SEMESTER I

Discipline : INTERDISCIPLINARY
Stream : ID1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221TCE100	PROBABILITY AND STATISTICS	DISCIPLINE CORE	3	0	0	3

Preamble: The objective of this course is to expose the students to the fundamental concepts of probability and statistics. The course aims to equip the students to find solutions for many real-world civil engineering problems and to understand basic data analysis tools by applying the principles of statistics.

Course Outcomes: After the completion of the course, the student will be able to

CO 1	To create an awareness of the concepts of statistics and probability distributions
CO 2	To formulate and test hypotheses for civil engineering problems
CO 3	To apply statistical data analysis tools such as ANOVA and experimental designs
CO 4	To build regression models for civil engineering applications and to identify the principal components
CO5	To apply the concepts of data analysis for a time series

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2		3			2
CO 2	3	2	2	3	3		2
CO 3	3	2	2	3	3		2
CO 4	3	2	2	3	3		2
CO5							

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	5
Create	5

Mark distribution

Total Marks	CIA	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation: 40 marks

Micro project/Course based project	:	20 marks
Course based task/Seminar/Quiz	:	10 marks
Test paper, 1 no.	:	10 marks

The project shall be done individually. Group projects are not permitted. The project may include the implementation of theoretical computation using software packages.
The test papers hall include a minimum 80% of the syllabus.

End Semester Examination: 60 marks

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A contain 5 numerical questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student shall answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Syllabus

Module 1- Introduction to probability distributions

Sample Space and Events, Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence. Random Variables–discrete and continuous random variables, Probability mass functions and probability density functions. Cumulative distribution functions, Mathematical Expectations, mean and variance.

Standard discrete distributions-Binomial and Poisson distribution. Standard continuous distributions –Exponential and Normal distribution, Mean and variance (derivation is not required). Computing probability using the above distributions, Fitting of binomial and Poisson distributions.

Module 2- Statistical Inference

Populations and samples. Sampling distribution of the mean(sigma known and unknown), Sampling distribution of the variance(sigma known and unknown).Interval estimation:-Confidence interval for mean and variance.-Tests of hypotheses:-Null hypothesis and alternative hypothesis, Type I and Type II errors.-Test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi-square test of goodness of fit (viii) Chi-square test for independence

Module 3- Analysis of variance

Analysis of variance. Completely randomized designs and randomized block designs.- Latin square designs -Factorial experiments: Two-factor experiments (overview only)

Module 4- Correlation and regression models

Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, correlation coefficient- Multiple linear regression, normal equations -Principal components (brief overview only)

Module 5-Time Series Models

Components of time series. Identifying linear trend: semi averages method and least squares method. Smoothing: moving averages, weighted moving averages, exponential smoothing using one smoothing coefficient. Forecasting, measuring forecasting accuracy

Course Plan

No	Topic	No. of Lectures
1	**Introduction to probability distributions**	
1.1	Sample Space and Events, Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence.	1
1.2	Random Variables–discrete and continuous random variables, Probability mass functions and probability density functions. Cumulative distribution functions, Mathematical Expectations, mean and variance.	2
1.3	Standard discrete distributions-Binomial and Poisson distribution. Standard continuous distributions –Exponential and Normal distribution, Mean and variance (derivation is not required). Computing probability using the above distributions, Fitting of binomial and Poisson distributions.	5
2	**Statistical Inference**	
2.1	Populations and samples. Sampling distribution of the mean(sigma known and unknown), Sampling distribution of the variance(sigma known and unknown).Interval estimation:- Confidence interval for mean and variance.	2
2.2	Tests of hypotheses:-Null hypothesis and alternative hypothesis, Type I and Type II errors.	2

2.3	Test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi-square test of goodness of fit (viii) Chi-square test for independence	4
3	**Analysis of variance**	
3.1	Analysis of variance. Completely randomized designs and randomized block designs.	4
3.2	Latin square designs	2
3.3	Factorial experiments: Two-factor experiments (overview only)	2
4	**Correlation and regression models**	
4.1	Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, correlation coefficient	4
4.2	Multiple linear regression, normal equations	2
4.3	Principal components (brief overview only)	2
5	**Time Series Models**	
5.1	Components of time series. Identifying linear trend: semi averages method and least squares method.	2
5.2	Smoothing: moving averages, weighted moving averages, exponential smoothing using one smoothing coefficient.	3
5.3	Forecasting, measuring forecasting accuracy	3
	Total hours	40

Reference Books

1. Gupta. S. C. and Kapoor. V. K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2020
2. Benjamin, Jack.R and Comell.C, Allin, Probability, Statistics and Decision for Civil Engineers, Mc- McGraw-Hill.
3. Johnson RA , Miller I, Freund J. Miller and Freund’s Probability and Statistics for Engineers (9th edition) Pearson. 2018.
4. Response Surface Methodology: Process and Product Optimization Using Designed Experiments, 4th EditionRaymond H. Myers, Douglas C. Montgomery, Christine M. Anderson-Cook ISBN: 978-1-118-91601-8 February 2016.
5. Introduction to Time Series Analysis and Forecasting Second Edition, DOUGLAS C. MONTGOMERY, CHERYL L. JENNINGS, MURAT KULAHCI, John Wiley & Sons, 2015.
6. Papoulis A, Pillai SU Probability, Random Variables and Stochastic Processes McGraw Hill 2022
7. Schiller J, Srinivasan RA, Spiegal M Schaum's Outline of Probability and Statistics, 2012 McGraw Hill
8. Ross S Introduction to Probability and Statistics for Engineers and Scientists Elsevier 6th Edition 2021

Model Question Paper INTERDISCIPLINARY-ID1

XXXX PROBABILITY AND STATISTICS

Time: 3 Hrs Max. Marks:60

PART A

(Answer all Questions: Each question carries 5 marks)

1. Explain the concept of mean, median and mode, and its applicability in various contexts with suitable examples.

2. Explain Type I and Type II errors with example.

3. What are the assumptions involved in Analysis of Variance (ANOVA)?

4. Obtain Karl Pearson's correlation coefficient for Stress and Performance.

Observation no.	1	2	3	4	5
Performance	75	80	85	90	95
Stress	80	75	80	60	55

5. Explain briefly the components of time series.

PART B

(Answer any five questions: Each carry 7 marks)

6. The number of products sold by a shop keeper follows Poisson distribution, with a mean of 2 per week. (i) Find the Probability that in the next 4 weeks the shop keeper sells exactly 3 products. (ii) The shop keeper monitors sales in periods of 5 weeks. Find the probability that in the next 15 of these 5-week period, there are exactly 10 periods in which more than 5 products are sold.

