Course Description for the Degree of M.Sc. in Fisheries

3712701 Supplementary Fish Aquaculture 2+1 Cr.
Latest advances in world fish culture, application of natural and synthetic for stimulating fish reproduction, fish sexing, brood production, closed circuit systems, cage aquaculture, automated aquaculture.

3712702 Supplementary Aquaculture 2+1 Cr.
Latest advances in world aquaculture, application of natural and synthetic for stimulating shrimp reproduction, shrimp reproduction, shrimp feeding, mollusks culture, lobster culture, seaweed culture.

3712703 Live feed Production 1+1 Cr.
Food chains and photosynthesis, live food importance in aquaculture, algae culture, rotifer culture, chironomid culture, Artemia culture.

3712704 Hygiene Management in Aquaculture 1+1Cr.
Criteria for choosing water and soil for aquaculture, hygienic criteria in aquatic import and export, pond design, fishing vaccination, genetic manipulation, quarantine.

3712705 Aquaculture Management 2 Cr.
Principles of aquaculture management, fishery organizations, management of aquatic propagation centers, human resources management in aquaculture, coastal aquaculture management, rules and regulations of aquatic protection.

3712706 Advanced Hydrobiology 2+1 Cr.
producers, consumers, aquatic production, water biogenic capacity, water protection from pollution, water self-purification, sea food cycles, Caspian sea plant and animal communities, pond communities.

3712707- Genetics & Biotechnology of Aquatic Animals 1+1 Cr.
Biotechnology in aquaculture, aquatic genetic management, karyology and cytogenetic, chromosome banding, cell culture, electrophoresis in population studies, genetic manipulation, gynogenesis, polyploidy, sex change, PCR.

3712708 Fish physiology 2+1 Cr.
Physiology of respiration, circulation, osmosis, ion regulation, stress, migration, reproduction, feeding and sense organs in aquatic animals.

3712709 Aquatic Nutrition & Feeding 1+1 Cr.
Importance of feeding in aquaculture, comparative physiology of feeding organs, feeding requirements, food analysis, food consumption, food interactions, food additives, food mixtures.

3712710 Application of Computers in Fisheries 1 Cr.
Introduction to internet, electronic mail, database searching, analytical, graphical and word processing software, fishery sites, fishery software.

3716511 Research Methods 2 Cr.
Definitions, defining scope of research, research groups, experimental procedures in research, types of research, application of statistics in research, research quality control.

3712810 Physiology &Behavior of Aquatic Animals 3 Cr.
Factors affecting fish behavior, physiological basis of behavior, communational behavior, shoaliong behavior, reproductive behavior, foraging behavior, fish behavior in relation to gears, colors and camouflage in fish, sound production and behavior, photophores and their function.

3712820 Fish Ecology 2 Cr.
Limitations of body form, feeding ecology, fish bioenergetics, fish growth and population dynamics, fish life history and biodiversity, biological interactions.

3712840 Benthic Ecology 2 Cr.
Bottom structure, sampling methods, physical and chemical and biological factors affecting bottom structure, benthic animals and plants, bottom types, biodiversity of benthos, benthic communities, energetics of benthos.

3712845 Evaluation & Conservation of Iran Aquatic Ecosystems 2 Cr.
Definitions of aquatic ecosystems, types of aquatic ecosystems, ecotoxicology, aquatic ecosystems protection.

3712835 Plankton Ecology 1+1Cr.
Plankton distribution, seasonal fluctuations, sea planktonic communities, planktonic blooming, plankton cycles, energetics of planktons.

3712830 Aquatic Stock Assessment 2 Cr.
Bertalanfy growth parameters, relative abundance, capture per unit of effort, marking, mortality estimation, natural mortality and life span, cohort analysis.

3712825 Advanced Limnology 2 Cr.
Inland water structure, organisms of lakes and rivers, material cycles, food webs in inland waters, type of polluted waters, self-purification of waters.

3712860 Remote Sensing & its Applications in Fisheries 2 Cr.
RS systems, earth resources satellites, characteristics of satellite data, geometric errors, RS application in fisheries.

