THE AMERICAN COLLEGE, MADURAI
(An Autonomous Institution affiliated to Madurai Kamaraj University)
POSTGRADUATE & RESEARCH DEPARTMENT OF ZOOLOGY

PROGRAMME FOR M. Phil. ZOOLOGY (2019-2020 onwards)

Mission statement: The M. Phil. program is focused to equip students with skills to understand and appreciate Zoology. It is also aimed at helping the student to realize the importance of research work, develop skills to interpret and present results pertaining to research.

SEM	S. No.	Course code	Course Title	Hours	Credits	Max marks
I	1	MPZ 6621	Research Methods	4	6	120
I	2	MPZ 6623	Biological techniques	4	6	120
Project paper						
I	3	MPZ 6625	Environmental Science & Biotechnology	4	6	120
I	4	MPZ 6627	Immunology			
I	5	MPZ 6629	Insect Diversity			
I	6	MPZ 6631	Applied Microbiology			
I	7	MPZ 6633	Probiotics			
I	8	MPZ 6671	Research Project-I	18	6	**
			Total	30	22	360
II	9	MPZ 6672	Research Project-II	30	6	240
			Grand Total	60	28	600

**Valued continuously till the end of Second Semester

M.Phil. Zoology

PROGRAMME SPECIFIC OUTCOMES

Upon completion of this Programme, thescholars will be able to:

1. Utilize biological techniques which can be applied in Zoological research.
2. Design and solve a research problem in any of the disciplines in Zoology.
3. Contribute to the accumulation of knowledge and information relevant to Zoology.
4. Analyze the concepts and developments in Zoology with an aptitude for continued self-directed learning.
5. Perform experiments, collect data related to animals and document them as a thesis and imbibe skills of communication and problem solving.
6. Use literature relevant to Zoological research using different sources and relate information relevant to their field of research.
7. Assess the principles, working methods and applications of equipments used in Biology research.
8. Compute and analyze data statistically using packages.
9. Create new concepts and publish their findings in conferences and journals which may be of use to the scientific society.
10. Assess the developments across the disciplines of Zoology.

Mapping of Courses with Programme Specific Outcomes (PSOs)

Course Code	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
MPZ 6621	✓						✓	✓	✓	✓
MPZ 6623	✓			✓			✓	✓	✓	✓
MPZ 6625	✓	✓	✓			✓	✓	✓	✓	✓
MPZ 6627	✓	✓	✓	✓	✓	✓	✓		✓	✓
MPZ 6629	✓	✓	✓	✓	✓	✓	✓	✓		✓
MPZ 6631	✓	✓	✓	✓	✓	✓	✓		✓	✓
MPZ 6633	✓	✓	✓	✓	✓	✓	✓			✓
MPZ 6671	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MPZ 6672	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Mapping of Programme Specific Outcomes (PSOs) with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PSO1	✓	✓	✓	✓		✓		✓	✓	✓
PSO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSO3	✓	✓		✓	✓	✓	✓		✓	✓
PSO4	✓	✓	✓	✓	✓		✓		✓	✓
PSO5	✓	✓	✓	✓	✓	✓				✓
PSO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSO7	✓	✓		✓		✓	✓	✓	✓	✓
PSO8	✓			✓	✓	✓		✓	✓	✓
PSO9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSO10	✓	✓	✓	✓		✓	✓	✓	✓	✓

MPZ 6621 Research Methods (4hrs/wk) (6cr)

This course gives an overall view on the techniques in modern biology. It gives a comprehensive understanding of the methodology involved in biochemical, radiolabelling, biophysical, immunotechniques and statistical methods.

Course Outcomes

Upon completion of this course, students will be able to:

i. Compare and analyze the various biophysical methods.
ii. Assess the principle and methodology in biochemical methods.
iii. Explain the importance and applications of radiolabelling techniques.
iv. Rate the applications of immunotechniques in the field of biology.
v. Compute biological data using statistical methods.

I. Biophysical methods: pH metry & colorimetry, ultra and density gradient centrifugation, UV/ visible spectrophotometer, IR, mass spectroscopy, UV/visible fluorescence, NMR & ESR , ICP, AAS, X-ray diffraction, flame photometer.

