Post Graduate Diploma in Biodiversity Informatics

Syllabus 2014 - 2015 onwards

UGC Innovative Programme

CENTRE FOR BIODIVERSITY INFORMATICS
Jamal Mohamed College (Autonomous)
(College with Potential for Excellence)
(Affiliated to Bharathidasan University)
(Accredited at 'A' Grade by NAAC – CGPA 3.6 out 4.0)
Tiruchirappalli – 620 020
Regulations and Syllabus

Course Description:

Biodiversity informatics is an emerging area with a perfect blend of modern and classical subjects like information technology, taxonomy, ecology and environmental biology with an innovative and new design curriculum to impart scientific base among students for globally needed important area of biodiversity conservation. This course aims to harness the power of information technology, network and software applications, bioinformatics, taxonomy, ecology and environmental biology to discover, develop and deliver human resources using novel technologies. This course is supported by University Grants Commission, New Delhi under Innovative Programme.

Name of course : Post Graduate Diploma in Biodiversity Informatics
Course duration : One Year Full Time Course (Two Semesters)
Eligibility : Post Graduate Degree in Life Science, Physical Science, Chemical and Earth Science, Computer Science, Humanities and Social Science with knowledge of Biology.

Admission for the programme will be based on the aggregated average of the performance of the candidate in PG examinations and also through the entrance examination conducted by the Department.

Medium of instruction : English
Intake capacity : 25 students

Programme Highlights:

- Course consists of instruction, assignment, six theory papers, four practical, an independent study paper and research project
- Course duration 12 months comprising two semesters
- Examinations at the end of every semester during November and April.
- Course is essentially field and computer laboratory based, interdisciplinary and applied in nature.
- Course deals with knowledge of biological data use in web accessible database for in silico biodiversity conservation purpose.
- Field visit and study is a unique opportunity for students to encounter a tropical flora & fauna and to get experience in a pragmatic way.
Regulations:

**Scheme of Examination:**

Examination will be conducted at the end of each semester. A candidate who fails in a course or courses can reappear for the same in the subsequent semesters. A candidate failing in the dissertation shall be required to resubmit his work in the next semester.

**Evaluation:**

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points. Evaluation for each course shall be done by a continuous internal assessment by the concerned Course Teacher as well as by the semester end examination and will be consolidated at the end of the course. The components for continuous internal assessment for theory courses are:

- Tests (Two) : 20 Marks
- Seminar (One) : 10 Marks
- Assignment (One) : 10 Marks

**Total** : 40 Marks

The evaluation of practical examination is also based on continuous internal assessment and on an end semester practical examination as 40 : 60.

**Internal Assessment** (20 marks):

- Performance in Practical Class : 05 marks
- Submission of observation note books : 05 marks
- Lab course test (Two tests) : 10 marks

**External Examination** (30 marks):

- Practical Examination : 20 marks
- Submission of Record note book : 05 marks
- Viva Voce : 05 marks

**Passing minimum:**

A candidate has to secure not less than 40 per cent of the marks in the Semester End Examination (SEE) and 50 per cent of the marks in the aggregate of the marks secured in the Continuous Internal Assessment (CIA) and the Semester End Examination (SEE) in each of the courses including practical. Out of 100 marks in each course, 40 per cent of marks are for Internal Assessment and 60 per cent for External Examinations.

**Pattern of Question Paper:**

The question paper in each of the course would comprise of Section A, Section B and Section C. In Section A, students have to answer 10 questions (10 × 1 = 10 marks). In Section B, there will be 5 questions in either… or pattern (5 × 4 = 20 marks). In Section C, three out of five questions have to be answered (3 × 10 = 30 marks).
**Independent Study Course:**

Students will have no written examination for the independent study course. They have to make a preliminary presentation of their chosen title before the faculty members and their classmates at the end of first month of the semester. This presentation will be evaluated by faculty members and all the students of the class and the marks secured will be considered for Continuous Internal Assessment I. A similar kind of presentation and evaluation will be made at the end of second month of the semester for Continuous Internal Assessment II. At the end of the semester, students will submit a hard and soft copy of their chosen title and make a presentation before the external examiner for their Semester End Examination. Out of 100 marks for the course, 40 per cent of marks are for Internal Assessment and 60 per cent for External Examinations.