7. After conducting series test on ProbabilityandStatistics the following scores were obtained for Batch A and Batch B. Conduct a hypothesis testing for checking the equality of variance in scores of two batchesat a significant level corresponding to a β error probability of 0.9.

A	35	40	42	30	12	50	45	28	26	30
B	20	24	28	26	18	50	50	48	48	09

8. In order to evaluate safety performance of employees across 3 departments, 5 employees across each department were randomly monitored and their safety behaviour on a hundred scale is given below. Do the departments differ in their safety behaviour?

Department	1	2	3	4	5
A1	68	73	75	65	78
A2	85	85	78	86	79
A3	73	77	72	70	76

9. Develop a Regression Equation between A and Busing Method of Least Square. Consider B as the dependent variable. Explain the significance of estimated slope.

Observation no.	1	2	3	4	5
A	75	80	85	90	95
B	80	75	80	60	55

10. Foodgrain production (in lakh tones) is given below. Find the Trend by using 3-yearly and 4-yearly movingaverage method, tabulate the trend values and predict the production for the year 2022.

Years	Production
2008	40
2009	60
2010	45
2011	85
2012	130
2013	135
2014	150
2015	120
2016	200

11. An evaluation of teaching methods shows the following outcomes.

Method of Teaching	No of students	Average marks obtained	Population Standard Deviation
Chalk and Talk Method	32	70	5
PPT and Talk Method	29	65	8

Conduct hypothesis testing for the mean difference of the teaching methods at a significant level corresponding to a Type I error probability of 0.01.

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CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221TCE013	ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY	PROGRAM CORE 1	3	0	0	3

Preamble: Environmental chemistry is considered important at the societal level as it is associated with environmental impact, pollutants, environmental management, and contamination reduction. It covers the basic concepts and parameters related with Environmental Engineering and related issues. Environmental Microbiology helps to define the concepts in Microbiology in relation to the environment. It helps the students to understand the basic microbiological practises to be adopted for monitoring the quality of air , water and soil.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To understand the fundamentals of physical Chemistry involved in Environmental processes
CO 2	To choose proper analytical tools for the qualitative and quantitative determination of various Environmental parameters
CO 3	To realize importance of biomolecules, surfactants, dyes, and their degradation.
CO 4	To classify and compare the general characteristics of microorganism
CO 5	To understand the basic concepts and techniques in Microbiology
CO 6	To define the concepts in Environmental Microbiology

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		3	3	3	1	
CO 2	2		3	3	3	1	
CO 3	1		3	2	2		
CO 4	2		3	3	3	2	
CO 5			3	2	1		
CO 6	1		3	3	2		

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Micro project/Course based project : 20 marks

Course based task/Seminar/Quiz : 10 marks

Test paper, 1 no. : 10 marks

The project shall be done individually. Group projects not permitted. Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern: 60 marks

Part A and B should be answered in two separate answer sheets
The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A (Environmental Chemistry) contain 6 questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 2 question from each module, having 6 marks for each question. Students shall answer any 5 questions. Part B (Environmental Microbiology) contains 6 questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 2 questions from each module, having 6 marks for each question. Students shall answer any 5 questions. Total duration of the examination will be 150 minutes.

Model Question Paper

INTERDISCIPLINARY-ID1

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering** and Management)

Subject: **221TCE013 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY**

Time: 2.5 Hrs Max. Marks: 60

Part A and B should be answered in two separate answer sheets

PART A- ENVIRONMENTAL CHEMISTRY

(Answer any **5** questions)

1) a. Describe the working principle of a spectrophotometer? Draw a neat diagram shows its components (4)
   b. Comment on Beer Lambert law (2)
2) a.Describe the classification of various enzymes.Write down its mechanism of action (4)
   b.Mention any two examples of cationic, anionic and non-ionic detergents (2)
3) Discuss about Le chatelier principle and factors affecting equilibrium (6)
4) Describe the classification, properties and preparation of colloids (6)
5) Suggest a suitable method for the detection of heavy metals in wastewater sample (6)
6) Derive Henderson – Hasselbalch equation . Explain the mechanism of action of different buffers (6)

PART B- ENVIRONMENTAL MICROBIOLOGY

(Answer any **5** questions)

7) Illustrate the structure of a bacterial cell with its major features (6)
8) a.Identify two enumeration techniques for the isolation of microorganism from a sample of soil (2)
   b. Summarise the major features of virus and protozoa (4)
9) Outline the major sterilization techniques based on heat for the control of microorganisms (6)
10) a. Point out two methods adopted for the quality control of water sample , in case of a suspected water borne disease outbreak (3)
    b. Explain two methods adopted for bioaerosol sampling (3)
11) a.Identify the etiology of botulism and outline the preventative measures to be adopted for this illness (3)
    b.Differentiate between the two major mechanisms of bacterial metabolism (2)

12) a.Discuss the role of microorganisms in the biogeochemical cycle of Nitrogen (3)
b.Bioleaching is as an environmentally friendly technique ,summarize your finding to substantiate this statement (3)