3712901 Seminar 1 Cr.
A seminar on the current topics in aquatic ecology & fisheries, aquaculture and related subjects.

9010606 Thesis 6 Cr.
Students are required to design a research project and report the results of their experiment to their supervisors as a Master's thesis.
Prerequisite: Consent of the supervisor.

Course Description for the Degree of M.Sc. in Environmental Sciences

3714613 Advanced environmental pollution 2 Cr.
Introduction, water and soil pollution, pollutants mobility and transport, modeling of pollutant transport.

3714615 Advanced Geographic Information Systems 2 Cr.
Understanding vector and raster models, Spatial raster Analyst basics: local, zonal and global functions, raster calculations, Developing a model for suitability analysis - Automating GIS procedures, Exploratory Spatial Data Analysis (ESDA), geodatabase topology, overlay & proximity concepts vector analysis and geoprocessing concepts. This course is designed to provide hands on experience using selected extensions to ESRI's ArcView.

3716526 Advanced Statistical Methods 3 Cr
Statistical models, Computation of confident limits, Correlation and two-variate linear regression, Matrices, linear multivariate regression, Non-linear regressions, Harmonic analysis, Profit analysis.

3712340 Animal Physiology 1+1 Cr.
Basic physiology of regulatory system and cellular organization, aspects of excretory, respiratory, circulatory and nerve system functioning, sensory organs, homeostasis, bioluminescence, color changes, nutrition, digestion and energy utilization.
Prerequisite: Zoology 37101

2118590 Chemical analysis methods of environmental samples 3 Cr.
Review of concentration and equilibrium, titration and weighting methods, electrochemical reactions, types of electrodes, potentiometry methods, and spectroscopy methods.

3714602 Complementary Wildlife Ecology 3 Cr.
This course provides an overview of the most important methodologies/techniques used by modern ecologists. The first part of the course focuses on the scientific method, designing experiments in ecological researches and choosing the appropriate statistical tests for analyzing the data collected in the field. The rest of the course concentrates on the practical aspects of the ecology such as estimating abundance, methods for measuring spatial pattern of organisms and methods for measuring diversity in an ecosystem.

3714605 Environmental Impacts Assessment 2 Cr.
Introduction, EIA in Iran and worldwide, EIA process and stages, screening and scoping criteria, impact identification & evaluation techniques: checklist, matrix, networks and overlay, predicting environmental impacts: prediction methods, criteria for selecting methods, examples of prediction techniques, mitigation and compensation measures, monitoring and evaluation, planning process and decision making.

3714429 Fundamentals of Molecular Ecology 2 Cr.
Concepts and history of molecular ecology, introduction to molecular genetic tools and their use in natural populations, Collection and storage of genetic samples, methods for studying genetic variation and overview of field and laboratory methods.

3714601 Industrial pollution 2+1 Cr.
Introduction on environmental pollution, pollution from chemical industry, iron and steel industry, petroleum industry, power generation, food industry etc., pollution prevention in industry, ISO 14000, LCA.

3714614 Land use planning 2 Cr.
Introduction (Human actions and natural processes, Limits of growth and basic concepts), history and theory of land use planning, conceptual framework for land use planning, land use goals and design, land suitability analysis and classification,land classification and field inventory methods, computerized land use, use of GIS as a Decision Support System (DSS).

3714612 Marine pollution 2 Cr.
Introduction on physical, chemical and biological properties of marine environments, source of marine pollution, oil pollution, heavy metal, PCBs, …effects of marine pollution, marine pollution control, international law on marine pollution.

3714611 Pollutants chemistry 2 Cr.
Air pollutants (NOx, CO, SOx, CFCs, heavy metals, smog,…), chemical oxidation, photo-degradation, water pollution, pesticides, PCBs, PAHs, agriculture pollution.

3716511 Research Methodology 2 Cr**.**
Research design and implementation, Introduction to quantitative and qualitative, Intermediate statistics and research design methods, Data gathering techniques.