**Project Work:**

Each candidate shall be required to take up a Project Work and submit report at the end of second semester. The Coordinator of the Programme shall assign the Guide who in turn will suggest the Project Work in consultation with the student in the beginning of the second semester. One typed copy of the Project Report shall be submitted to the Controller of Examinations through the Coordinator of the Innovative Programme on or before the date fixed by the Controller of Examinations of the College. The Dissertation will be evaluated by two External Examiners (one each of Life Sciences and Information Technology), appointed by the Controller of Examinations. The candidate concerned will have to defend his project in a Viva-Voce examination.

**Dissertation :** 80 marks [Two Interim Review Presentation (2 × 20) : 40 marks
Project Report Valuation by External Examiners : 40 marks

**Viva Voce**

: 20 marks

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Total : 100 marks

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A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva/Voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-Voce. A candidate who gets less than 40% in the Project Report must resubmit the Project Report. Such candidates need take again the Viva-Voce on the resubmitted project.
POST GRADUATE DIPLOMA IN BIODIVERSITY INFORMATICS

UGC Innovative Programme

COURSE STRUCTURE

(Applicable to the candidates admitted from the year 2014-2015 onwards)

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<th>COURSE</th>
<th>COURSE TITLE</th>
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SEMESTER I: CORE - I
BIODIVERSITY INFORMATICS FOR CONSERVATION AND MANAGEMENT

Course Code: 14PDBD1C1  Max Marks: 100
Hours/Week: 6  Internal Marks: 40
Credit: 4  External Marks: 60

Objective:
To enable students to understand the Key concepts of Evolution leading to speciation, Biodiversity and Conservation, Biodiversity informatics data requirements, Web resources, Biodiversity values and Protecting Biodiversity.

UNIT I:


UNIT II:


UNIT III:

Biodiversity Data Requirements: Taxonomic and Historical Data – Museum and Herbarium, Molecular Data- Geonomics and Barcode Data. Spatial datasets. Data Standards: TDWG, SDD, DELTA, Darwin core, ABCD and Geodatabase Standards, biodiversity multimedia standards; Online tools for Standards - IPNI, Species 2000, Barcode Data Standards.

UNIT IV:

Web Resources for Biodiversity Informatics: GBIF, Catalogue of Life, OBIS, MANIS, Avibase, Fishbase, Fishnet, COP, UNEP-WCMC, ITIS, IUCN, FAO, GLCF, IBIS, Vertnet, ATCC, PCC, NCBI Taxonomy, AVIS, Indian Biodiversity Portal, Western Ghats Biodiversity Portal, Biodiversity Information System Bioinformatics
databases: Major Bioinformatic Resources – Genome, Sequence, Bibliographic, Protein Structure databases.

UNIT V:


Text Books:


Books for Reference:


Detailed Notes of Reference:

UNIT I: Evolution and Speciation:


UNIT II: Biodiversity:

UNIT III: Biodiversity Data Requirements:

UNIT IV: Web Resources for Biodiversity Informatics
a. Refer to specific Websites for every database

UNIT V: Biodiversity Economics, Legislation and Intellectual Property Rights (IPR):
CORE COURSE II: BIOGEOINFORMATICS

Course Code: 14PDBD1C2  Max Marks: 100
Hours/Week: 6  Internal Marks: 40
Credit: 4  External Marks: 60

Objective:

To enable students to understand key concepts of Genomics, Genome annotation, Phylogeny and Geoinformation Technology.

UNIT I:

Bioinformatics:

Genomics: Definition of Genomics, Genome, Elements of genome organization, Genome sequencing; Genome maps: High and low-resolution map, Map elements, Polymorphic markers; Types of maps: Cytogenetic, Linkage, Transcript, Physical, Comparative, Integrated maps; Map repositories: NCBI – Entrez, Human genome map viewer, Practical uses of genome maps: Locating genomic regions, Target identification, Arrangement of genes and SNP diagnosis.