Syllabus and Course Plan

(For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Fundamentals of Physical Chemistry**	
1.1	Introduction-solutions-normal, molar and molal solutions - vapour pressure, Henry's law, Graham's law, Raoult's law- Law of mass action - chemical equilibrium, Le Chatelier's principle	3
1.2	Fundamentals of chemical kinetics, Types of reactions, Rate and order of reactions Zero order, First order, Second order Reactions-Derivation of first order kinetic equation – Distribution coefficient-Principle of solvent extraction	2
1.3	Theory of ionization, pH and buffers – Henderson Hasselbalch's equation – Basic concepts from surface and colloidal chemistry – preparation, classification, Properties and their stability - Zeta potential and its determination	3
2	**Analytical methods in Environmental Chemistry**	
2.1	Beer – Lambert law, Principle, instrumentation and applications of spectrophotometry -UV-visible spectroscopy, IR spectroscopy, Atomic Absorption Spectroscopy (AAS), Nephelometry and Tubidimetry,	3
2.2	Principles of Chromatography – thin layer and paper – adsorption – partition – ion exchange – HPLC, GC-size exclusion – electro chromatography-	3
2.3	Potentiometric titration of Iron, Acid-base conductometric titrations	2
3	**Biomolecules & Environmental Pollutants**	
3.1	Biomolecules - proteins, carbohydrates, lipids , enzymes, nucleic acids, vitamins, Surfactants – Cationic, anionic and non-ionic detergents. Environmental effects- Eutrophication and Degradation. Dyes-Chemical classification (azo, anthraquinone, Phthalocyanines)-Environmental impacts of Dyes. Radioactive pollution-sources, methods of monitoring and control.	4
3.2	**General properties of microorganisms**- General properties of bacteria, fungi, algae, protozoa, rickettsia and chlamydia. Characterization & classification of microorganisms	4
4	**Fundamentals of Microbiology**	

4.1	Morphology and structure of bacteria. Staining methods. Microscopy- Light and Electron Microscopy	3
4.2	Culture media and growth factors for microbes . Enumeration techniques for bacteria .Growth curve of microbes	2
4.3	Microbial metabolism. -. Aerobic and anaerobic growth. Physical and chemical control of microorganisms-sterilization principles and techniques. Antibiotics-mechanism of action. Microbes associated with food spoilage, food preservation methods	3
5	**Environmental Microbiology**	
5.1	Aeromicrobiology, outdoor and indoor, bioaerosol sampling. Air borne diseases and control	3
5.2	Concept of indicator organisms. -total coliforms, MPN and membrane filter techniques. water borne diseases and control.	2
5.3	Role of microorganisms in biogeochemical cycling. Microbial leaching. Biopesticides and biofertlizers	3

Text Books

1. Raina.M. Maier, Ian LPepper& Charles P Gebra, Environmental Microbiology, 2nd edition ,Elsevier India Pvt ltd, New Delhi, 2008.
2. Michael. J. Pelczar, Microbiology, 5th edition Tata McGraw Hill company Ltd, New Delhi, 2010.
3. Anathanarayanan and Panikers Text book of Microbiology ,7th edition ,Orient Longman pvt ltd,2007
4. P.D.Sharma,Microbiology,4th edition Rastogi publications, Meerut, 2019.
5. Instrumental Methods of Chemical Analysis, Dr. B. K. Sharma, 30th ed, Goel Publications, 2015
6. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of physical chemistry, 47th Vishal Publishing, 2016

Reference Books

1. Clair N. Sawyer, PeryL.McCarty, Chemistry for Environmental Engineering ,
2. Donald, V. and Judith G.V., John, Biochemistry 4th ed., Wiley & Sons Asia Pvt.Ltd. (New Jersey), 2011.
3. Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Biochemistry 7th ed., Freeman and Company (New York), 2012.
4. Peter Atkins, Julio de Paula, James Keeler, Physical Chemistry, 4th ed, Oxford HED, 2018
5. A. Skoog and Donald M. West, Fundamentals of Analytical Chemistry, 9th ed., Cengage Learning ,2013

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221TCE014	PHYSICOCHEMICAL WASTEWATER TREATMENT	PROGRAM CORE 2	3	0	0	3

Preamble: The course aims to impart in-depth knowledge on water and wastewater treatment techniques and enable to design suitable treatment processes based on achieving the required quality

Course Outcomes: After the completion of the course the student will be able to

CO 1	To enhance the knowledge of process kinetics involved in water/wastewater treatment
CO 2	To design appropriate technologies for water treatment
CO 3	To identify the possible sources of water pollutants and the methods for estimating the quantity and quality of wastewater generated
CO 4	To enable students to design treatment processes accordingly to meet relevant water quality standards
CO 5	To impart skills on advanced treatment technologies

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2	3	2	1	1	1
CO 2	3	2	3	3	3	2	2
CO 3	3	2	3	3	3	2	2
CO 4	3	2	3	3	3	2	2
CO 5	3	2	3	2	2	2	2

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	20
Evaluate	15

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Micro project/Course based project : 20 marks

Course based task/Seminar/Quiz : 10 marks

Test paper, 1 no. : 10 marks

The project shall be done individually. Group projects not permitted. Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A contain 5 numerical questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student shall answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the rate and order of reactions

2. Distinguish between zero order and first order reaction with examples

3. Explain the kinetics of a plug flow reactor

Course Outcome 2 (CO2)

1.Discuss the different types of settling

2. Explain the theory of coagulation

3. Discuss the different mechanisms involved in filtration.

Course Outcome 3(CO3):

1. Explain any three chemical characteristics of sewage and their significance

2.Discuss the different methods for estimating the quantity of wastewater

3.Discuss the various factors affecting dilution of streams

Course Outcome 4 (CO4):

1. Discuss the working and design considerations of a grit chamber with neat sketches

2.Explain the two film theory of gas transfer

3.Explain the factors affecting disinfection

Course Outcome 5 (CO5):

1. Discuss the significance of micropollutants

2. Explain the different methods of advanced oxidation

3. Distinguish between electrodialysis and reverse osmosis

Model Question Paper

INTERDISCIPLINARY-ID1

APJ Abdul Kalam Technological University M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **Environmental Engineering**

Subject: **221TCE014 PHYSICOCHEMICAL WASTEWATER TREATMENT**

Time: 2.5 Hrs Max. Marks: 60

(Answer **All** Questions)

1 Discuss the factors affecting wastewater generation

2. Discuss the design considerations of a flocculator

3. Discuss the procedure for estimating the volume of equalization tank.

4. What are isotherms? Explain any one isotherm in detail

5 Explain the process of membrane fouling

(5X5=25 marks)

PART B

(Answer **any 5** Questions)

6. a. A certain city has a projected population of 50,000 residing over an area of 40 hectares. Find the design discharge for the sewer line for the following data 4

Rate of water supply- 200 l/c/d, Average impermeability coefficient- 0.3, Time of concentration- 50 minutes. The sewer line is designed for a flow equivalent to wet weather flow plus twice the dry weather flow. Assume that 75% of water supply reaches sewer as wastewater.

b. Explain any three chemical characteristics of water and their significance in estimating water quality. 3

7. A particle size distribution has been obtained from a sieve analysis of sand particles. For each weight fraction an average settling velocity has been calculated. The data are as follows 7

Settling velocity, m/minute	3.0	1.5	0.6	0.30	0.22	0.15
Wt. fraction remaining	0.55	0.46	0.35	0.21	0.11	0.03

What is the overall removal for an overflow rate of 4000m^3/m^2/day?