II. Biochemical methods: Quantification of carbohydrates, proteins, amino acids, and lipids. Pharmacological testing – Paper, TLC, column, ion exchange, affinity chromatography, GC-MS and HPLC.

III. Radiolabelling techniques: Radiation dosimetry, radioactive isotopes, autoradiography, GM & scintillation counter, molecular image of radioactive material - safety guidelines.

IV. Immunotechniques: Antibody generation, ELISA, RIA, immunopreciptation,immunodiffusion, immunoelectrophoresis. Flow cytometry, immunofluorescence microscopy, immunoblotting, FISH, GISH.

V. Statistical methods: Sampling, data collection, measures of central tendency & dispersion, probability, Binomial, Poisson and Normal distributions. Regression & correlation, ANOVA, t-test, Chi-square test- confidence levels, errors and levels of significance.

References

Own JA, Puntt J and Starnford S (2013) Kuby Immunology. 7th Edition, Freeman Company, New York

Sheehan C (1999) Clinical Immunology. 2nd Edition, Lippincott Raven Publications, Philadelphia.

Srivatsava SC and Srivatsava S (2003) Fundamental Statistics, Anmol Publications. New Delhi

Upadhyay A, Upadhyay K and Nath N (1998) Biophysical Chemistry Principles & Techniques. 2nd Edition, Himalaya Publishing house, New Delhi.

Wilson K and Walker J (1994) Principles and Techniques of Biochemistry & Molecular Biology. 7th Edition Cambridge University Press, London.

Zar JH (2006) Biostatistical Analysis, 4th Edition, Pearson Education, New Delhi.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1				4		
CO2					5	
CO3			3			
CO4					5	
CO5			3			

Mean = 4

MPZ 6623Biological Techniques (4hrs/wk) (6cr)

This course gives an overall view on the techniques in modern biology. It gives a comprehensive understanding of the methodology involved in microscopy, molecular & rDNA methods, field biology and statistical methods.

Course Outcomes

Upon completion of this course, students will be able to:

i. Identify the techniques used in Microscopy.
ii. Evaluate the role of molecular techniques in various areas of research.
iii. Discuss the techniques and intricacies involved in rDNA methods.
iv. Explain and evaluate field biology methods.
v. Analyze biological data using bioinformatics tools.

I. **Microscopy:** Fixation and staining. Resolving power, Light microscope, phase contrast microscope, SEM, TEM, STEM, AFM, freeze fracture methods, image processing methods, micrometry.

II. **Molecular techniques:**Analysis of DNA, RNA and proteins - Electrophoresis, 2-D and isoelectric focusing. Blotting techniques, microarray, MALDI-TOF, RFLP, RAPD and AFLP.

III. **Recombinant DNA methods:**Cloning strategies – Bacteria, Eukaryotes – gene libraries, cDNA cloning. Expression of cloned DNA molecules. DNA sequencing – PCR - types - Site directed mutagenesis.

IV. **Field biology methods**: Estimating population density of plants and animals- diversity indices, indirect & remote observations - sampling methods - behavioural study, ground and remote sensing methods.

V. **Bioinformatics**: Basics of bioinformatics, databases, Pair-wise and Multiple sequence alignment, phylogenetic analysis, tools for primer design and drug designing.

References

Attwood TK and Parry-Smith D (2001) Introduction to Bioinformatics. Pearson Education, New Delhi

Chandler DE and Oberson RW (2009) Bioimaging: Current concepts in light and electron microscopy. Jones & Bartlet Publishers, USA.

Giese AC (1963) Cell Physiology. 2nd Edition, WB Saunders Co., Philadelphia.

Hoppert M (2003). Microscopic Techniques in biotechnology, Weinheim, Germany.

Huntingford F (1984) The Study of Animal Behaviour. Springer Netherlands.

Old RW and Primrose SB (1994) Principles of Gene Manipulation, 5th Edition, Blackwell Scientific Publications, New Jersey.