UNIT II:

Genome Annotation:


UNIT III:


UNIT IV:

Geo-information Technology:

UNIT V:


**Text Books:**


**Books for Reference:**


Detailed Notes of Reference:

UNIT I and UNIT II: Genomics and Genomic Annotation:


UNIT III: Phyloinformatics:


UNIT IV and UNIT V: Remote Sensing; GIS and GPS


c. Image Classification:
   http://www.sc.chula.ac.th/courseware/2309507/Lecture/remote18.htm (accessed on 12/1/2015)

d. GPS/GNSS general account:


f. Spatial Modelling


h. Map script General definition:
   http://www.invet.net/images/catalog/creating_maps.pdf


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CORE COURSE III: PYTHON PROGRAMMING

Course Code: 14PDBD1C3
Max Marks: 100
Hours/Week: 6
Internal Marks: 40
Credit: 4
External Marks: 60

Objective:
To enable students to understand python programming language for analyzing biological and geospatial data

UNIT I:


UNIT II:


UNIT III:

Modules, I/O and Exception Handling: Modules - Search path - Compiled modules - Standard modules - Packages - Input and Output functions - Files – Read and write - Exception – Handling and Raising – User defined Exceptions.

UNIT IV:

Python Standard Library: OS Interface – Command line arguments -String Pattern Matching – Mathematics – Internet Access – Dates and Times

UNIT V:


Text Books:

T.B.1 : Payne, J. Beginning Python Using Python 2.6 and Python 3.1 www.wrox.com
T.B.2 : Guido van Rossum ,Fred L. Drake , Python Programming Python Tutorial Release 3.2.3. Python Software Foundation .

Books for Reference

Detailed Notes of Reference:
UNIT I to 5:
   a. Payne, J. Beginning Python Using Python 2.6 and Python 3.1 www.wrox.com
   b. Guido van Rossum, Fred L. Drake, Python Programming Python Tutorial Release 3.2.3. Python Software Foundation.
CORE COURSE IV: DATABASE MANAGEMENT SYSTEMS

Course Code: 14PDBD1C4  
Max Marks: 100

Hours/Week: 6  
Internal Marks: 40

Credit: 4  
External Marks: 60

Objective:
To enable the students to understand Database concepts as well as designing and developing of an RDBMS database.

UNIT I:

Database system concept:  Characteristics of data in a database - Functions of DBMS - File Based Data Management - Disadvantages of file system -- Components of a database - Comparison between Database and file-processing systems - Data dictionary - Data abstraction - Data independence.  
Architecture: Overall Architecture of DBMS, Three level architecture.  

UNIT II:

Relational Data Model: Characteristics - Codd's rules - Relational Structure - Tables (Relations), Rows (Tuples), Domains, Attributes, Extension, Intention.  
Keys: Candidate Key, Primary Key, Foreign Key, Super Keys, Unique Keys.  
Data Constraints: Primary key constraint, Unique, Check constraint, strong Entity, Weak Entity.  
Normalization: Introduction - Purpose of Normalization - Definition of Functional Dependence (FD) Relational database Design, - Normal forms: 1NF, 2NF, 3NF, BCNF.

UNIT III:

Interactive SQL: Introduction to SQL - Advantages of SQL - Invoking SQL*PLUS, The Oracle Data-types, Data Definition Language (DDL), Data Manipulation language (DML), Data control language (DCL), Data Query Language (DQL) and related commands.  
Queries using Group by and Order by clause & Join: Querying a Single Table, Ordering Results, Grouping the results, Joins, Types of Joins, Sub queries.  
Operators: Arithmetic, Comparison, Logical Operators, Set operators.  
Build in Functions: Character, Arithmetic, Date and time, Group and Miscellaneous functions, Commit, Rollback, Save Point.  
Format models: Character, Numeric & Date format models.

UNIT IV:

Indexes: Index Types, Creating of an Index: Simple Unique and Composite Index,
Dropping Indexes. **Introduction to PL/SQL:** The PL/SQL Syntax, The PL/SQL Block Structure, Fundamentals of PL/SQL, Advantages of PL/SQL data Types. **Control Structure:** Conditional Control, Iterative Control, Sequential Control.

**UNIT V:**

**Exception Handling, Cursors:**

- **Exception handling** – Predefined Exception – User defined Exception.
- **Cursors:** Declaring – Opening and Closing a Cursor – Fetching a Record from Cursor
- **Procedures:** Advantages – Creating – Executing and Deleting a Stored Procedure.
- **Functions:** Advantages – Creating – Executing and Deleting a Function.

**Text Books:**


**Books for Reference**


**Detailed Notes of Reference:**

**UNIT -1 to 5**

a. Edvin Dayanand and R.K.Selva Kumar. Relational Database Management, NV publications, Pollachi


CORE COURSE V: LAB COURSE I: BIOGEOINFORMATICS

Course Code: 14PDBD1C5P  Max Marks: 50
Hours/Week: 3  Internal Marks: 20
Credit: 2  External Marks: 30

Objective:

Students to get practical exposure in field data collection, software used in Bioinformatics, Geoinformatics and Spatial modeling.