8 a Design the underdrainage system of a rapid sand filter for treating 5 Mld of water 4

b Explain any one method to determine the loss of head in filters 3

9. A city discharges sewage at a rate of 1200 liters per second into a stream whose minimum flow is 5000 litres per second. The temperature of sewage and stream is 20^0C. The 5 day BOD at 20^0C for sewage is 160 mg/l and that of river water is 2 mg/l. The DO content of sewage is zero while that of stream is 90% of saturation DO. Find out the degree of treatment required if the minimum DO to be maintained in the stream is 4 mg/l. Assume deoxygenation coefficient as 0.1 and reoxygenation coefficient as 0.3. Given saturation DO at 20^0C as 9.17 mg/l. 7

10. a. Design a bar screen for an average wastewater flow of 40Mld 4

b. Explain the two film theory of gas transfer 3

11 a. 100 ml of a 600 mg/l solution of Xylene is placed in each of the five containers with different amounts of activated carbon and shaken for 48 hours. The samples are filtered and the concentration of Xylene measured, yielding the following analyses. Obtain the Freundlich constants and plot the isotherm. 4

Container	1	2	3	4	5
Carbon (mg)	600	400	300	200	50
Xylenes, mg/l	25	99	212	310	510

b Explain the different types of aerators used for water treatment 3

12. a. Distinguish between electrodialysis and reverse osmosis 4

b. Explain any one method of advanced oxidation process used for wastewater treatment 3

Syllabus and Course plan

No	Topic	No. of Lectures
1	**Introduction to water and wastewater (8 hours)**	
1.1	Physical and chemical quality of water, Sources of water pollution-domestic, industrial, water quality standards	2
1.2	Wastewater - sources, quantity, collection and conveyance. Storm water-Quantity, Factors affecting. Sewerage systems. Time of concentration, Flow rate and fluctuations of wastewater, variations in concentrations of wastewater constituents	3
1.3	Physical and chemical characteristics of wastewater, BOD, COD, Population equivalent, Effluent standards	3
2	**Water treatment(8 hours)**	
2.1	Sedimentation processes-types of settling, design of sedimentation tanks, Tube settlers	3
2.2	Coagulation and flocculation-Types, processes and Design.Clariflocculator.	2
2.3	Filtration- processes, types. Hydraulics of filtration-losses in filter, Design of filters, Depth filters	3
3	**Wastewater treatment and disposal (8 hours)**	
3.1	Disposal in streams, Dilution and dispersion, self purification-factors	3

	affecting-physical, chemical, Streeter Phelps equation, oxygen sag curve INTERDISCIP	INARY-ID1
3.2	Screening-Types, Design of bar screen. Grit removal, Design of grit chamber, Proportional flow weir	3
3.3	Flow Equalization, Design of equalization tank, flotation , types	2
4	**Theory and design of physicochemical unit operations for wastewater: 8 hours**	
4.1	Reactors, Completely mixed batch reactor, Continuous flow stirred tank reactor, Plug flow reactor	2
4.2	Aeration- methods of aeration, gas transfer, Two film theory	2
4.3	Adsorption- types, adsorption isotherms, Ion exchange	2
4.4	Disinfection-Methods, Kinetics, Disinfection by-products	2
5	**Advanced water/wastewater treatment: 8 hours**	
5.1	Wastewater treatment by membrane based technologies- Removal of micro pollutants, membrane filtration- Ultra, Nano, Micro filtration. Membrane fouling	2
5.2	Desalination, Reverse osmosis, Electrodialysis	2
5.3	Advanced oxidation- Fenton process, catalytic treatment, Electrochemical treatment	2
5.4	Case studies on wastewater treatment in various processes, chemical and allied industries	2

Text Books

1. Metcalf and Eddy Inc., Wastewater Engineering Treatment Disposal Reuse, Tata McGraw Hill Publishing Company, 1991.

2. Ronald L.Droste, Theory and practice of water and wastewater treatment, John Willy and sons (ASIA) Pvt Ltd, 1997.

3. Mark J Hammer, Mark J Hammer Jr, Water and wastewater technology Prentice Hall of India Pvt Ltd, 2007.

4. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), “Environmental Engineering”, McGraw Hill

5. Fair, G.M., Geyer J.C and Okun, (1969) “Water and Wastewater Engineering” Vol II, John Wiley Publications.

Reference Books

1. Weber W.J Physico-chemical processes for water quality control, John Willy and sons ,Newyork, 1990.

2. John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe, George Tchobanoglous, MWH's Water Treatment: Principles and Design, Third Edition: Principles and Design, Third Edition

3. AWWA, (1971), "Water Quality and Treatment "McGraw Hill.

4. APHA, 2005, Standard methods for examination of water and wastewater, 21st Edition

5. Ministry of Urban Development, Manual on Water Supply and Treatment, Ministry of Urban Development, New Delhi, 1991.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221LCE006	ENVIRONMENTAL MONITORING LAB 1	LABORATORY	0	0	2	1

Preamble: The objective of this course is to enable students to familiarise themselves with various analytical techniques in Environmental Engineering. The course is also designed to make students familiar with different softwares related to Environmental Engineering.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To have an understanding of the various analytical techniques in Environmental Chemistry for the analysis of water and waste water samples
CO 2	To have an understanding of the various Microbiological practises in the laboratory
CO 3	To carry out biological water quality analysis of a given sample
CO 4	To apply softwares in Environmental Engineering practices

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1		3	3	3	3		
CO 2		3	3		1		
CO 3		3	3	3	1		
CO 4	3	3	3	3	3	2	
CO 5							

Mark distribution

Total Marks	CIE
100	100

Continuous Internal Evaluation Pattern:

The laboratory courses will be having only Continuous Internal Evaluation and carries 100 marks. Final assessment shall be done by two examiners; one examiner will be a senior faculty from the same department.