Pevsner J (2015) Bioinformatics and functional genomics. 3rd Edition. Wiley Blackwell, New York

Rastogi SC, Rastogi P and Mandiratta N (2008) Bioinformatics methods and applications: Genomics, Proteomics and Drug discovery. 3rd Edition. PHI learning, New Delhi.

Thenkabail PS (2015) Remote sensing of water resources, Disasters & Urban studies, CRC press. New York

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1		2				
CO2					5	
CO3				4		
CO4					5	
CO5				4		

Mean = 4.0

MPZ 6625 Environmental Science and Biotechnology (4hrs/wk)(4cr)

This project paper is designed to impart current knowledge to the students who choose their research career in areas related to environmental science and environmental biotechnology. The basic aspects concerned with ecosystem, natural resources will be dealt along with biotechnology principles related to Bioremediation, Bioproducts and sustainability.

Course Outcomes

Upon completion of this course, students will be able to:

i. Assess the importance of environmental resources and identify the problems related to environment.
ii. Plan strategies for biodiversity conservation.
iii. Utilize biotechnology principles in monitoring and restoring the quality of environment.
iv. Design eco-friendly bio-products and utilize them to solve energy crisis and pollution problems.
v. Discuss unsustainability problems related to food, energy and environment.

I. Ecosystem and Natural resources: Structure and Function - Major ecosystems - Energy flow - Role of microbes – Ecological stress and its Management. Natural resources, environmental effects of resource extraction - Monoculture, Crop rotation. Urbanization - Environmental Impact Assessment, Geographical Information System.

II. Environmental and Biodiversity Conservation: Conservation of aquatic systems and forests. Nature Parks and Sanctuaries - Wildlife conservation. Biodiversity - Concept, types and values. Biosphere reserves - IUCN - Measurement - Inventory and documentation. Hot spots - Threats and Conservation - Management Strategies.

III. Biodegradation and Bioremediation: Xenobiotics – Recalcirtants – Detoxification – Microbial transformation of pesticides – Biotreatment – Biofilters – Bioscrubbers – Biospargers – Bioventing – Immobilized enzymes – Root zone treatment – Role of GMOs – Bioremediation – types – methods – Influencing factors – Phytoremediation. Biosorption – mechanism, factors, equilibrium models and biosorbents.

IV. Bioproducts and Bioengineering: Biofertilizers – Vermicomposting – Microbial biopesticides – Integrated Pest Management – Biofuels. Bioleaching – Bioplastics – Biopulping – Biomonitoring – Bioindicators – Biosensors.

V. Sustainability and Human Development: Sustainability and Resources – Energy Sources, Uses and Conservation. Waste disposal methods. Urban Problems – Food and Agriculture – Environmental Education and Environmental Policy – International Treaties and Conventions – Environmental Legislation.

References

Chatterji AK (2005) Introduction to Environmental Biotechnology. Prentice-Hall of India Pvt. Ltd., New Delhi, xv+179pp.

Cunningham WP and Cunningham MA (2002) Principles of Environmental Science: Inquiry and Application. McGraw Hill, New York, USA. 418pp.

Kormondy EJ (2006) Concepts of Ecology. 4th Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, xvi+559pp.

Murugesan AG and Rajakumari C (2006) Environmental Science and Biotechnology: Theory and Techniques. MJP Publishers, Chennai, 460pp.

Odum EP and Barrett GW (2005) Fundamentals of Ecology. 5th Edition, Thomson Brooks/Cole, Australia, xviii+598pp.

Rittmann BE (2001) Environmental Biotechnology: Principles and Applications. McGraw Hill, New York, xiv+754pp.

Scragg A (2005) Environmental Biotechnology. 2nd Edition, Oxford University press, Oxford.447pp.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1				4		
CO2			3			
CO3			3			
CO4				4		6
CO5					5	

Mean=4.1

MPZ 6627 Immunology (4hrs/wk)(4cr)

The project paper on Immunology deals with antibody structure, Major Histocompatibility Complex, antigen-antibody interactions, HLA polymorphism, serological methods in histocompatibility testing and molecular typing methods. Emphasize is also given to cell and antibody mediated immunity, autoimmunity, transplantation and tumour immunity. In the last section immunodeficiency diseases, vaccines, animal experimental systems, stem cells are also included.

