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**Department of Animal Resources**

**College of Agriculture**

**University of Salahaddin–Erbil**

**Subject: (Experimental Design and Analysis)**

**Course Book – Third Class**

**Lecturer's name: - Mohammed sulaiman (Ph.D)**

**Academic Year: 2022/2023**

**Course Book**

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| **1. Course name** | **Experimental Design and Analysis** |
| **2. Lecturer in charge** | **Mohammed Sulaiman Abdullah** |
| **3. Department/ College** | **Agriculture College/Animal Resources Department** |
| **4. Contact** | **e-mail:** **Tel: (07504686486)** |
| **5. Time (in hours) per week**  | **Theory : 2 hours** **Practical: 3 hours**  |
| **6. Office hours** | **Available all days during the week** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | **B.ch. In animal production -2001****M.sc. In poultry breeding -2007****Ph.D in Poultry Breeding -2020** |
| **9. Keywords** | **statistics , treatments , Design , Experimental unit , Experimental error , experiment design ,** |
| **10. Course overview:** **Introduction :****Ronald A. Fisher** developed basic principles of design and analysis from 1919 to 1933 at Rothamsted Experimental Station, England• The Arrangement of Field Experiments (Fisher, 1926)”, he outlined and advanced three fundamental components for experiments in agricultural trials: Local control, Replication and Randomization • Statistical Principles for Research Workers (Fisher, 1925)• The Design of Experiments (Fisher, 1935). Much of Fisher‘s contributions to statistics were based on biological data from Rothamsted. Fisher invented the techniques **of maximum likelihood and analysis of variance (F-test),** was a pioneer in the design of experiments, and originated the concepts of sufficiency, ancillarity, and Fisher information score, making him a major figure in 20th century statistics. |
| **11. Course objective:*** The course is designed to expose students to the following fields in experimental design:
* 1. Exp. Design Identification
* 2. Analysis of Variance: CRD, RBD, Latin, and Split Plot Designs
* 3. Treatment Arrangements
* 4. Post ANOVA Tests and Calculations
* 5. Analysis of Covariance
* 6.Develop the student’s ability in how to collect, analyze data statistically and discuss their results.
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| **12. Student's obligation**The students should be obligated attendance and completion of all tests, exams, quizzes, assignments, reports , essays…etc  |
| **13. Forms of teaching**1- PowerPoint. 2- Whiteboard |
| **14. Assessment scheme*** **Examinations:-**
* 1st exam. After 5 lectures
* 2nd exam. After 10 lectures

**Mark Distribution** **Monthly Exam 40 %( Theoretical 25% + Practical 15%)**  **Final Exam 60% (Theoretical 40% + Practical 20%) = Final** **Mark 100%.**  |
| **15. Student learning outcome:*** **A) knowledge and understanding:**

a. Basic concepts of statistical models and use of samplesb. Review analysis of variances and experimental designs**B) Intellectual skills (cognitive and analytical):**a. Achieve maximum power and benefits from designing experiments. b. Ability to interpret results efficiently* **C) Subject specific skills:**

a. Design of experiments and use to analyse experiments and ability to emphasis b.. Data analysis and interpretation |
| **16. Course Reading List and References‌:**1. Experimental Design and Analysis (Arabic), K.M. Al-Rawi.
2. Biostatistics for Animal Science, 2004. Miroslav \kaps & William R. Lamberson.
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| **17. The Topics:** |

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| **Weekly Lectures schedule** |
|  | ***subjects*** | ***weeks*** |   |
|  |  **1. Exp. Design Identification** **Experiment , Design , Analysis , Analysis of Variance, Experimental unit , Treatments , experimental error** 1. **Basic Principles of Experimental Design .**

**Randomness , Replications , local Control** | **1st week** | 1 |
|  | **The Completely Randomized Design (C.R.D) Definition, Advantages and Disadvantages .****At : equal number of replication** **b- Unequal number of replication.****Linear Model** **Analysis of Variance Table (ANOVA)****Test of Hypotheses****Linear Model to any design** **ANOVA Table** | **2nd week**  | 2 |
|  | **. Estimation of Variance Components** **Tests Suggested after Experimentation** 1. **Comparison all treatments with Control**
2. **Dunnett test**
3. **Multiple Comparisons .**
4. **LSD test**

**b-Duncans Multiple Range test** | **3rd and 4th weeks** | 3-4 |
| **The Completely Randomized Design (C.R.D) Definition, At : Unequal number of replication** | **5th week** | 5 |
|  | **Randomized Complete Block Design (R.C.B.D)****1- introduction , Advantages (R.C.B.D) and Disadvantages .**  | **6th week** | 6 |
|  | **Relative Efficiency of R.C.B.D Compared with C.R.D****Missing Values for CRD** | **7th week** | 7 |
|  | **Latin Square Design (L.S.D) .****Introduction. advantages and disadvantages** | **8th week** | 8 |
|  |  **Relative Efficiency of R.C.B.D with L.S.D** **Relative Efficiency of C.R.D with L.S.D****Missing Values** | **9th week** | 9 |
|  | **Factorial Experiments conducted in C.R.D** | **10th week** | 10- |
|  | **A- Two factors A\*B (2\*3)****B-Three factors A\*B\*C (2\*2\*3) .** | **11th-12th weeks** | 11-12 |
|  | **Factorial Experiments conducted in R.C.B.D** | **13-14th weeks** | 13-14 |
|  | **Mutiple Questions**  | **15th week** | 15 |

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| **18. Examinations:****Sample of questions in Experimental Design and Analysis – Animal Resources Department****Q1. Define: treatments, Design , Replication , Experimental Unit and Experimental error ?****Q2. Write advantage and disadvantages of CRD?****Q3/ A /** Calculate missing value and write Linear model from the following data ?

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| --- | --- | --- | --- | --- |
| Treatments | R1 | R2 | R3 | R4 |
| T1 | 8 | 7 | ….. | 5 |
| T2 | 7 | 6 | 3 | 7 |
| T3 | 9 | 4 | 4 | 6 |

B/ calculate ANOVA table and write linear model ?

|  |  |
| --- | --- |
| Treatments  | Observations ( yij)  |
| T1 | 4 , 8 , 9 |
| T2 | 10 , 8 , 6 , 9 |
| T3 | 3 , 5 , 7 , 6 , 9 |

**Q4 /** from the following data , calculate ANOVA table and find RE % as compared to C.R.D?:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | C1 | C2 | C3 | C4 |
| R1 | t3 7 | t2 5 | t1 2 | t4 10 |
| R2 | t4 11 | t3 8 | t2 6  | t1 3 |
| R3 | t1 2 | t4 12 | t3 7 | t2 5 |
| R4 | t2 6 | t1 3 | t4 12 | t3 8 |

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| **19. Peer review پێداچوونه‌وه‌ی هاوه‌ڵ** This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.*(A peer is person who has enough knowledge about the subject you are teaching; he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*  |