Syllabus and Course Plan

Note: Any ten experiments are mandatory

No	Topic	No. of lab hours
1	Analysis of water quality parameters like pH , Conductivity, Turbidity , Alkalinity and Total solids in a given sample	2
2	Analysis of Residual Chlorine and Iron in a given water sample	2
3	Analysis of Chlorides and Sulphate in a given water sample	2
4	Analysis of Nitrate and Phosphate in a given water sample	4
5	Analysis of BOD and CODin a given water sample	3
6	Analysis of oil and grease in a given water sample	2
7	Analysis of Heavy metals (any two) in a given sample	3
8	Study of instruments and equipment in a Microbiology Lab	2
9	Culture media preparation and Pure culture techniques in Microbiology	2
10	Preparation of Gram stained smear of bacteria	2
11	Isolation of microorganisms from soil ,water & air	3
12	Determination of total bacterial population by standard plate count technique	2
13	Analysis of coliforms and *E coli* by MPN and Membrane filtration technique	3
14	Introduction to Environmental Engineering softwares	4
		36 hrs

Reference Books

1.APHA (2017) Standard methods for the examination of water and waste water, 23rdedn. American Public Health Association, Washington, DC

2. MamtaTomar (1999),Quality Assessment of Water and wastewater ,Lewis Publishers
3. R. C. Dubey and D. K. Maheshwari(2002), Practical Microbiology, S.Chand publishers

4. F.W. Fifield and P.J. Haives Blackie (2000) Environmental Analytical Chemistry, Academic & Professional Glasgow.

5.N.Gray, M Calvin and S C Bhatia (2019) Instrumental Methods of Analysis, CBS Publishers and distributors, New Delhi.

SEMESTER I

PROGRAM ELECTIVE I

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE072	ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: The goal of this course is to expose the students to the fundamental concepts and purpose of Environmental Impact Assessment and the need for environmental management. After this course, students will be able to assess the impact of a particular developmental project and be able prepare an EIA report.

Course Outcomes: After the completion of the course, the student will be able to

CO 1	Understand the basic concepts and purposes of Environment Impact Assessment
CO 2	Assess the impact of developmental activities on the environment
CO 3	Evaluate the impact of various environmental resources
CO 4	Explain the principles and objectives of Environment Management Plan
CO 5	Generate EIS on the basis of various case studies related to developmental projects

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3		3		2		
CO 2	3		2	2			
CO 3			3	2		1	
CO 4	3		3		2		
CO 5					2	3	2

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	15
Analyse	15
Evaluate	20
Create	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Preparing a review article based on peer reviewed Original publications (minimum 10 publications shall be referred): 15 marks
Course based task/Seminar/Data collection and interpretation: 15 marks
Test paper, 1 no.: 10 marks
Test paper shall include minimum 80% of the syllabus

End Semester Examination Pattern: 60 marks

The end semester examination will be conducted by the respective college. There will be two parts; Part A and Part B. Part A contain 5 numerical questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem-solving and quantitative evaluation), with a minimum of one question from each module of which student shall answer any five. Each question can carry 7 marks. The total duration of the examination will be 150 minutes.

Course level assessment questions:

Course Outcome 1 (CO1):

1. To understand the basic concepts of EIA

2 To analyse the basic components of EIA

3. To differentiate different types of impacts

Course Outcome 2 (CO2):

1. To determine basic methods of EIA

2. To identify various methods of impact prediction

3. To evaluate various methods and assess the cost-effectiveness of a particular project

Course Outcome 3 (CO3):

1. To evaluate the air quality impact analysis

2. Assess water quality impact studies

3. To outline socio-economic aspects of a particular developmental project

Course Outcome 4 (CO4):

1. To summarise the concepts of the environment management plan (EMP)

2. To understand the benefits of EMS and ISO standards

Course Outcome 5 (CO5):

1. To evaluate the impacts of various developmental projects with the understandings of case studies

2. To Preparation of checklist for various stages of projects

Model Question Paper INTERDISCIPLINARY-ID1

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation:**(Environmental Engineering, Environmental Engineering and Management)**

Subject: **221ECE072 ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. What is Environmental Impact Assessment (EIA)? Explain the various stages of EIA.
2. Differentiate screening and scoping?
3. How will you assess the surface water quantity or quality impacts of proposed projects?
4. Explain the important steps involved in environmental auditing?
5. Explain the checklist as an EIA method along with its advantages and disadvantages

(5x5 = 25 marks)

PART B

(Answer **any 5** Questions)

6. (a)It is necessary to define the scope of EIA at the early stages of environmental impact assessment. Justify.
   (b) Distinguish the direct and indirect impacts in environmental impact assessment.
7. Explain cost-benefit analysis and discuss the advantages and disadvantages of CBA
8. (a) Mention the objectives and types of Energy Audit
   (b) List down the general measures that can be adopted to mitigate noise impact
9. Explain environmental standards, Write a short note on ISO 14000 standards.
10. A large dam is proposed in a rural setting. What public involvement techniques might be used to support the EIA of the project?
11. What are the major economic impacts of development projects? List down the objectives of economic impact analysis
12. Analyze the impact of nuclear energy and hydroelectric energy on the environment

(5x7=35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Environment Impact Assessment (EIA)**	**8Hrs**
1.1	Introduction to EIA- EIA Guidelines and notification of Govt. of India-Procedure for reviewing Environmental Impact Analysis and statement-Definition, aim, principles, concepts and purposes of EIA	2
1.2	Components or participants of EIA	2
1.3	Types of EIA- Rapid EIA- Comprehensive EIA- Strategic Environment Assessment (SEA)	2
1.4	Types of Impact-Primary & Secondary-Short Term & long term-Reversible and Non-Reversible-Positive and Negative impacts	2
2	**Process and Methods of EIA**	**8Hrs**
2.1	Screening, Scoping, Environmental Baseline data collection-Factors causing environmental effects in development projects	2
2.2	Identification of Impacts-Prediction of Impacts, Consideration of alternatives	2
2.3	Evaluation and assessment of impact-Assessment of effects on - Human beings, Flora, fauna and geology Mitigation Measures-Public Consultation and Participation-Environment Impact Statement Preparation	2
2.4	Methods of EIA – (Leopold Metric)- Networks Method- Overlays Method- Index Method-Simulation Mode- Cost Benefit Analysis	2
3	**Various Impact Analysis**	**8Hrs**
3.1	Air quality impact analysis - Air pollutants-sources -Atmospheric interaction- Environmental impact assessment methodology	2
3.2	Water quality impact analysis – water quality criteria and standards –Environmental setting- modelling - water quality impacts by projects like highways, power plants, mining, agriculture and irrigation, forest management	2
3.3	Vegetation and wildlife impact analysis – assessment methodologies Energy impact analysis- Energy impact considerations, organization and methodology.	2

