
	Department of Animal Husbandry and Dairy Science Mahatma Phule Krishi Vidyapeeth Rahuri-413 722, Dist. Ahmednagar (MS)	
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Doctoral Programme in Animal Husbandry

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit(s)
1.	Major	18
2.	Minor	08
3.	Supporting	06
4.	Seminar	02
5.	Research	45
	Total Credits	79
	Compulsory Non Credit Courses	06

Sr. No.	Course Number	Course Title	Credits
A) Major subjects (Min. 18 credits)			
1	AH – 601	Advances in Livestock Production and Management	3 = 2 + 1
2	AH – 602	Advances in Selection Methodology	2 = 1 + 1
3	AH – 603	Modern Concepts of Feeding Ruminants and Forage Utilization	3 = 2 + 1
4	AH-604	Recent Trends in Animal Breeding	2 = 2 + 0
5	AH-605	Nutrition and Rumen Fermentation	2 = 1 + 1
6	AH-606	Advances in Poultry Production	3 = 2 + 1
7	AH- 611	Advances in Sheep and Goat Production	3 = 2+1
B) Minor Subjects (Min. 08 credits)			
1	AH- 607	New feed Resources and Toxicants in Animal Feeding	2 = 2 + 0
2	AH – 608	Utilization of Non-additive Genetic Variance in Farm Animals	2 = 1 + 1

3	AH - 609	Production of Organic Livestock Products	2 = 1 + 1
4	AH - 610	Advances in Quality Control of Livestock Products	2 = 2 + 0
C) Supporting Subjects (Min. 06 credits)			
1	DSC-601	Advances in Milk and Milk Product Technology	3 = 2+1
2	STAT-601 OR STAT-604	Advanced Statistical Methods OR Genetical Statistics	3= 2+1 /1+2
3			
D) Seminar (02 credits)			
1	AH - 691	Doctoral Seminar –I	1=0+1
2	AH-692	Doctoral Seminar –II	1=0+1
E) Doctoral Research (45 credits)			
1	Thesis- 699	Doctoral Research	45=0+45
F) Non Credit Compulsory Courses			
1	PGS-501	Library and Information Services	1=0+1
2	PGS-504	Basic Concepts in Laboratory Techniques	1=0+1
3	PGS-502	Technical Writing and Communication Skills	1=0+1
4	PGS-503	Intellectual Property and its Management In Agriculture	1=0+1
5	PGS-505(ecourse)	Agriculture Research, Research Ethics and Rural Development Programmes	1 = 1 + 0
6	PGS-506(e course)	Disaster Management	1 = 1 + 0

Course Contents

A) Major Subjects:

Course No. AH 601

Course Title: Advances in Livestock Production and Management

Course Credit: 2+1 = 3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Present status of dairy farming in India,	1	3
2	Global scenario and reasons for the same	1	3
3	Avenues for progress.	1	3
4	Advances in housing management of dairy cattle in various agro climatic zones of India	2	7
5	Advances in housing management of buffaloes in various agro climatic zones of India	1	3
6	Advances in housing management of sheep in various agro climatic zones of India	2	7
7	Advances in housing management of goat in various agro climatic zones of India	1	3
8	Management systems for cattle,	1	3
9	Management systems for buffaloes	1	3
10	Management systems for sheep	1	3
11	Management systems for goat.	1	3
12	Establishing Dairy Cattle Enterprise,	1	3
13	Characteristics of a successful dairy farm	1	3
14	Choice of the foundation stock.	1	3
15	Breeding Management	1	3
16	Problems associated with reproduction	1	3
17	Advances in Feeding Management of cattle in different stages	1	3
18	Advances in Feeding Management of buffalo in different stages	1	3
19	Advances in Feeding Management of sheep in different stages	1	3
20	Advances in Feeding Management of goat in different stages.	1	3
21	Management of high yielding animals.	1	3
22	Recent development in sheep and goat management and their relevance under Indian conditions,	2	7