Course Outcomes

Upon completion of this course, students will be able to:

i. Revise the structure of antibody and its functions.
ii. Discuss HLA genetics& polymorphism, tissue & molecular typing.
iii. Explain the mechanisms involved in CMI, tolerance and hypersensitivity.
iv. Critique about autoimmunity&immune response to tumors.
v. Evaluate the role of vaccines, transgenic animals and stem cells in combating immunodeficiency diseases.

I. Antigen, Antibody and Major Histocompatability Complex: Molecular structure of antibody – Monoclonal antibodies – Antibody engineering – Antigen-Antibody interactions – MHC – Antigen Presentation.

II. HLA Polymorphism and Typing: HLA genetics – HLA polymorphism and nomenclature – inheritance – serological methods in histocompatibility testing – tissue typing by lymphocytotoxicity tests. Molecular typing methods – gene amplification – SSP – SSOP typing – SBT - HLA typing for allogeneic transplantation.

III. Cell & Antibody Mediated Immunity, Control Mechanisms and Hypersensitivity reactions: B and T cell activation and differentiation – Antibody Mediated and Cell Mediated Effector Functions – Major Pathways for Complement activation – Tolerance – Hypersenstivity reactions.

IV. Autoimmunity, Transplantation and Tumor Immunology: Organ specific and systemic autoimmunity – Graft rejection – Immunosuppressive therapy – Immune response to tumour – Immunotherapy.

V. Immunodeficiency Diseases, Vaccines and Animal Experimental Systems: Primary and Secondary immunodeficiency diseases – Vaccines – Inbred Strains – Congenic strains – adoptive transfer system – Transgenic animals – Knock-in and Knock-out technologies – the *cre/lox* systems – Cell culture systems – Stem cells.

References

Coico R and Sunshine G (2015) Immunology – a short course. 7th Edition, Wiley Blackwell, New York.

Delves PJ, Martin SJ, Burton DR and Roitt IM (2011) Roitt's Essential Immunology. 12th Edition, Wiley-Blackwell, New York.

Owen JA, Punt J and SA Stranford (2013) Kuby Immunology 7th Ed. W.H. Freeman and Company, New York

Parslow G, Stites DP, Terr AI and JB Imboden (2001) Medical Immunology, 10th Ed. McGraw Hill Company, New York.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1				4		
CO2		2				
CO3		2				
CO4			3	4		
CO5					5	

Mean = 3.1

MPZ 6629 Insect Diversity (4hrs/wk)(4cr)

This project paper is aimed to acquaint students with the basics of insect morphology, physiology and systematics. It is designed to impart knowledge on the ecology, abundance and their role in ecosystem. It will help to develop strong foundation in entomology by understanding the importance of insects to human society, concern related to disease, insecticide, their use in forensics and in biotechnology.

Course Outcomes

Upon completion of this course, students will be able to:

i. Outline the morphology and physiology of insects.
ii. Assess the role of insects in an ecosystem.
iii. Analyze the importance of agricultural and forest pests.
iv. Identify and apply the procedures following in industrial entomology.
v. Evaluate the role of pesticides, regulators, parasitoids in pest management.

I. **Insect Morphology, Taxonomy and Physiology**: External morphology of insect- head, thorax, abdomen, appendages - function. Insect taxonomy – principles of systematics, classification, apterygotes, exopterygotes, endopterygotes. Digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive system and endocrine glands.

II. **Insect Ecology and Biotechnology**: Population dynamics, factors, dispersal, migration, seasonality, diapause, prey–predator interaction, mimicry, coloration, life history strategies, bees, butterflies - Pollinators, decline, conservation, attracting native pollinators. Genetic engineering in insects, insect vectors, transgenic mosquitoes, rDNA technology in sericulture.

III. **Agricultural and Forest Entomology**: Pest- biology, damage, life history, control - paddy, sugarcane, cotton, vegetables. Insects and trees - diet, defence, coevolution, outbreak, pest of forest seed, nursery, standing trees and timber.