3.4	Socio economic impact analysis- Types of socioeconomic impacts – Outline the basic steps in performing a socioeconomic impact assessment.	2
4	**Environmental Management Plans (EMP)**	**8Hrs**
4.1	Objectives of EMP	2
4.2	Components of EMP- Environmental Monitoring- Principles & types of monitoring-Environmental Auditing-Guidelines for Auditing-Objectives and benefit of Auditing-Steps in Auditing-Types of Auditing	3
4.3	Environmental Management Systems (EMS)- Benefits of EMS-International Standard Organization and ISO 14001	3
5	**EIA case studies**	**8Hrs**
5.1	Case studies of EIA-Nuclear Power plants-Hydroelectric Projects-Thermal Power Plants-Mining projects-Transportation projects-industries-development projects	4
5.2	Preparation of checklist for various stages of projects (examples only)	4

Text Books

1. Larry W. Canter, Environmental Impact Analysis. *McGraw Book Co* ,New York
2. John G. Rau and David C. Wooten, Environmental Impact Analysis Handbook, McGraw Hill Book Company.

Reference Books

1. Agarwal S. K., Environmental Management, A P H Publishing Company , New Delhi
2. Bhatia A. L., Sustainable Environment Impact Assessment, Avishkar Publishers. Jaipur
3. Peter Wathern , Environment Impact Assessment: Theory and Practices, Unwin Hyman, Boston
4. *Shrivastava A K, Environment Impact Aseesment, A P H Publishing Corporation, New Delhi*
5. *Trivedi P R, Environment Impact Asessment, A P H Publishing Company , New Delhi*
6. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002
7. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
8. Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
9. N.S. Raman, A.R. Gajbhiye, S.R. Khandeshwar, Environment Impact Assessment, IK International Publishing House, Pvt. Ltd. New Delhi

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE073	SUSTAINABLE TECHNOLOGIES AND CLEANER PRODUCTION	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: The aim of this course is to educate students about 'Cleaner Production Techniques' and its application, leading to pollution minimization in a sustainable manner. Students will gain knowledge in the domains of environmental, economic and technological aspects of Cleaner Production Methods.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To examine the significance of Pollution Prevention and Cleaner Production concepts in engineering
CO 2	To analyse the step-by-step procedure for Cleaner Production Methodology
CO 3	To analyse and apply suitable sustainable technologies in various engineering applications
CO 4	To analyse Life Cycle Assessment and Environmental Management Systems
CO 5	To apply the concept of pollution prevention and cleaner production techniques in industrial production based on case studies

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	3	2		2	2	
CO 2	3	3	2	2	3	2	
CO 3	3	3	3	2	3	2	3
CO 4	3	3	3	2	2	2	3
CO 5	3	3	2		3	2	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	30
Analyse	20
Evaluate	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration

100	40	60	2.5 hours

Evaluation shall only be based on application, analysis or design-based questions (for both internal and end semester examinations).

Continuous Internal Evaluation: 40 marks

Continuous Internal Evaluation Pattern:

- Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred) : 15 marks
- Course based task/Seminar/Data collection and interpretation : 15 marks
- Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination: 60 marks

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College.

There will be two parts; Part A and Part B.

Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions.

Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **221ECE073 SUSTAINABLE TECHNOLOGIES AND CLEANER PRODUCTION**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. "Cleaner production technology is a continuous environmental management approach" Justify this statement.
2. Is waste audit significant for waste audit in industries? What are the various types of data that are required to be collected in a paper manufacturing plant for the conduct of waste audit?
3. Explore any two pathways through which biomass can be converted to energy
4. Outline any two environmental certifications which are acceptable world wide
5. Consider a construction industry which generates a substantial volume of construction and demolition wastes. Suggest any 5 measures of pollution prevention which can be implemented there

5x5 = 25 marks)

PART B

(Answer **any 5** Questions)

6. Illustrate how source reduction techniques can lead to pollution prevention using any 4 examples, specifying a manufacturing industry
7. Demonstrate the role of industrial ecology in achieving sustainable development goals in the energy sector.
8. With the help of a flow chart, illustrate the six-step methodology for cleaner production, taking any suitable example
9. Can carbon trading be adopted as a suitable measure to combat environmental pollution for a country like China? Discuss in detail with suitable examples
10. Propose any three sustainable water management/conservation methods that can be adopted in an industry which makes use of water-intensive processes.

11. How do you proceed to achieve an internationally accepted global environmental standard for your institution? What are the benefits of achieving the same? Explain in detail with an example
12. Assume a conventional textile processing industry. Identify the major sources of pollution which can arise from various processes. Bring out any 10 measures with which cleaner production can be ensured in that industry.

(5x7=35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Concept of Pollution Prevention and Cleaner Production (8 h)**	
1.1	Importance - Historical Evolution – Benefits - Promotion - Barriers – Role of Industry, Government and Institutions - Environmental Management Hierarchy	2
1.2	Source Reduction techniques – Process and Equipment Optimization, Reuse, Recover, Recycle, Raw material substitution	3
1.3	Industrial Ecology – Pollution Prevention (PP) and Cleaner Production (CP) in achieving Sustainability- Prevention versus Control of Industrial Pollution -	3
2	**Cleaner Production Methodology (8 h)**	
2.1	Theory of cleaner production – Effect, Need and Barriers for Cleaner Production	2
2.2	Six step methodology for Cleaner Production - Total quality management - Project development and implementation – Overview of CP Assessment steps and skills, Preparing the site, Information gathering, and Flow diagram, Material balance, PP and CP Option generation, Technical and Environmental Feasibility analysis, Total Cost analysis - PP and CP Financing	3
2.3	Establishing a Program - Organizing a Program- Preparing a program plan - Measuring progress – Pollution Prevention and Cleaner Production Awareness Plan - Waste Audit- Environmental Statement	3
3	**Sustainable technologies (8 h)**	
3.1	Greenhouse gases and carbon credit- carbon sequestration- Sustainable development through trade - carbon trading – SDGs and cleaner production	2
3.2	Green technologies – Green technologies for sustainable water management, ZLD processes, Green computing, Intelligent Construction Machinery	3
3.3	Sustainable Energy - Energy production from biomass and wastes and energy conservation	3
4	**Life Cycle Assessment and Environmental Management Systems (8 h)**	
4.1	Economic, Environmental, and Social Performance Indicators LCA - Steps in conducting LCA - Life Cycle Costing	3