23	Role of sheep husbandry in dry farming in India.	1	3
24	Present development programmes in sheep and goat production,	2	7
25	Advances in reproduction,	2	6
26	Metabolic disorders of high yielder	1	3
27	Advances in preventive measures for production related diseases.	1	3

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Advances in different farm structures on livestock farm	4	25
2	Atomization in feeding, milking and sanitation,	2	12
3	Least cost feed formulation,	4	25
4	Energy recycling through dairy farm waste	2	13
5	Computer application in dairy farm management	2	12
6	Visit to modern livestock farms	2	13

Suggested Readings:

Clarence HE. 2007. Dairy Cattle & Milk Production. Daya Publ. House.

Gupta JL 2006. Sheep Production and Mangement. CBS.

Thomas CK & Sastry NSR. 1991. Dairy Bovine Production. Kalyani.

Course No. AH 602
Course Title: Advances in Selection Methodology
Course Credit: 1+1 = 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Fundamental theorem of natural selection	1	6
2	Selection in infinite populations and estimation of its effect on genetic structure and variance.	1	6
3	Optimum designs for genetic parameters.	1	6
4	Designing of selection experiments for testing selection theory.	1	6
5	Methods of measurement of genetic and environmental trends.	1	6
6	Advances in selection indices, Multistage, restricted and retrospective selection indices.	1	7
7	Multi-information, empirical evaluation of	1	7

	selection theory		
8	Genetic slippage	1	6
9	Limits to selection, asymmetry of response	1	6
10	Selection experiments, effect of selection on variance.	1	7
11	Selection for threshold traits, single and multiple trait,	1	6
12	Best liner unbiased estimation (BLUE) and prediction (BLUP)	1	6
13	Selection under single and multiple trait animal models	1	7
14	Direct and correlated response through various selection indices,	1	6
15	Relationship between BLUP and selection index,	1	6
16	Fundamentals of marker assisted selections.	1	6

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Estimation of relative economic values	4	25
2	Determination of culling levels and selection intensity	4	25
3	Construction of various indices	4	25
4	Estimation of direct and correlated response	2	12
5	QTL analysis using LDMAS & LEMAS.	2	13

Suggested Readings:

Selected articles from journals

<p align="center">Course No. AH 603 Course Title: Modern Concepts of Feeding Ruminants and Forage Utilization Course Credit: 2+1 = 3</p>

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Developments in ruminant digestive physiology	2	6
2	Energy protein requirement and measurement	2	6
3	Requirements of other nutrients	2	6
4	Importance of energy and protein quantity and quality	3	10
5	Feed input and milk output relationship.	1	3
6	Concept of limiting amino acids for high yielder.	1	3
7	Strategic feeding of high yielding dairy cows and meat producing ruminants.	2	7

8	Concepts of Phase feeding.	1	3
9	Bypass Nutrient technology.	1	3
10	Feeding during stress.	1	3
11	Nutrition-immunity interaction	1	3
12	Designer milk and meat.	1	3
13	Rumen manipulation to reduce methanogenesis.	2	7
14	Nitrogen oxide emission and heavy metal residues.	1	3
15	Metabolic profile tests.	1	3
16	Use of conserved forages in ruminant feeding.	1	3
17	Chemical composition of common and newer forage	1	3
18	Factors affecting nutritive value of commonly available grasses, pastures, silage, hay and crop residues,	2	7
19	Voluntary intake of fodder at different stages of growth.	1	3
20	Newer methods of forage evaluation – calculated <i>in vitro</i> ME and DOMD by using prediction equations.	1	3
21	Merits and demerits of using leaf protein	1	3
22	Top feeds and their effective utilization	1	3
23	pasture consumption and evaluation studies.	1	3
24	Seminars on current topics of special interest.	1	3

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Determination of volatile fatty acids,	1	6
2	<i>in vitro</i> estimation of ME and DOMD by using prediction equations.	2	13
3	Estimation of energy and protein requirement for high yielding dairy cows and meat producing ruminants.	5	32
4	Estimation of protein quality,	2	12
5	Rumen manipulation to reduce methanogenesis,	2	12
6	Evaluation of nutrients from pasture.	4	25