IV. **Industrial, Medical and Forensic Entomology**: Sericulture, apiculture, lac culture, insects as human food, predators, diseases, stored product pest. Medically important insects - Diptera, Anoplura, Mallophaga, Hemiptera, biology & ecology of mosquitoes - control. Insects of forensic importance - life cycle.

V. **Insect Toxicology and Pest Management**: Insect growth regulators, microbial-botanical insecticides, insect resistance, Probit analysis, evaluvation of insect toxicity, pesticide appliance, toxicity to beneficial insects. Biological control, biodiversity of biocontrol agents, parasitoids, predators and advances in IPM.

References

Chapman (1998) The Insects Structure and Function, 4th Edition Cambridge University Press London.

David BV and Kumarasamy T (1982) Elements of Economic Entomology, Popular Book Depot Chennai.
David BV and N Ramamurthy (2016) Elements of Economic Entomology, 8th Edition, Brillion Publishing.
Fennermore PG and Alkaprakash (1992) Applied Entomology, Wiley Eastern Ltd New Delhi.
Kunte K (2000) Butterflies of Peninsular India, University Press, Hyderabad.
Richards OW and Davies RG (2013) Imms General Textbook of Entomology Vol. 1 & 2, 10th Edition, Springer Science & Business media.
Srivastava KP and Dhaliwal N (2015) Textbook of Applied Entomology, Kalyani Publications New Delhi.
Wigglesworth VB (2012) Principles of Insect Physiology, 7th Edition, Springer Science & Business media.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1		2				
CO2		2				
CO3			3	4		
CO4				4	5	
CO5					5	6

Mean = 3.8

MPZ 6631 Applied Microbiology (4hrs/wk)(4cr)

This research project paper is designed to promote the interest of research in basic and applied areas of microbiology such as industrial, food, medical, environmental and agricultural microbiology.

Course Outcomes

Upon completion of this course, students will be able to:

i. Discuss the origin and compare archaebacterial cells with modern microbial organisms.
ii. Evaluate the bacterial growth and metabolism.
iii. Assess the microbial diversity and microbial interaction with other lives.
iv. Explain the importance of food preservation, microbial spoilage and food borne diseases.
v. Identify the problems related to public health and evaluate the control measures.

I. General Microbiology and Taxonomy: Members of microbial world and microbial evolution – Origin of microbiology - Bacterial and Archaebacterial cells - Taxonomy ranks – techniques for determining microbial taxonomy - Phylogenic trees, concept of microbial species - Bergey's classification of bacteria - Classification of algae, fungi, protozoa and viruses.

II. Microbial Physiology and Biochemistry: Nutritional types – Growth curve – Culture media – Bacterial cell cycle – Measurement of microbial growth – Pattern of microbial death – Physical, chemical and biological control of microorganisms - Chemotaxis and endospore formation – Microbial metabolism - Oxidation-reduction reactions.

III. Microbial Ecology and Soil microbiology: Biogeochemical cycles - Global climate changes, Assessing microbial diversity, Microbial community activity, Water as a microbial habitat, Marine and freshwater ecosystems and Coliform analysis, Soil as a microbial habitat, Normal microbiota of human body, Plant-microbe association - mycorhizza. Water purification and sanitary analysis - Waste water treatment - Biodegradation, Bioremediation and Bioaugmentation - Sewage treatments and recycling wastes.

IV. Food and Industrial Microbiology: Types of food for microbial growth spoilage and preservation of foods – food borne diseases – detection of food borne pathogens - microorganisms as food and food amendments – SCP and applications of microbial products in human welfare – Microorganisms used in industry - Downstream processing Production strains - Production of antibiotics, Vitamins, enzymes and vinegar – Primary, secondary screening of microbes and scale up fermentations - Types of fermentors - raw materials.

V. Medical microbiology & Public Health: Types of causative agents, disease and control measures – Development of chemotherapy and general characteristics of antimicrobial drugs – Drug effectiveness and Antibiotic resistance - Epidemiology - infectious diseases

in population – Nosocomial infections - Control of epidemics - Bioterrorism - Global health considerations – Airborne, Zoonotic, Prion, Direct, Contact and Opportunistic diseases.