4.2	Environmental certifications - Eco labelling – Energy star Certified Carbon Neutral - The Global Organic Textile Standard – USDA Organic Green building certification – national and international	IN_TERDISIPLINARY-ID13
4.3	Good housekeeping – checklists and implementation International Environmental Standards - ISO 14001 – Eco Warranty	2
5	**Case Studies on Cleaner Production (8 h)**	
5.1	Cleaner production case studies - Industrial Applications of PP and CP, LCA, EMS and Environmental Audits in the following industries : Textile processing industry, Distillery, Paper mill, Dye manufacturing industry, Construction industry, Petroleum industry	8

Text Books

1. Misra Krishna B., "Clean Production: Environmental and Economic Perspectives", Springer, Berlin, Latest edition
   ISBN -13 :978-3-642-79942-6
2. Freeman, H.M, Industrial Pollution Prevention Handbook", McGraw Hill", latest edition
   ISBN-10 : 0070221480; ISBN-13 : 978-0070221482
3. Dr. Ruth Hillary, "Environmental Management Systems and Cleaner Production", Wiley, New York, Latest edition
   ISBN-10 : 9780471966623; ISBN-13 : 978-0471966623
4. Paul L. Bishop, "Pollution Prevention: Fundamentals and Practice", McGraw-Hill International, latest edition.
   ISBN-10 : 0073661473; ISBN-13 : 978-0073661476

Reference Books:

1. Environmental Life- Cycle Assessment- Marry Ann Curran, McGraw Hill, 1996.
   ISBN-10 : 007015063X; ISBN-13 : 978-0070150638
2. World Bank Group, "Pollution Prevention and Abatement Handbook-Towards Cleaner Production", World Bank and UNE, Washington D.C., latest edition.
   ISBN-10 : 082133638X; ISBN-13 : 978-0821336380
3. James G. Mann and V.A. Liu, "Industrial Water Reuse and Wastewater Minimization", McGraw Hill, 1999.
   ISBN-10 : 0071348557; ISBN-13 : 978-0071348553

Learning Websites:

i. h tp://www.gcpcgujarat.org.in/
ii. h tp://www.unido.org/ncpc.html

CODE	COURE NAME	CATEGORY	L	T	P	CREDIT
221ECE074	GIS AND REMOTE SENSING FOR ENVIRONMENTAL APPLICATIONS	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: Goal of this course is to expose the students to the fundamental concepts of satellite remote sensing and various applications of GIS in environmental engineering. After this course, students will be able to process satellite information and perform data interpretation using GIS to solve various environmental problems.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the concepts, physics and characteristics of remote sensing and the capabilities of various satellite sensors
CO 2	Perform digital image processing using remote sensing datasets
CO 3	Analyse the applications of GIS, GPS and Remote sensing in environmental science and engineering
CO 4	Apply knowledge on the spatial data analysis techniques and suggest solutions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	1	2	1	1	1	1
CO 2	3	1	2	1	2	1	1
CO 3	3	2	2	2	3	2	2
CO 4	3	2	2	2	3	2	2

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	20
Analyse	20
Evaluate	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

Original publications (minimum 10 publications shall be referred) :15 marks

Course based task/Seminar/Data collection and interpretation :15 marks

Test paper, 1 no. :10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain EMR and illustrate atmospheric windows.
2. Explain spectral reflectance for (i) vegetation and (ii) soil
3. Mention different types of platforms available for remote sensing with examples.

Course Outcome 2 (CO2)

1. Explain the terms: (i) Spectral resolution and (ii) Radiometric resolution.
2. Illustrate various image data formats commonly used for remote sensing
3. Discuss the image enhancement techniques in digital image processing

Course Outcome 3(CO3):

1. Discuss the mechanism involved in GPS to capture the location of a point
2. Differentiate vector data model and raster data model
3. Suppose you have downloaded a satellite image of your town from the internet. Describe the steps you will follow to (i) Get the shapefile of roads in your study area (ii) Demarcate the schools within 3km around landfill area in your map.

Course Outcome 4 (CO4):

1. Explain the terms: (i) Digitizing (ii) DEM (iv) Geospatial data
2. Explain any four methods involved in vector data analysis. Specify its applications
3. Illustrate the use of raster calculator

Model Question Paper

A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

221ECE074 GIS and Remote Sensing for Environmental Applications

Time : 2.5 Hours Max. Marks: 60

PART A

(Answer **All** Questions)

1. Explain and mention its use. (i)Spectral resolution (ii)Temporal resolution.
2. Define FCC. Mention its importance in remote sensing.
3. Define datum. Explain local datum & global datum with examples.
4. Briefly explain the role of control segment and ground antennas in GPS system.
5. Explain how GIS can be used for natural resource management

(5 x 5 marks = 25 marks)

PART B

(Answer **any 5** Questions)

6. a) Explain different types of platforms available for remote sensing with examples. (4 marks)
   b) Explain available digital image formats in remote sensing (3 marks)

7. a) Briefly explain the mechanism of push broom sensors and whisk broom sensors (3 marks)
   b) Explain how the position of a location is calculated in GPS (4 marks)

8. Explain the process involved in image rectification and restoration in digital image processing.

9. Differentiate with examples
   (i) Projected coordinate system and geographic coordinate system (3 marks)
   (ii) Vector data and Raster data (4 marks)