2118595 Sample Preparation Methods and Chromatography 3 Cr.
Crliquid-liquid extraction, extraction by solid phase, extraction methods of organic and inorganic compounds, principles of chromatography, gas chromatography,

3714603 Solid Wastes and Recycling 2 Cr.
Generality, Waste production and classification, integrated waste management, biological and thermal treatment of waste, environmental and economic impacts of recycling, recycling of metal, paper, glass and plastic.

3714604 Wetland management and migratory birds 3 Cr.
The course includes wetland types and classification, structure of wetlands, wetland values and functions, threats to wetlands, wetland laws and regulations, migration and migratory birds, routes of migration and policy and regulatory issues related to migratory birds and their habitats, wetland restoration and rehabilitation.

3714606 Wildlife and Park management 3 Cr.
This course has been designed to provide guidance on the implementation of conservation techniques from assessing and monitoring biodiversity to the planning and management of protected areas. To put the theoretical knowledge of conservation biology into practice, the course provides technical information for identifying conservation problems, utilizing research methodology and suggesting analytical techniques that assist in resolving the problems.

Course Description for the Degree ofM.Sc. in Range Management& Combating Desertification:

3716517 Analysis of Rangeland Ecosystems3 Cr.
Analysis and discussion about energy flow, mineral cycling, primary and secondary production in range ecosystems. Theories about succession in range ecosystems.

3716514Phytosociology 2 Cr.
Phytosociology definition, application, history, Plant Community Ecology, Basic Problems and Methods in Phytosociology, Estimation of horizontal and vertical structure of rangelands, Methods of determining community's productivity, Analytical Methods in phytosociology, Vegetation ordinations and classification techniques.

3716532 Advanced Remote Sensing 1+1 Cr.
Advanced topics in remote sensing such as hyperspectral imagery (methods of analysis and interpretation), examinations of spectral libraries, mapping subpixel components with multi- and hyperspectral imagery, applications of hyperspectral imagery with the focus on rangelands and related topics, practical exercises using image processing softwares.
Analytical models.

3716511 Research Method2Cr.
Research design and implementation, Introduction to quantitative and qualitative, Intermediate statistics and research design methods, Data gathering techniques.

3716530 Soil, Water and Plant Interactions 2 Cr.
Water characteristics, Water quality for irrigation, water-soil relationship: Soil moisture and measuring methods, Forces in soil, Water potential in soil, Water movement in soil, Application of Darcy formula in saturated and unsaturated zones, Soil hydrodynamic coefficients, Water-plant relationship: Water role in plant, Different root systems in plant and their distribution in soil, Roots depth, Effective factors in water absorption by plant, Plant resistance in dry periods, Water-soil-plant relationship: Water-soil-plant-atmosphere system, Evapotranspiration of plant and effective factors, Computation of water requirement for plants, Required water for irrigation, Water production and consumption curve, Irrigation time determination.

3716531 Plant Ecophysiology 2 Cr.
Systems approach to the analysis of basic physiological and ecological responses of plants in arid environments, plant photosynthetic and respiration pathways, Assessing the response of plants to water and heat stress, Examining the water use efficiency of plants living in desert environments, Associating the physiological and developmental response of vegetation to defoliation and nutrient limitations.

3716513 Rangeland Hydrology 2 Cr.
Soil infiltration, percolation, rainfall interception loss, effects of grazing in Soil infiltration and runoff generation, effects of fair, plugging, chaining, freezing, pitting, ripping and furrowing in Soil infiltration and runoff generation, water harvesting in rangeland.

3716534 Industrial, Medicinal & Poisonous Plants 2 Cr.
Classification, ecological condition, agronomy, chemical components, utilization methods, application and management issues of Medicinal and Industrial Plants in rangeland ecosystems, Issues about poisonous plants with focus on Iranian rangelands and their effect on animal health condition.

3716536 Range ManagementSeminar 1 Cr.
Research seminars and instruction on research methods and tools, Short practice seminars, literature search, critique of papers, thesis manuscripts, the art of seminar presentation.

3716529Arid & Mountainous Regions Reclamation2 Cr.
Processes of desertification and techniques and methods available for desert and mountainous rehabilitation. Control of sand dunes, Farming Practices, Afforestation, Irrigation techniques.