References

Kingsbury, D.T., Wagner. G.E. (1990) Microbiology, NMS (series). 2nd edition. National medical series.

Kapil, A., Bhaskaran, C.S. (2013) Ananthanarayan and Paniker's Textbook of Microbiology. 9th Edition. University Press.

Willey, J.M., Sherwood, L.M., Woolverton, C.J. (2016) Prescott's Microbiology. 10th edition. McGraw Hill International publication.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1		2				
CO2					5	
CO3				4		
CO4			3			
CO5				4	5	

Mean = 3.8

MPZ 6633 Probiotics (4hrs/wk)(4cr)

This course is designed to understand and apply various strains of probiotics, their identification and their role in animal and human health. This course gives an idea for role of probiotics in immune response and stress. It also includes the application of probiotics in animal husbandry and aquaculture.

Course Outcomes

Upon completion of this course, students will be able to:

i. Identify and classify beneficial microbes and their biological role.
ii. Describe the procedure for commercial probiotic production and consumption.
iii. Apply probiotics in animal physiology and human health.
iv. Analyze the role of probiotics in immune response and stress.
v. Explain the effect of beneficial microbes in animal husbandry and aquaculture.

I. **Biological role, Classification and Identification of Microbes:** History of probiotics – FAO guidelines-contribution of probiotics and prebiotics- Identification of individual strains. –Selection of strains for human use – Beneficial microbes and their role in human health and animal husbandry.

II. **Commercial Production of Strains and Consumption:** Various processes in commercial production- Registration procedures-EFSA- Identity – and quality safety and efficacy – ethical and approval-dosage and product formulation- sensory additives – nutritional additives digestability enhancer and gut microflora stabilizer.

III. **Probiotics in Animal Physiology and Human Health:** Beneficial effects on mineral metabolism-Increasing boro density and stability reduction in metabolic disorder-Enhancement of gut microflora balance- Feed efficacy enrichment - Improvement of digestive health and comfort- cancer prevention.

IV. **Probiotics in immune response and stress:** Probiotic effect on innate and acquired immunity- Reduction in food borne pathogen carriage-modification in immunoglobulin synthesis – reduced impact during stress – Impact of stress related hormones and probiotics.

V. **Probiotics in animal husbandry and aquaculture:** Probiotic role in animal health- effect on intestinal microflora- Immune protection of digestive tract- growth promoters-therapeutic agents – mechanism of probiotics in fish and shrimp culture- developing probiotics for aquaculture.

References

Fraunhofer JAV (2012) Prebiotics and Probiotics. Create Space Independent Publishing Platform.

Michail S and Shermen PM (2009) Probiotics in Pediatric Medicine (Nutrition and Health). Humana Press.
Otles S (2013) Probiotics and Prebiotics in food, Nutrition and Health. CRS Press.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1						6
CO2			3			
CO3		2				
CO4					5	
CO5			3			

Mean = 3.8

MPZ 6671, 6672 **Research Project I and II** **(18hrs/wk + 30hrs/wk)**
(6cr+6cr=12cr)

This is a two semester sequential course. It aims at training the students in collecting, analyzing and interpreting the data for drawing valid conclusions. The students are allowed to choose the problems in the five subject areas of the project paper. The student's initiative and inventiveness in designing experiments are encouraged. The research project sequentially spread over the first and second semesters will be evaluated at the end of the second semester.

The students have to submit 4 typed copies of the dissertation to the department at the end of the second semester. A copy of dissertation will be sent to the external examiner for review. Internal valuation will be done by the guide. A viva-voce examination will be conducted by a panel of examiners which includes the external examiners also.

Course Outcomes

Upon completion of this course, students will be able to:

i. Design a research project and do literature survey.
ii. Plan experiments and collect data.
iii. Analyze collected data statistically to arrive at conclusions.
iv. Demonstrate ability to do independent research.
v. Create new applications and prepare project proposals.

	K1: Remembering	K2: Understanding	K3: Applying	K4: Analyzing	K5: Evaluating	K6: Creating
CO1						6
CO2			3			
CO3		2				
CO4					5	
CO5			3			

Mean = 3.8