Biodiversity

1. Diversity Measurements – Shannon-Weiner, Simpson, Jaccard
2. Constructing phylogenetic tree using Phenetic/Morphological data
3. Demarcating the species of your region using Venn diagram
4. Identifying the species name for TDWG using I
5. Identifying various web resources for Biodiversity informatics

Bioinformatics:

1. Sequence databases, nucleic acid sequence database – NCBI, EMBL, DDBJ
2. Data base file formats – NCBI, EMBL and DDBJ
3. Gene structure and function prediction – GENE SCAN
4. Sequence similarity searching – NCBI BLAST
5. Molecular phylogeny – PHYLIP

Remote Sensing & Geoinformatics

1. Geo-rectification images
2. Onscreen Visual Interpretation
3. Thematic Data Generation – Road network, Drainage, Soil, Rainfall,
4. GPS data collection
5. Species Distribution map generation using Latitude and Longitude values
6. Overlay analysis, Ranking/Weighting methods
7. Spatial Models – Habitat Suitability Model, Conservation Priority Setting

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CORE COURSE V: LAB COURSE II: PYTHON PROGRAMMING AND DBMS

Course Code: 14PDBD1C6P  Max Marks: 100
Hours/Week: 3  Internal Marks: 20
Credit: 2  External Marks: 30

Objective:

Students get practical exposure to Python programming and its application in Biological sciences, and get knowledge on Database Development using PLSQL.

Python Programming

1. Program using arithmetic operators
2. Program using logical operator
3. Storing strings in variables and Print (Example using Sequence Data)
4. Concatenation of two strings and Print (Example using Genus and Species Name)
5. Calculating AT content
6. Identify Complementing DNA
7. Cleaning Data and Graphing in Python
8. Arrange the given strings in alphabetical order
9. Using List concept using Python Programming

DBMS

1. Installation and Configuration of WAMP server.
2. a. Creation of New Table with minimum five fields with different data types.
   b. Inserting values to the New Table with INSERT Command. (Minimum 5 records).
   c. Use of ALTER TABLE COMMANDS in Existing Tables.
3. a. Use of UPDATE Commands in Existing Tables.
   b. Use of DROP, TRUNCATE, DELETE, TRUNCATE Commands.
   c. Creating VIEW for existing tables.
4. a. Use of SELECT with Where Clause.
   b. Use of BETWEEN Clause in Where Condition.
5. a. Use of SET operation in tables.
   b. Use of Sub Query in Tables.
   c. Use of Logical Operation in SELECT Clause.
6. PL/SQL Program using Exception Handling.
7. PL/SQL Program using function and procedures.
8. PL/SQL Program using Cursors.
9. Creating Simple website with Texts and an Image using HTML
10. Creating a Web page with Lists, Check Box, Radio Button using HTML.
CORE COURSE I: DATA INTEGRATION FOR BIODIVERSITY AND WEB APPLICATION DEVELOPMENT

Course Code: 14PDBD2C1
Max Marks: 100

Hours/Week: 6
Internal Marks: 40
Credit: 4
External Marks: 60

Objective:
To enable students to develop or enhance skills in analyzing, synthesizing, and integrating biodiversity related information and create effective web applications.

UNIT I:

UNIT II:
UNIT V: Web development: General account on Python for web development.


UNIT III:
Java Script: Introduction, Program structures, Execution procedure, Data types, Variables, Strings, Operators, If-else structure, Else-if, Switch-case structure, Looping structures, Built-in functions, Form Handling and validation, Dialog Box, Alert boxes and Prompt Boxes.

UNIT IV:
PHP: Introduction, PHP program structures, Execution procedure, Data types, Variables, Strings, String functions, Operators, If-else structure, Else-if, Switch-case structure, Looping structures, PHP functions, Form handling and validation, Data base Connection using MySql, Retrieving data from data base and displaying in the web site.

UNIT V:
Text Books:


Books for Reference


4) iCloud for Developers Automatically Sync Your iOS Data, Everywhere, All the Time Cesare Rocchi, The Pragmatic Programmers, LLC, USA. 2013.

