morphological characteristics of the oocyte (cytoplasm, vacuole, SER, refractile body, perivitelline space, zona pellucida, polar body) – Identification of nuclear maturity – Abnormal oocytes

Unit 5: Non-invasive Sperm Selection — 20 hours

Novel sperm tests – Sperm selection based on surface electrical charge – Microfluidics for sperm selection – Sperm binding to the zona pellucida, hyaluronic acid binding assay and PICSI – Non apoptotic sperm selection – MSOME – IMSI

Total hours: 90

Reference Books:

1. Gautam Nand Allahbadia, 2015, Ovarian stimulation protocols
2. Pasquale Patrizio, A color atlas for Human Assisted Reproduction
3. Ashok Agarwal, Non-invasive sperm selection for in vitro fertilization

Course Outcomes:

1. Understand the investigation process and prognosis.
2. Acquire knowledge about the various stimulation protocols.
3. Theoretical knowledge about the classification of oocytes.
4. Understand about the handling of oocytes in the laboratory.
5. Thorough knowledge about the sperm selection tests.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1			H				L	M	M	H	L	M	L	
CO 2	M	H			L	M	L	M	M		L	H	L	H
CO 3	L	M	M	H	M	M			L		L	H	M	M
CO 4			H	H	M	M	M	M	L			M	M	H
CO 5	L		H	L	L		M	M	H		M	H		M

Practical III – Cryopreservation of Sperm

Semester – II
22MCEC10

Hours of Instruction/Week: 3
No. of Credits: 5

Course Objectives:

1. To learn about the vitrification cryopreservation methods
2. To learn the freezing methods for ejaculate, testicular sperm samples

- Sperm cryopreservation methods for ejaculate samples
    - Sperm freezing methods for ejaculate samples
    - Sperm thawing methods for ejaculate samples
- Sperm cryopreservation methods for testicular samples
    - Sperm freezing methods for testicular samples
    - Sperm thawing methods for testicular samples
- Recovery rate for the freezing -thawing methods

Total hours: 45

Reference Books:

1. WHO laboratory manual for examination and processing of human semen, 6th edition, 2022
2. In vitro fertilization, 4th edition, Kay Elder and Brian Dale

Course Outcomes:

1. Understanding of the appropriate processing method for sperm cryopreservation based on the sperm parameters.
2. Acquire knowledge about the appropriate sperm processing method for ejaculate samples.
3. Learn the appropriate method for thawing with maximum sperm survival.
4. Acquire knowledge about the appropriate sperm processing method for testicular tissue sample.
5. Learn the appropriate method for thawing testicular sperm samples with maximum sperm survival.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	H	L			M	L	H	M	L	M		M
CO 2	L	M	H	L				H			M	M		L
CO 3	L	L	H	L					H		M	M		L
CO 4	L	L	H	L					H		M	M		L
CO 5	L	L	H	L			M	L	H	M	L	H		L

Practical IV – Media Aliquoting

Semester – II **Hours of Instruction/Week: 3**
22MCEC11 **No. of Credits: 5**

Course Objectives:

1. To learn about media aliquoting for the various procedures
2. To learn about the cold storage maintenance of media
3. To learn about the temperature and pH maintenance of media prior to procedures

- Media aliquoting for oocyte aspiration
- Media aliquoting for oocyte screening
- Media aliquoting for sperm processing
- Media aliquoting for hyasing
- Media aliquoting for ICSI
- Media aliquoting for IVF
- Media aliquoting for IVF fertilization check
- Media aliquoting for embryo culture
- Media aliquoting for embryo transfer

Total hours: 45

Course Outcomes:

1. Learn about the various media required for the necessary procedure.
2. Understand the calibration required for media prior to the procedures.
3. Acquire knowledge about the various consumables used for media aliquoting.
4. Acquire knowledge about the good laboratory practices to follow while aliquoting media.
5. Obtain the know-how of aliquoting media for the processes.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	M	M	L	M	L	M		L	H	L	H
CO 2			H	L	L	L			M		L	H		H
CO 3			H	M	L				M			H	L	H
CO 4	L	L	M	M	H	H	H	H	M	M		M		H
CO 5			M	L		L	L	L	L			H		H

Mini Project

Semester – II
22MCEC12

Hours of Instruction/Week: 1
No. of Credits: 2

Course Objectives: To enable students to

1. Apply Research Methodology to practice.
2. Emphasize on action research.
3. Spread scientific knowledge through presentations and publication

Course Outcomes:

1. Apply the concepts of research and its methodologies identify appropriate research topics.
2. Practice select and define appropriate research problem and parameters.
3. Compose a project proposal.
4. Organize and conduct research.
5. Write a project report with good APA style for scholarly writing.