Suggested Readings:

Selected articles from journals

Course No. AH 604

Course Title: Recent Trends in Animal Breeding

Course Credit: 2+0 = 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application,	6	19
2	Use of programmes in the field of animal breeding.	4	12
3	Formulation of detailed breeding plans.	4	12
4	Ongoing breed improvement programmes of various livestock species	8	25
5	Impact analysis of ongoing breed improvement programmes in various species of livestock under different situations.	4	13
6	Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.	6	19

Suggested Readings:

Selected articles from journals.

Course No. AH 605

Course Title: Nutrition and Rumen Fermentation

Course Credit: 1+1 = 2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Nutrient requirements for fertility and gestation,	2	12
2	Nutrient requirements for prenatal growth and foetal nutrition.	2	13
3	Post-natal feeding, growth and developments	2	12
4	Body composition at prenatal and postnatal stages,	2	13
5	Abnormalities due to malnutrition.	2	13
6	Rumen microflora and microfauna – considerations and limitations in relation to ruminant feeding practices.	2	12
7	Manipulation of rumen fermentation – physical, chemical and biological means	2	13
8	Role of sulphur and phosphorus in rumen fermentation	1	6
9	Modeling ruminant digestion and metabolism – principles	1	6

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Microbial and protozoal count,	4	25
2	Determination of TVFA by chromatography	4	25
3	Estimation of ammonia in rumen liquor,	2	13
4	Study on protection of protein in relation to degradability,	2	12
5	Rumen fermentation products	1	6
6	Artificial rumen techniques.	1	6
7	Rumen enzyme assay	2	13

Suggested Readings:

Selected articles from journals.

Course No. AH 606
Course Title: Advances in Poultry Production
Course Credit: 3:2+1

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Present poultry scenario in India and abroad,	1	3
2	Strategies for improving sustainable poultry production and commercial poultry production in India.	3	10
3	Planning, execution and management of commercial poultry farms of various sizes.	2	6
4	Planning, execution and management of hatcheries of various sizes.	2	6
5	Problems and new management techniques in chicken production in India and other countries of the world	2	7
6	Problems and new management techniques in turkey production in India and other countries of the world	2	6
7	Problems and new management techniques in ducks production in India and other countries of the world	2	7
8	Problems and new management techniques in quails and guinea fowl production in India and other countries of the world.	2	6
9	Recent advances in layer and broiler feeding	2	6

	management.		
10	Recent Advances in housing management of chicken	2	6
11	Recent Advances in housing management of duck	2	7
12	Recent Advances in housing management of turkey and guinea fowl.	2	6
13	Poultry diseases management	2	6
14	Marketing of poultry products.	2	6
15	Automation in poultry industry.	2	6
16	Pollution problems from commercial poultry farms and their preventive measures.	2	6

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Case studies of commercial layer farms.	1	6
2	Case studies of commercial broiler farms.	1	6
3	Case studies of commercial duck farms.	1	6
4	Case studies of commercial turkey farms.	1	6
5	Case studies of commercial quail and guinea fowl farms.	1	6
6	Equipment used in processing of broilers.	2	12
7	Grading of eggs.	2	13
8	Case study of broiler market.	1	6
9	Case study of eggs market.	2	13
10	Visit to modern broiler processing unit.	2	13
11	Visit to modern hatchery unit.	2	13

Suggested Readings:

1. Poultry production By Mahapatra.
2. Poultry production By B.Panda & Mahapatra.
3. Indian farming special issue, Sept. 1996 (20th world poultry congress- New Delhi.)
4. Commercial chicken production Manual By Mack O. North.
5. Poultry production By L. E. Card. & M. C. Nesheim.

