CourseNo.PSZOTC-413

Title:MolecularGenetics&Cytogenetics

CREDITS: 4

MAXIMUMMARKS:100

a) **MinorTestI: 20**
b) **MinorTestII:20**
c) **MajorTest:60**

Course Learning Objectives:

Molecular Genetics & Cytogenetics are amongst the most exciting branches of biological sciences wherein continuous advancement is being made at an unprecedented pace. A post graduate level student of Zoology is expected to know about the latest techniques and concepts evolving in both these branches. Thesyllabus under consideration herehas been prepared accordingly and shall prove helpful to students who intend to take up research after completing post-graduation. The contents are also in sync with the syllabi prescribed for the NET examination.

LEARNINGOUTCOMES:

Aftercompletionofthecourse,astudentisexpectedtohavegainedknowledgeabout

- ChromosomepreparationsandKaryotyping.
- AdvancedcytogenetictechniqueslikeFISH, and CGH and SpectralKaryotyping
- Organizationofhumangenomeandevolutionofhumannucleargenome.
- Stemcellsandtheir useinhumanwelfare.
- Commongeneticdisordersandtheirgeneticbasis.
- Variousdiagnostictoolsforgeneticdisorders.
- Importantaspectsofgeneticcounseling.
- Recent techniques being used in molecular biology.

Theoutcomesofthiscourseshallhaveabearingontheresearchprospectsofthe students.

Course contents:

UnitI AnalysingHumanChromosomes (13hrs)

1.1 HumanChromosomes:Overview and types.
1.2 Techniquesinthestudyofchromosomesandtheirapplications:chromosome preparations.

1.2.1 Human lymphocyteculture
1.2.2 G-Banding
1.2.3 C-Banding
1.2.4 Q-Banding
1.2.5 Karyotyping

2.1 AdvancedCytogeneticTechniques
2.1.1 FluorescentinSituHybridization(FISH)
2.1.2 ComparativeGenomicHybridization(CGH)
2.1.3 SpectralKaryotyping
2.1.4 Concept of automated karyotyping

UnitIIHumanGenomeandHumanGenomeproject (12 hrs)

2.1 Organizationofhumangenome
2.1.1 Nucleargenome
2.1.2 MitochondrialGenome
2.2 Evolutionofhumannucleargenome
2.3 HumanGenefamilies:MultigenefamiliesandSuperfamilies
2.4 Homolog,paralogsandorthologs
2.5 Repetitive DNAanditstypes
2.6 HumanGenomeProject
2.6.1 History,OrganizationandGoalsofHuman Genome Project
2.6.2 FindingsandImplications.

UnitIIIStemCellBiology,GenetherapyandGeneticDisorders (13hrs)

3.1 Stemcellresearchandtherapeuticcloning
- StemCellBasics:types,potency, source
- Useofstemcellsinhumanwelfare
- TherapeuticCloning

3.2 EthicalIssuesintherapeutic cloning
3.3 Genetherapy: Concept and applications
3.4 Geneticbasisoffollowing:
3.4.1 Huntington'sdisease
3.4.2 Cysticfibrosis
3.4.3 Thalassemia
3.4.4 Haemophilia
3.4.5 Fragile-XSyndrome

UnitIVDiagnosis ofgeneticdiseases and Genetic Counselling (12hrs)

4.1 Pre-implantationgenetic diagnosis
4.2 Prenatal diagnosis
4.4.1 Invasivetechniques:CVS, Amniocentsis,Fetoscopy
4.4.2 Noninvasivetechniques:Ultrasonography,FetalCellsinmaternalblood, maternal fetalserum
4.4 PopulationScreening
4.5 Geneticcounselling
- Purposeof Counselling
- Componentsofgeneticcounseling
- Eugenics
- Euphenics

UnitV Recent trends in molecular genetics: (10 hrs)

5.1 Genome-wide association studies (GWAS)
5.2 Functions of microRNAs, long non-coding RNAs, and circular RNAs
5.3 Therapeutic potential of non-coding RNAs
5.4 Next-generation sequencing (NGS)
5.4.1 Next-generation sequencing in cancer diagnostics.
5.5 Third-generation sequencing (TGS)
5.6 CRISPR-Cas9 mechanism: Fundamentals and Applications.

NoteforPaperSetting

Examination	Syllabustobe covered inexamination	Timeallottedfor Exam	%weightage (marks)
MinorTestI	upto20%	1Hr.	20
MinorTestII	21%to40%	1Hr.	20
MajorTest	41%to100%	2Hrs.&30mins.	60

i. Majortestwillhavetwosections(A&B)
ii. Section A is compulsorycomprising of10 questions of1.5 marks each and be spread over entire syllabus
iii. Section B comprises of6 questions (2 from each unit) from theremaining 3 units andcandidatehastoattempt one questionfromeachunit(15marks each).

Suggested readings:

1. T.A.Brown,(2002).Genome,SecondEdition,BiosScientificPublishersLtd

2. DavidP.Clark,(2005).MolecularBiology.ElsevierAcademicPress.
3. T.A. Brown,(2006):Genomes:ThirdEdition,GarlandScience
4. BenjawinLewin,(2008).GeneIX.JonesandBarlettPublishers.
5. RickiLewis.(2009)HumanGenetics-ConceptsandApplication.SecondEdition.WCB-McGraw Hill.
6. JudithGoodship,PatrickChinnery,andTomStrachan(2010).GeneticsandGenomicsin Medicine.
7. FVogelA.G.Motulusky.(2010).HumanGenetics:ProblemsandApproaches.T hird Completely Revised Edition, Springer-Verlag.
8. D. Peter Snustad and Michael J.Simmons. (2012). Principles of Human Genetics. Fifth edition. John Wiley & Sons, Inc.
9. MolecularGenetics-DFriefelder
10. MolecularCellBiology-Lodish
11. CellandMolecularBiology-G.Karp
12. TheCell,amolecularapproach-G.M.Cooper&R.E. Hausman
13. EssentialsofCellBiology-Albertsetal,GarlandPressScience
14. MolecularGenetics-Klug& Cummings

Committee members (External)

1.	**Prof. (Dr.) Seema Langer** Head, Department of Zoology & Dean, Life Sciences, University of Jammu	
2.	**Dr. N. K. Tripathi,** Professor (Retd.) Department of Zoology, University of Jammu	
3.	**Dr. Suraya Partap Singh** Assistant Prof. & Head, Department of Zoology, GDC Basholi	
4.	**Dr. ShvetambriJasrotia,** Assistant Prof., Department of Zoology, Central University of Jammu	
5.	**Mr. Munish Sharma** Assistant Director, Fisheries, Jammu	
6.	**Col. (Retd.) Sunil Sambyal** Biofloc Expert & Entrepreneur	

Class	**M.Sc. Sem-IV**
Course No.	**PSZOPC-416**
Maximum Marks	**100**
Course Title	**Lab Course-II (Based on course no. PSZOTE-413)**
Credits	**4**
Sessions	**M.Sc. Zoology Sessions 2024, 2025 & 2026**

Exercises:

1. ExtractionofgenomicDNAusingPhenol-Chloroformmethod(organic)
2. ExtractionofgenomicDNAusingextractionkits.
3. Enzymaticdigestionofgenomic DNA.
4. EnzymaticdigestionofprokaryoticDNA.
5. Todemonstratechromosomebanding.
6. DNAamplificationusingPolymeraseChainReaction.
7. Karyotypingfrommetaphasephotographs.
8. Tostudypedigreesymbolsandtocarryoutpedigreeanalysis.
9. Toprepareapedigreeofownfamily.

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