3716515 Analysis of Range Assessment and Monitoring Methods 2 Cr.
Theories for Inventory and analysis of rangeland resources. Shortcomings and strengths of inventory and assessment methods in rangeland ecosystems.

3716526 Advanced Analytical methods 2Cr.
Statistical models, Computation of confident limits, Correlation and two-variate linear regression, matrices, Linear multivariate regression, Non-linear regressions, Harmonic analysis, Profit analysis.

3716516 Economical and Social Aspects of Watershed Basins 2 Cr.
The whole issues around the management and utilization of the resources within watersheds and focuses highly on the socio-economic factors. Skills in incorporating relevant social science, specifically economic, aspects in range management decisions, Discussion of the basic concepts such as peoples' perceptions about rangelands, human and ecosystem interactions, consumers and their wants, market and governments, time preference and intergenerational equity, and non-market valuation techniques.

3716513 Seed Technology of Rangeland Plant Species 2 Cr.
Principles and practices of production techniques, mechanical conditioning, storage, seed treatment, and testing of seeds used for planting

3716655 Geographic Information Systems 2 Cr.
The basic principles and terminology of geographic information systems (GIS), The GIS process, GIS application.

3716503 Quaternary Formations 2Cr.
Formation definition and concept, Iranian geological zones, geological formations of Iran prior to quaternary, quaternary phenomena in the world (such as climate change, glacial and interglacial periods, glacial sediments, losses, wind processes), quaternary stratigraphy, and quaternary phenomena in Iran.

3716535 Land Use Planning 2Cr.
Land use definition and principals, Goal development and formalization, planning intelligence and information systems, population and employment forecasting, land use forecasting, land suitability analysis, land use location requirements, land classification planning, land use design, plan implementation, and public presentation of land use plans.

3716540 **An Introduction to Modeling in Rangeland Ecosystems** 2 Cr.
Model definitions, features and types. The necessity of models in range management. History of model development and use in rangeland ecosystems, Steps to Build a Model, Test model behavior by Sensitivity and scenario analysis, Introduce some models currently in use in the rangelands and discuss their advantages and limitations.

Course Description for the Degree of M.Sc. in Combating Desertification

3716538 Desertification and Control Methods 2 Cr.
Desert and desertification concepts, desertification factors and processes, land degradation and its trend in different biomes, land degradation and its trend in Iran, combating desertification techniques (biological, chemical and physical), wind erosion and control techniques, natural vegetation condition of Iran in the past and present.

3716519 Advanced Remote Sensing 2 Cr.
Advanced topics in remote sensing such as hyperspectral imagery (methods of analysis and interpretation), examinations of spectral libraries, mapping subpixel components with multi- and hyperspectral imagery, applications of hyperspectral imagery with the focus on arid land degradation and related topics, practical exercises using image processing softwares.

3716502 Arid land hydrology 2 Cr.
Climatological and hydrological characteristics of arid land, arid land precipitation, arid land flood, probability and statistic in arid land hydrology, statistical distributions for flood frequency in arid land, drought and hydrological drought, low flow analysis, water quality, geostatistic in hydrology

3716505 Rehabilitation Methods and Planted Vegetation Management 2 Cr.
Arid zones characteristics, distributions and classification, Restoration approaches and planning, The specifications and typology of arid zones plants, Land utilization methods in arid areas, The effect of arid zone factors on vegetation, Natural and planted Saxaul woods in Iran, Sand dune fixation by Saxual and people cooperation, Saxaul utilization and management.

3716508 The Economic and Social Development in Desert Areas 2 Cr.
The Economical and Socio-Cultural development theories along with sustainable development. The principles and methods of exogenous development and endogenous development, the functions and roles of development processes in desertification, the efficient patterns to prevent the inappropriate change in climate and environment through development, Sustainable development in desert systems, Population and immigration, Socio-economic and physical factors imposed upon desert settlements, Physical development of desert communities.

3716511 Research Method 2 Cr.
A broad definition of the research activity in general, the techniques of data-gathering in experimental, social and action researches. The philosophy of science, along with sampling methods and different statistical analysis, Research design and implementation, Introduction to quantitative and qualitative, Intermediate statistics and research design methods.