Course No. AH 611
Course Title: Advances in Sheep and Goat Production
Course Credit: 2+1=3

Theory:

Sr. No.	Topic	No. Lectures required	Weightsage (%)
1	Introduction, population structure and importance	2	6
2	Unexplored sheep and goat breeds	2	6
3	Advantages and disadvantages of sheep and goat farming	2	6
4	Systems of management under different climatic conditions	2	6
5	Stationary and migratory flock systems	2	6
6	Newer techniques in housing and equipments	2	6
7	Advances in breeding management viz., oestrus synchronization, MOET, ONBS, Cloning, marker assisted selection, QTL etc.	4	14
8	New methods of detection of heat	1	3
9	Range management	1	3
10	Stocking rate and pasture improvement and utilization	3	10
11	Management under stall fed conditions	1	3
12	Disease Management	1	3
13	ITK in sheep and goat production	2	6
14	Avoidance of goaty odour in milk	1	3
15	Value added wool products	2	6
16	Planning of sheep and goat farm of various sizes	2	7
17	Economics of sheep and goat farming	2	6

Practical:

Sr. No.	Topic	No. Lectures required	Weightsage (%)
1	Critical analysis of various managerial practices under different conditions	2	7
2	ITK's in disease control	2	6
3	Disease forecasting on the basis of database	2	6
4	Oestrus synchronization	1	3
5	Pregnancy diagnosis	1	3
6	Methods of identification of sheep and goat	2	6
7	Rearing of sheep and goats for special purpose	2	7
8	Vistas in sheep and goat nutrition	1	3
9	Housing plans for various age and categories of sheep and goat	3	11

Suggested Readings:

Devendra C & Mecleroy GB. 1982. Goat and Sheep Production in Tropics. Longman.

Gupta JL. 2006. Sheep Production and Management. BS Publ.

ICAR. 2002. Handbook of Animal Husbandry 3rd Ed. ICAR.

Kaushish 1994. Sheep Production in the Tropics and Sub Tropics. Scientific Publ.

B) Minor Subjects

Course No. AH 607

Course Title: New Feed Resources and Toxicants in Animal Feeding

Course Credit: 2+0=2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Demand and availability of feed	1	3
2	Formulation of database in compute	1	3
3	Strategy in animal feed production,	1	3
4	Agricultural by – products and their feeding value in animals.	2	6
5	Agro industrial by – products and their feeding value in animals.	2	6
6	Farm waste and their feeding value in animals.	1	3
7	Crop residues and their feeding value in animals.	2	6
8	Organic wastes of animal origin and their feeding value in animals.	2	7
9	Slaughter house waste and their feeding value in animals.	2	6
10	Industrial waste and their feeding value in animals.	2	7
11	Processing to enhance feed utilization and availability.	1	3
12	Possible health hazards due to waste utilization	1	3
13	Chemical and nutritional changes in waste product due to processing.	2	7
14	Quality standard and their acceptance.	1	3
15	Food and feed contaminants – their impact on animal performance.	2	7

16	Naturally occurring toxicants – Toxicants of plants and non-microbial origin.	2	6
17	Mycotoxins and their toxicity.	1	3
18	Acquired toxicants, pesticides, weedicides and heavy metals.	2	6
19	Effect of toxins on rumen fermentation and nutrient utilization.	2	6
20	Methods of detection of toxins	1	3
21	Detoxification of toxins.	1	3

Suggested Readings:

Selected articles from journals.

Course No. AH 608
Course Title: Utilization of Non-Additive Genetic Variance in Farm Animals
Course Credit: 1+1=2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Heterosis: Forms and genetic basis;	1	6
2	Detection and estimation of non-additive genetic variance: average dominance and over dominance.	2	13
3	Partitioning of between cross variance: General combining ability, specific combining ability and reciprocal effects.	2	13
4	Methods of analyzing diallel crosses.	2	13
5	Utilization of non-additive genetic variance.	1	6
6	Crossbreeding systems: crossbreeding effects.	1	6
7	Recurrent selection and their forms	2	13
8	Reciprocal recurrent selection and their forms.	1	6
9	Development of specialized sire and dam lines.	2	12
10	Development of inbred lines and their maintenance	1	6
11	Inbreeding and hybridization.	1	6

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Computation of degree of dominance using NC Plans;	2	12
2	Analysis of partial and complete diallel cross data;	4	26
3	Estimation of crossbreeding effects;	2	13
4	Estimation of genetic correlation among paternal	2	12

	purebred		
5	Estimation of genetic correlation among crossbred half sibs;	2	13
6	Estimation of genetic correlation among crossbred half sibs;	2	12
7	Computation of response through RRS.	2	12

Suggested Readings

Selected articles from journals.