Micromanipulation, Fertilization, Zygote and Embryo Assessment

Semester – III **Hours of Instruction/Week: 6**
22MCEC13 **No. of Credits: 5**

Course Objectives: To enable students to

1. Understand the theory behind the micromanipulation techniques
2. Acquire knowledge fertilization process
3. Obtain the know-how of the pronuclei pattern and embryo grading

Unit 1: Oocyte Denudation and Preparation for ICSI **20 hours**

Preparation and evaluation of oocytes for ICSI – Handling of oocytes – Oocyte denudation and preparation of oocytes for ICSI – IVM of immature oocytes

Unit 2: ICSI and IVF **20 hours**

Setting up of microscope for the ICSI procedure – selection of oocytes for the ICSI procedure – selection of oocytes for the IVF procedure – Intra cytoplasmic sperm injection and polar body alignment – spindle view imaging for ICSI procedure - cytoskeletal events during in vitro fertilization -Assisted hatching

Unit 3: Fertilization Check **15 hours**

Fertilization check for IVF/ICSI oocytes – Polar body extrusion – Pronuclei alignment and grading – Culture of zygotes

Unit 4:Embryo Culture and Grading **20 hours**

Day 2 check and grading of embryos – Single step and sequential media – Day 3 check and embryo grading – Day 4 check and embryo grading – Day 5 check and embryo grading – David Gardner's blastocyst grading method – Emerging technologies for embryo assessment

Unit 5: Advanced Embryology Techniques **15 hours**

Transport IVF and transport ICSI – IVM – IVG – Epigenetics and epigenetic markers – Genomic imprinting – Epigenetic events during fertilization and preimplantation development – Epigenetic modification and ART – Epigenetic signatures of infertility – Future of epigenetics

Total hours: 90

Reference Books:

1. Handbook of in vitro fertilization, 2017, David Gardner and Carlos Simon
2. Text book of Assisted Reproductive Techniques (2 volumes) by David Gardner, Ariel Weissman, Colin Howles, ZeevShoham
3. In-Vitro fertilization, 4th edition, Kay Elder and Brian Dale

Course Outcomes:

1. Understand the preparation and evaluation process of sperm for fertilization.
2. Acquire knowledge about the ICSI and IVF insemination procedures.
3. Learn about the biology of iv vitro fertilization and zygote formation.
4. Thorough understanding of the embryo culture and embryo grading.
5. Acquire an insight into the future of ART

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L	M	H						M			H	L	H
CO 2	L	M	H		L	L			M			H	L	H
CO 3	L	M	H						M			H	L	H
CO 4	L	L	M		L	L	L		M			H	L	H
CO 5			M	H	H	H	H	H				H		

Choosing the Right Embryo and Chromosomal Abnormalities (Self Study)

Semester – III **Hours of Instruction/Week: 1**
22MCEC14 **No. of Credits: 4**

Course Objectives: To enable students to

1. Understand the embryo loading and transfer techniques
2. Acquire knowledge about the in vitro implantation process
3. Obtain the know-how of the choosing the right embryo for maximizing IVF success rate
4. Understand the diagnosis of diseases in preimplantation embryos

Unit 1: Handling of the Embryo and Embryo Transfer **3 hours**

Choosing the right embryo for transfer and cryopreservation – Embryo catheter loading – Embryo transfer technique – Segregating embryo for cryopreservation and freezing methodologies – Maintenance of embryo in liquid nitrogen – Thawing of embryos

Unit 2: Fertility Preservation in Females **3 hours**

Oocyte vitrification for cancer affected girls, adolescent girls and adult women – ovarian tissue cryopreservation and transplantation – Fertility preservation for social and other indications

Unit 3: Cryopreservation of Gametes and Embryos **3 hours**

Principles of cryobiology – Cryopreservation protocols – Potential contamination during cooling and storage of cryopreserved samples – Embryo cryopreservation policies – Embryo selection for freezing – Ice Nucleation – Blastocyst cryopreservation – Clinical aspects of frozen embryo transfer – Ovarian tissue cryopreservation – Semen cryopreservation – TESE and TESA sperm cryopreservation

Unit 4: Implantation and Genetic Disease **3 hours**

Embryonic regulation in the implantation process – use of biomarkers for the assessment of endometrial receptivity – chromosomal abnormalities in human embryos – genetic analysis of the embryo – polar body biopsy – blastomere biopsy – blastocyst biopsy

Unit 5: Essentials of ART Unit **3 hours**

Data management and interpretation – Evidence based medicine – KPI's and statistics – Example template forms for reports and lab charts – Consent forms for various procedures – National guidelines for ART clinics, banks and surrogacy clinics

Total hours: 15

Reference Books:

1. Text book of Assisted Reproductive Techniques (2 volumes) by David Gardner, Ariel Weissman, Colin Howles, ZeevShoham
2. Organization and management of IVF clinics, Alex 26arghese

Course Outcomes:

1. Understand about the handling techniques and transfer techniques of embryo.
2. Acquire knowledge about indications for fertility preservation.
3. Thorough understanding of the cryobiology of gametes and embryos.
4. Learn about the implantation process and genetic diagnosis diseases.
5. Understand about the other essential requisites for the successful running of an IVF unit.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L		M	L		L			M			H	L	M
CO 2	M	L	M					M	M	L		H	M	H
CO 3	M	H	H	M					M		L	H		H
CO 4	L	H	M						L	M	L	H	L	M
CO 5			L	H	H	H	H	H				H		H

Practical V - Oocyte Handling

Semester – III **Hours of Instruction/Week: 5**
22MCEC15 **No. of Credits: 5**

Course Objectives: To enable students to

1. Understand the technicalities and equipment's required for oocyte handling
2. Acquire knowledge about maintenance of optimal temperature during the procedure
3. Obtain the know-how of good laboratory practices

- Oocyte retrieval and identification of oocytes in the follicular fluid
- Oocyte washing and assessment of cumulus complex
- Oocyte culture – Group culture and single droplet culture **40 hours**

- Stripping of oocytes to remove cumulus complex
- Grading of oocytes
- Selection of oocyte for ICSI **35 hours**

Total hours: 75

Reference Books:

1. Text book of Assisted Reproductive Techniques (2 volumes) by David Gardner, Ariel Weissman, Colin Howles, ZeevShoham
2. In vitro fertilization, Kay Elder and Brian Dale
3. A color atlas for human assisted reproduction, Pasquale Patrizio, Michael J Tucker, Vanessa Guelman

Course Outcomes:

1. Understanding of the equipment's used for the oocyte aspiration and hyasing process.
2. Learn to identify the oocytes from the follicular fluid.
3. Learn to grade the oocytes based on the cumulus.
4. Acquire the practical skills required for this particular procedure.
5. Acquire practical skills for the hyasing of oocytes while with minimal outside exposure.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L		L	H	H	H	M	M	L			H	L	H
CO 2	L	M	H						M		L	H	M	H
CO 3	M		H	L								H		H
CO 4	L		H	M	M	M	M	M	H			H	H	H
CO 5	M		H	M	M	M	M	M	H			H	H	H

Practical VI – Intracytoplasmic Sperm Injection (ICSI) and In Vitro Fertilization (IVF) Insemination

Semester – III **Hours of Instruction/Week: 6**
22MCEC16 **No. of Credits: 5**

Course Objectives: To enable students to

1. Understand the microscope basics and setting up of microscope for ICSI procedure
2. Acquire knowledge about insemination procedures
3. Obtain the know-how of optimal maintenance of laboratory and incubators

- Setting up of microscope for ICSI procedure
  - Setting of the injection needle
  - setting of the holding needle
  - Alignment of the needles in the same plane
- Choosing the right sperm for ICSI
- Immobilization of sperm
- Holding the sperm in the needle **50 hours**

- Alignment of oocytes with polar body position for ICSI procedure
- Alignment of holding needle, oocyte and injection pipette with sperm in the same plane
- Intra Cytoplasmic Sperm Injection without oocyte damage **40 hours**

Total hours: 90

Reference Books:

1. Text book of Assisted Reproductive Techniques (2 volumes) by David Gardner, Ariel Weissman, Colin Howles, ZeevShoham
2. In vitro fertilization, Kay Elder and Brian Dale
3. A color atlas for human assisted reproduction, Pasquale Patrizio, Michael J Tucker, Vanessa Guelman

Course Outcomes:

1. Acquire knowledge about the handling of microscopes
2. Setting up of the microscope required for the process.
3. Obtain practical skills for the immobilization of sperm prior to injection.
4. Acquire knowledge about the alignment of oocytes correctly prior to injection.
5. Obtain practical skills on injecting the sperm into the oocyte without damaging the oocytes.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M		L	H	H	H	L	L	H			H	M	H
CO 2				H		H			L			H		H
CO 3	M		L	M	M	M	M	M	H			H		H
CO 4	M	M	H						H		M	H	M	H
CO 5	M		H	M	M	M	M	M	M			H	L	H

Practical VII – Zygote/Embryo Grading and Culture

Semester – III **Hours of Instruction/Week: 5**
22MCEC17 **No. of Credits: 5**

Course Objectives: To enable students to

1. Understand the practicalities of fertilization check for IVF/ICSI oocytes
2. Acquire knowledge about embryo culture and grading
3. Obtain the know-how of optimal maintenance of laboratory and incubators

- Fertilization check – 0pn, 2pn, 3pn
- Pronuclei grading – alignment and number of pronucleus
- Embryo culture
- Day 2 grading
- Day 3 grading
- Day 4 grading
- Day 5 grading

Total hours: 75

Reference Books:

1. Text book of Assisted Reproductive Techniques (2 volumes) by David Gardner, Ariel Weissman, Colin Howles, ZeevShoham
2. In vitro fertilization, Kay Elder and Brian Dale
3. A color atlas for human assisted reproduction, Pasquale Patrizio, Michael J Tucker, Vanessa Guelman

Course Outcomes:

1. Obtain practical knowledge about identifying the fertilization process of the zygotes.
2. Understand about the quality of the embryo based on pronuclei grading.
3. Acquire knowledge about the embryo grading.
4. Obtain practical knowledge about the segregation of embryos.
5. Choose the best embryo for transfer or cryopreservation.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L		H	L		L			H			H	M	H
CO 2	H	M	M		L				H		L	H		H
CO 3	H	M	H		L				H		L	H		H
CO 4	M		H	L	L	L			H			H	L	H
CO 5	M		H	L	L	L			H			H		H

Practical VIII – Embryo and Oocyte Cryopreservation

Semester – III **Hours of Instruction/Week: 5**
22MCEC18 **No. of Credits: 5**

Course Objectives: To enable students to

1. Understand the practicalities of embryo freezing and thawing
2. Have hands on training on the thawing protocol of oocytes and embryos
3. Obtain the know-how of optimal maintenance of laboratory and incubators

- Choosing oocytes for cryopreservation
- Oocyte freezing
- Oocyte thawing
- Choosing embryos for cryopreservation
- Embryo freezing
- Embryo thawing

Total hours: 75

Reference Books:

1. Text book of Assisted Reproductive Techniques (2 volumes) by David Gardner, Ariel Weissman, Colin Howles, ZeevShoham
2. In vitro fertilization, Kay Elder and Brian Dale
3. A color atlas for human assisted reproduction, Pasquale Patrizio, Michael J Tucker, Vanessa Guelman

Course Outcomes:

1. Thorough knowledge about the choosing the right oocytes for cryopreservation.
2. Acquire practical skills about the oocyte vitrification technique.
3. Obtain thorough knowledge about choosing the right embryos for cryopreservation.
4. Acquire practical skills about the embryo vitrification technique.
5. Learn hands-on skill for the thawing of oocytes and embryos.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	M	M						H		M	H	M	H
CO 2	M		M	L	L	L			M			H		H
CO 3	M	M	M						H		M	H	M	H
CO 4	M		M	L	L	L			M			H		H
CO 5	M		H	L	L	L			H			H	L	H

Internship

Semester – III **Hours of Instruction/Week: -**
22MCEC19 **No. of Credits: 2**

Course Objectives: To enable students to

1. Integrate knowledge and training in dealing with people
2. Examine the knowledge and executing it in reality
3. Develop trained manpower with strong knowledge base in clinics

Course Outcomes:

1. Effectively manage the health and safety aspects of a biological laboratory.
2. Acquire knowledge and skills in educational technology.
3. Write an internship report.

Practical IX – Laser Hatching and Embryo Biopsy

Semester – IV **Hours of Instruction/Week: 5**
22MCEC20 **No. of Credits: 3**

Course Objectives: To enable students to
1. Observe the embryo biopsy techniques for genetic analysis

- Observation of blastomere biopsy for genetic analysis
- Observation of blastocyst biopsy for genetic analysis
- Observation of laser assisted hatching

Total hours: 75

Reference Books:

1. Atlas of Preimplantation Genetic diagnosis, 3rd edition, AnverKuliev, Svetlana Rechitsky, Oleg Verlinsky

Course Outcomes:

1. Understand the technicalities behind laser assisted hatching.
2. Acquire practical knowledge about blastomere biopsy for genetic analysis.
3. Acquire practical knowledge about the blastocyst biopsy for genetic analysis.
4. Learn to segregate and freeze the embryos.
5. Acquire knowledge about report assessment.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	L	M	M	M	M	L	L	H			H		H
CO 2	M		H						H			H	L	H
CO 3	M		H						H			H	L	H
CO 4	M	M	M		L	L			M			H	H	
CO 5	L	L		L	M	M	H	H	M		L	M	L	M

Research Project

Semester – IV **Hours of Instruction/Week: 25**
22MCEC21 **No. of Credits: 8**

Course Objectives: To enable students to

1. Determine the purpose of the study with assumed outcomes
2. Overview of research and statistical models commonly used in medical and biomedical sciences.
3. To impart an intuitive understanding and working knowledge of research designs and statistical analysis.

Course Outcomes:

1. Describe the research process and the principle activities, skills and ethics associated with the research process.
2. Practice select and define appropriate research problem and parameters.
3. Organize and conduct research using various interventions.
4. Understating of background theory of various commonly used statistical techniques as well as analysis interpretation & reporting of results and use of statistical software.
5. Write a project report with good APA style for scholarly writing.