3716506 Arid Land Ecosystems 2 Cr.
The importance, causes, types and features of deserts. Conceptual frameworks to understand the structure and function of desert systems, Plant and animal adaptation mechanisms in desert, Species diversity in deserts, interaction effects and feedbacks, how to manage desert ecosystem, Desertification, and the techniques for monitoring and quantifying it.

3716539 Wind Erosion and Control Methods 2 Cr.
Understand wind erosion processes in order to assess the risk of soil loss, Provide a scientific basis for choosing wind erosion control methods, what plant density and cover is needed for effective erosion control, What methods for plant establishment work best.

3716503 Quaternary Formations 2Cr.
Formation definition and concept, Iranian geological zones, geological formations of Iran prior to quaternary, quaternary phenomena in the world (such as climate change, glacial and interglacial periods, glacial sediments, losses, wind processes), quaternary stratigraphy, and quaternary phenomena in Iran.

3716537 Water Resources Management 2 Cr.
Hydrology and surface water resources,the hydrological cycle, climate systems; an introduction to rivers, flood plains and wetland environments, hydrometeorologic parameters and measurement; surface water quality, surface water ground water interactions; data gathering, monitoring programmes and data analysis.

3716527 Medicinal and Industrial Plants 2 Cr.
Introduce the most important medicinal and industrial plants in rangeland ecosystems. Introduction to chemical components, utilization methods, application and management issues of medicinal and industrial plants.

3716509 Arid land Climatology 2 Cr.
Arid lands of the world. Climatological and meteorological characteristics of arid land, causes of aridity, Radiation, atmospheric humidity, temperature, air pressure, wind and air circulation in arid land, evaporation and evapotranspiration in arid land, drought indices, drought and aridity, duration, intensity and frequency of drought.

3716507 Ecophysiology of Arid Land Plants 2 Cr.
Systems approach to the analysis of basic physiological and ecological responses of plants in arid environments, plant photosynthetic and respiration pathways, Assessing the response of plants to water and heat stress, Examining the water use efficiency of plants living in desert environments, Associating the physiological and developmental response of vegetation to defoliation and nutrient limitations.

3716901 Seminar 1 Cr.
Research seminars and instruction on research methods and tools, Short practice seminars, literature search, critique of papers, thesis manuscripts, and the art of seminar presentation.

3716550 Desert, Resources and Potentials 2 Cr.
Water Resources in the Desert, Primary and Secondary Productivity in Desert Ecosystems, Use of Marginal Soils and Water Resources in Desert Areas, Ecotourism potential of deserts, Mines and deserts, Energy from the deserts.

3716521 **Saline and Alkaline Soils and improvement Methods** 2Cr.
Reclamation Methods of Salt, affected and alkaline Soils, Irrigation water and its suitability for utilization their relations to the formation of salt affected and alkaline Soils, Irrigation efficiency, Soil water movement, basic soil-water-plant relationships. Utilization management of saline soil, Soil desertification, its reasons and resistance.

3716528 **Flood Control** 2 Cr.
Strategies for integrated river basin management with special emphasis on flood control, Using rainwater to grow sustainable communities: Sustainable storm water best management practices

3716655 Geographic Information Systems 2 Cr.
The basic principles and terminology of geographic information systems (GIS), The GIS process, GIS application.

PhD Program in Range Sciences

Introduction and goal
PhD covers both educational and research activities in which the most recent findings of the field are included. The main goal of this program is to educate highly qualified experts by employing the most recent scientific methods and findings in the field in order to fulfill the scientific recruitments of the country in educational, research and planning affairs.

Length and details of the program
The PhD program covers a 4 year period including educational and research phases which ends with writing up the dissertation. The educational phase is 2 years which includes 4 semesters, each 16 weeks. The educational system is credit based and covers 16 hours of lecture for each credit point in each semester.