Course No. AH 609
Course Title: Production of Organic Livestock Products Teaching Schedule
Course Credit: 1+1=2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Definition, Concepts of organic livestock farming,	1	6
2	Present scenario of organic livestock production in India and abroad	2	13
3	Importance and scope of organic livestock production in India,	1	6
4	Limitations in implications organic livestock production,	1	6
5	Requirements for organic livestock farming, Breeds and breeding, Animal Nutrition, Health care, Transport and slaughter,	2	13
6	Socio-economic impact of organic livestock farming,	1	6
7	Marketing and export potential – inspection, certification, labeling, evaluation, accreditation, Record keeping,	2	13
8	Steps to promote organic animal husbandry in India,	1	6
9	Legal aspects–Registration, National programme and standards for organic animal husbandry,	2	13
10	Organic fodder production,	1	6
11	Characteristics of organic livestock products,	1	6
12	Economics of production of organic livestock products.	1	6

Practical:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Comparative evaluation of organic and existing livestock products,	2	12
2	Organic fodder production,	2	13
3	Organic livestock management,	2	12
4	Feeding of livestock for organic products,	2	13
5	Development of database for establishment of standards for organic animal products,	1	6
6	Health care of livestock,	1	6
7	Marketing and export of organic livestock products,	2	13
8	Cost of production of organic livestock and their products.	2	12
9	Case study of organic dairy farm.	2	13

Suggesting Readings

Banerjee, A. 2001. The organic dairy and food industry paradigm shift. Indian Dairyman 53(12): 31-33

Brandl, M. 2000. general consumer altitudes to milk organic dairy products. IDF Seminar, Athens, Greece, September, 1999. Bull.Int. Dairy Fed.. 347:16-18

Chander, M. 2001. Organic milk in India: Looking Beyond tomorrow. Indian Dairyman. 53 (12): 35-39

Hirsberg, N. 2000. US. Organic dairy: the processors perspective. Organic dairy products IDF seminar. Athens, Greece, September, 1999. Bull. Int. Dairy Feed. 347:12-15

Janet, J. P. 2000. retailing of organic dairy products. Int. DAIRY Red. Bull. 347:8-11

Lapisse, S. 1997. Organic agriculture. Cornerde-in nature. 1997. 164: 32-35

Markhals, Mandals and Kanawji, S. K. 2004. Organic milk in India: somnambulism or a New Pragmatic Vision. Indian Food Industry23(3): 32-41

Ponnusamy, K. and Shanmugan, M. 2004. Problems and prospects of production of organic dairy products in India. Indian Food Industry. 23(3): 41-44

Sen, D. C. and Bag, S. K. 2003. Organic milk: An Emerging Area of Food Science, Beverage and Food word, August, 2003. PP. 47-48

The Indian Express. 2004. Organic gathers critical mass. Chandigarh Edition, 6th February, P.11.