Detailed Notes of Reference

UNIT-1

UNIT-2 to 4


UNIT-5

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CORE COURSE II: BIOSTATISTICS

Course Code: 14PDBD2C2
Hours/Week: 6
Credit: 4
Max Marks: 100
Internal Marks: 40
External Marks: 60

Objective:
To enable the students to understand and apply statistical methods that are necessary to process and interpret biological data and to develop skill in using statistical software like R.

UNIT I:

Statistical concepts: Data vs Information, Importance of Statistics in Biodiversity,

UNIT II:

Measurement of Variables: One way, Two way Annova, Student t-test, Paired t-test, Wilcoxon Signed Rank test, Sign test. Multiple measurement – Linear Regression and Non Linear Regression, Sperman rank correlation, Polynomial regression, Multiple and logistic regression.

UNIT III:


UNIT IV:


UNIT V:

Text Books:


Books for Reference


Detailed Notes of Reference

UNIT I& 2: Statistical concepts & Measurement of Variables:


UNIT III& 4: R statistics, Data Management – Spatial Statistics


UNIT V: Modelling


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CORE COURSE III - INDEPENDENT STUDY PAPER

Course Code: 14PDBD2C3
Max Marks: 100

Hours/Week: 6
Internal Marks: 40

Credit: 4
External Marks: 60

Objective:
To enable the students to remediate deficient areas of knowledge, behavior or skills in Biodiversity Informatics.

Course Requirements

- Students discuss their topic with a faculty member with whom they would like to complete the independent study course and solicit the faculty member’s commitment to being the course supervisor.

- Once the faculty supervisor is identified, the student and faculty supervisor determine the specific title in which the student will be involved.

- After this discussion, the student presents a typed outline of the independent study paper to the faculty supervisor to get his approval. The outline must consist of the following elements;
  - Purpose and Objective of the independent study
  - A short description of the paper of study, including a title
  - A list or description of the components of the project to be completed by the student
  - A timeline for completion of the project within one semester.
  - A list of the number and approximate dates for meetings between the faculty and student for evaluation and discussion.

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CORE COURSE IV: LAB COURSE III- DATA INTEGRATION FOR
BIODIVERSITY AND WEB APPLICATION DEVELOPMENT

Course Code: 14PDBD2C4P  Max Marks: 50
Hours/Week: 3  Internal Marks: 20
Credit: 2  External Marks: 30

Objective:
To enable students to get exposure in Data mining software, Geodatabase creation for web domain, Web application development using PHP, Java script and Open Source Technologies like Django and Web GIS

Data mining

1. Application in Biological Sciences
2. WEKA software applications in Data mining

Geo Database Creation and Web GIS

1. Creation of Spatial Database
2. Import the GIS database
3. Connect the Geo Data into Server.
4. Symbolize the thematic layer.

Web Development

1. Creating Simple website with Texts and an Image using HTML
2. Creating a Web page with Lists, Check Box, Radio Button using HTML.
3. Creating A Web page with Lists, Check Box, Radio Button using PHP
4. Simple Form Creation using PHP.
5. Program for Connecting MySql Database with PHP and Display the table values.
6. Program for inserting values to MySql tables thru PHP.
8. Web Development using Django.

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CORE COURSE V: LAB COURSE II- BIOSTATISTICS

Course Code: 14PDBD2C5P
Max Marks: 50
Hours/Week: 3
Internal Marks: 20
Credit: 2
External Marks: 30

Objective:
To enable students to get exposure to application of various statistical techiques for assessment of biodiversity samples and apply R language for Biodiversity measurement

Test Statistics
1. The significance of behavior of birds in a forest using G test
2. Cochran–Mantel–Haenszel test for wildlife underpasses on a highway
3. Student’s t-test to compare tree girth in healthy and disturbed forest ecosystem
4. Nest Anova to assess the habitat of lichens
5. Correlation and linear regression in species diversity estimates
6. Spearman rank correlation in pouching size and sound in birds.

R statistics for Assessment of Biodiversity data
1. Diversity indices
2. Rarefaction
3. Taxonomic and functional diversity
4. Multivariate Analysis of Ecological Communities in R
5. Importing species occurrence data
6. Data cleaning, Duplicating, Cross checking
7. Extracting Raster layers
8. Model fitting, prediction and Evaluation
9. Models in R – Geographic Models, Regression Model, Combining Model Prediction

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## PROJECT WORK

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