Number of credit points
PhD program in Range Sciences includes 36 credits as follows:
Core courses: 30 credit points
Optional courses: 6 credit points
Dissertation: 24 credit points

Course Description for Ph.D. Degree in Range Sciences

3716802 **Ecological topics** 2 Cr.
Ecology and other sciences, different majors in ecology, an overview of different ecosystems (i.e. humid, semi-arid, arid and desert ecosystems), effects of abiotic factors (i.e. light, climate, wind) on growth and regeneration of range plant species, importance of water for vegetation, plant water resistance, modeling and drought prediction in rangeland ecosystems, climate change and sustainable rangeland management, human interface and vegetation, plant life forms in arid and desert areas, classification of plant species based on soil properties, ecological requirement of main range plant species (autecology).

3716804 **Biological erosion control** 2 Cr.
An overview of Iranian ecological zones; water and wind erosion mechanisms; basics, goals and methods of biological approaches to control wind and water erosion; Landslide, rill and Gully control, kinds of live wind break, wind break calculation.

3716800 **Quantitative plant ecology** 2 Cr.
Applications of quantitative, analytical techniques used to describe and assess range plant communities, vegetation description (Abundance, Frequency, Cover,…),sampling methods (Random, Systematic, Stratified,…), vegetation distribution patterns (spatial pattern, normal and negative distributions), species association (X^2 test), vegetation analysis (Qualitative methods, Community classification, Braun- Blanquet method, gradient analysis, ordination methods (Polar ordination, PCA, DCA, CCA)
Practical remarks: Case studies

3716807 **Range animal nutrition** 2 Cr.
The balance between forage and livestock feeding requirements, forage quality (concept, measuring methods and index), determining livestock daily nutrition requirements, based on environmental characteristics, forage quality and livestock physiological condition, feeding behavior of livestock, and utilization of rangeland.
Experimental section: Experimentation in measurement of nutrient requirements and analysis of the range animal nutritional aspects.

3716540 **Modeling in rangeland ecosystems** 2 Cr.
Principles of modeling; definition and functions of models; modeling approaches; application of Decision Support Systems (DSS) in rangeland ecosystems; model components; advantage and disadvantages of models; model feedback; modeling calibrations; model evaluations; sensitivity analysis approaches; ecological models; habitat models; data models; statistical models (parametric and non parametric approaches); Bayesian belief network modeling; practical work: case studies

3716806 **Living organisms and rangeland ecosystems** 2 Cr.
Diversity, distribution and the role of living organisms (human, plant, free-ranging mammals, birds, livestock,….) in rangeland ecosystems, immigration in plant and animal species, adaptation and distinction in plant and animal species and related classifications, fundamental of bio-geo chemical cycling in rangeland ecosystems, individual, species and population in rangeland ecosystems, population energy flow, interaction between species, living organism as an open system, theoretical and practical conservation, estimation of animal population size.

3716806 **The Economics of rangelands** 2 Cr.
The economical aspects and preferences of the rangelands in Iran, comparison of the objectives of the herders in Iran and other countries, concepts of carrying out capacity and production functions, full-cost pricing and externality costs, logistic growth curves and their applications, productivity indicators and indices, technical and economical efficiency in pastoral management, planning for sustainable pastoral management.

3716803 **Sustainable development and natural Resources** 2 Cr.
History, concepts, economical systems and their relation with sustainable development, sustainable and socioeconomic development in developed and developing countries, traditional systems, economical principles, resourcedistribution, poverty and sustainable development, needed information to design a sustainable system, evaluating criteria, integrated plans, and future strategies

3716808 **New theories in range science** 2 Cr.

Challenges to rangeland science, including trends in ecology and evolution of rangeland management; range ecosystem functions; uncertainty and sustainability in the management of rangelands, rangeland dynamics and different paradigms; limitations of using scientific tools in rangeland ecosystems and introducing adaptive management and participatory approaches; holistic approach to range ecosystem management.

3716809 **Seminar** 2 Cr.

According to supervisors' guidance, a research project will be performed. It should be approved by the Educational Division Council and the Graduate Office. The results will be announced in the presence of the Educational Division members.

1310088 **Operations Research** 2 Cr.

Definitions and concepts, the application of operations research in natural resources, assignment model, queuing models, linear programming, simplex method, dual simplex method, transportation problems, allocation problems, dynamic programming (deterministic/probabilistic), optimization, sensitivity analysis