Course No. AH 610
Course Title: Advances in Quality Control of Livestock Products
Course Credit: 2+0=2

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (%)
1	Recent advances in quality control in dairy and meat industry with special reference to Total Quality management,	4	13
2	HACCP	1	3
3	Good manufacturing practices for manufacturing of quality and safe livestock products.	1	3
4	PFA and BIS standards, international standards organization (ISO 9000),	2	6
5	Product quality certification	1	3
6	International standards for milk powders	1	3
7	American Dairy Products Institute (ADPI) standards.	1	3
8	Rheology of milk products	1	3
9	Preservatives	1	3
10	Antioxidants, antibiotics and pesticides residue in milk	1	3
11	Advances in bacteriological and physico-chemical analysis of milk and milk products.	2	7
12	Importance of quality assurance of livestock products for domestic and export trade	2	7
13	Quality standards for meat	2	6
14	Effect of processing on nutritional and chemical qualities of meat products,	2	6
15	Sensory evaluation of meat products	2	6
16	Physicochemical and microbiological quality assessment and standards	2	6
17	Meat hygiene regulations in relation to slaughter houses and processing plants	2	7
18	International regulations	1	3
19	State, Municipal and other regulations pertaining to meat trade	1	3
20	Meat Food Products Order	1	3
21	Codex alimentarius commission.\	1	3

Suggested Readings:

Selected articles from journals.

C) Supporting Subjects

Course No. DSC 601

Course Title: Advances in Milk and Milk Product Technology

Course Credits: 2+1=3

Theory:

Sr. No.	Name of Topic	No. of Lectures	Weightage (Marks)
1	Globalization: Meaning, mode of action, functioning, draft guidelines	2	6
2	Initiatives from Indian context, private, public sector	2	6
3	Enforcement of rules / regulations in general and dairy sector in particular	2	6
4	Requirements to become a global member in relation to Indian dairy sector	1	3
5	SWOT analysis of Indian dairy industry in globalization context	2	6
6	Scope for India to become a global leader in dairy sector	2	6
7	Impact of globalization on Indian dairy sector present scenario and future perspectives	2	6
8	Genesis of milk grid and benefits to producers and consumers	2	7
9	Role of various organizations in milk grid Functioning and impact of milk grid on dairy industry	2	6
10	Principles and practices of hygienic handling of milk- on farm, storage, transport, processing, after process storage and marketing	1	3
11	Role of end user in hygienic handling of finished milk and milk products	2	6
12	Advanced techniques in handling of milk and milk products	1	3
13	Advancements in cream separation	4	13
14	Review of innovative technique in hygienic milk	1	3
15	Innovative techniques in dairy product manufacturing- evaporated, concentrated, heat-acid coagulated, fermented, frozen	3	10
16	Review in development of newer dairy products	3	10

Practical:

Sr. No.	Title of Practical	No. of Practical	Weightage (Marks)
1	Various innovative techniques and its applications in dairy product manufacturing and quality assessment	12	75
2	Manufacture of new dairy products	4	25

Suggested Readings:

1. Sukumar De (2006) Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.
2. Henderson, J.L. (1971) Fluid milk industry. The AV Publ. Co. Inc. Westport Connecticut.
3. Robinson, R.K. (1986) Modern Dairy Technology Vol. 1. Elsevier Applied Science, London.
4. Harper W.J. and Hall C.W. (1981) Dairy Technology and Engineering.
5. Aneja R.P., Mathur, B.N; Chandan R.C. and Banerjee A.K. (2002) Technology of Indian Milk Product.
6. Dilip Shah (1987) Milk Pricing and Marketing practices, Maricheemalee Prakashan, Surat
7. Selected articles from journals

2	STAT-601 OR STAT-604	Advanced Statistical Methods OR Genetical Statistics	3= 2+1 /1+2
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D) Seminar

1	AH - 691	Doctoral Seminar –I	1=0+1
2	AH-692	Doctoral Seminar –II	1=0+1

E) Doctoral Research

1	Thesis- 699	Doctoral Research	45=0+45
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F) Compulsory Non Credit Courses

1	PGS-501	Library and Information Services	1=0+1
2	PGS-504	Basic Concepts in Laboratory Techniques	1=0+1
3	PGS-502	Technical Writing and Communication Skills	1=0+1
4	PGS-503	Intellectual Property and its Management in Agriculture	1=0+1
5	PGS-505(ecourse)	Agriculture Research, Research Ethics and Rural Development Programmes	1 = 1 + 0
6	PGS-506(e course)	Disaster Management	1 = 1 + 0

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