10. Explain any four methods involved in vector data analysis. Specify its application in mapping and network analysis.

11. Explain the following:
    (i) Georeferencing (2.5 marks)

(ii) Shape files (1.5 marks)
(iii) TIN (1.5 marks)
(iv) Metadata (1.5 marks)

12. Suppose you have downloaded a vegetation map from the internet. But the map is not in geographic coordinate system. Describe the steps you will follow to:
(i) Convert the coordinate system to geographic coordinate system. Mention the name of the process. (4 marks)
(ii) Get the shapefile for the area which is unsuitable for cultivation (3 marks)

(5 x 7 marks = 35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Introduction to Remote sensing (8 hours)**	
1.1	Physics of remote sensing, interaction of earth surface features with electromagnetic radiations, atmospheric windows, effects of atmosphere, spectral signatures	2
1.2	Types of remote sensing, active and passive measurements, platform characteristics, satellite orbits, Sensor characteristics-spatial, temporal, spectral, radiometric resolutions, principles of image processing, methods of encoding image data-BIL, BIP, BSQ, False Color Composite (FCC)	3
1.3	Elements of digital image interpretation, image correction techniques-atmospheric, geometric and radiometric, principles of photogrammetry, algorithms and data products.	3
2	**Application of Remote sensing (8 hours)**	
2.1	Analysis of land surface biophysical properties, land surface temperature, classification of land use and land cover-supervised and unsupervised techniques	3
2.2	Development of terrain models-DEM &DTM, soil type and soil moisture monitoring, vegetation indices	2
2.3	Remote sensing of environment- aerosol optical depth, air quality monitoring using satellite data, Remote sensing of water quality, flood mapping, ocean remote sensing for oil spill detection	3
3	**Introduction to GIS (8 hours)**	
3.1	Introduction to GIS, History and development of GIS, components of GIS, Coordinate reference systems, datum and projections, map scales	2
3.2	Georeferencing, Spatial data concepts, data sources in GIS, data input methods, file formats for GIS standard GIS packages.	3
3.3	Type of data, Spatial and attribute data, Data models- vector and raster, Spatial data structure- Vector data structure and raster data structure, Database management systems (DBMS), Relational database management systems (RDBMS)	3

4	**Data Analysis in GIS (8 hours)**	
4.1	Spatial data analysis, single layer operations- spatial and attribute query, buffer analysis, point pattern analysis, network analysis, surface analysis, Interpolation.	3
4.2	Multi-layer operations-topological overlays, point in polygon, line in polygon, polygon in polygon, logical operators-AND, OR, NOT, XOR, vector overlay operations-Clip, erase, split, union, identity and intersect; raster calculators	3
4.3	Global navigation satellite systems- types, Global positioning system-components and principle, satellite ranging- calculating position, GPS errors and biases, Differential GPS (DGPS)	2
5	**Application of GIS in environmental problems(8 hours)**	
5.1	Familiarising a GIS tool, Application of GIS in Urban planning, agriculture, landuse/land cover changes	3
5.2	Application of GIS in disaster management, natural resources management, Irrigation water management	3
5.3	Application of GIS in mapping and navigation, site suitability analysis for infra projects, environmental science, network analysis	2

Text Books

1. Lillesand T.M. and Kiefer R.W., Remote sensing and Image Interpretation, Second Edition, John Wiley and Sons, 1987.

2. AnjiReddy, M. Remote Sensing and Geographical Information System, BSP Publications., 2001

3.Chang, K (2005). Introduction to Geographic Information Systems, Tata McGraw Hills Edition, NewDelhi.

References

1.Manual of Remote Sensing, American Society of Photogrammetry and Remote Sensing, 1993.

2. Paul Curran P.J., Principles of Remote Sensing , ELBS, 1983.

3. Sabins F.F. Jr., Remote Sensing Principles and Interpretation, W.II. Freeman and Company, 1978.

4. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992.

5. Burrough P.A., Principles of GIS for Land Resources Assessment, Oxford Publication, 1980.

6. Jeffrey Star and John Estes, Geographical Information System – An Introduction, Prentice – Hall Inc., 1990.

7. Marble D.F., Galkhs H.W. and Pequest, Basic Readings in Geographic Information System, Sped System Ltd., New York, 1984.

8. Clarke, K.C. Parks B.O., and Crane M.P. (2006) Geographic Information systems and environmental modeling- PHI of India , New Delhi.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE075	MITIGATION AND ADAPTATION STRATEGIES IN CLIMATE CHANGE	PROGRAME ELECTIVE 1	3	0	0	3

Preamble: The course aims to enrich the understanding of causes, impacts, adaptive measures, and mitigation of climate change. The course also covers the global and regional level policies to control the factors influencing climate change.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Describe the physical principles of global climate system
CO 2	Identify the global initiatives to address climate change challenges and mitigation measures
CO 3	Analyse the impacts of climate change on various environmental components
CO 4	Demonstrate various adaptation techniques related to climate change issues
CO 5	Adopt suitable methodologies to mitigate the damages due to climate change

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1	2				1	
CO 2	1	2	1	1		3	
CO 3	1	2				2	1
CO 4	1	2	3		3	2	1
CO 5	1	2	3	3	3	2	1

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	15
Apply	20
Analyse	10
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer-reviewed Original publications (minimum 10 publications shall be referred) : 15 marks

Course based task/Seminar/ Data collection and interpretation : 15 marks

Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem-solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List and explain any 5 causes of climate change.
2. How does the human Footprint can be related to global warming?
3. Write a note on Greenhouse gases emission

Course Outcome 2 (CO2):

1. What were the main outcomes of the Paris conference?
2. What was the need for the National Action Plan on Climate Change (NAPCC)?
3. Write a note on various Social Movements against the factors influencing climate change.

Course Outcome 3(CO3):

1. Write a note on Life Cycle Assessment of Greenhouse Gas Emissions.
2. What are the impacts of climate change on agriculture and livestock?
3. Relate climate change with sea level rise. How does it affect the global economy?

Course Outcome 4 (CO4):

1. Explain some methods that can be adapted to provide food security in the current climate change scenario.
2. How can a city be redesigned to adopt climate change problems?
3. What is the role of green infrastructure against climate change issues?

Course Outcome 5 (CO5):

1. What is the critical difference between Carbon Capture and Storage (CCS) and Carbon Sequestration?
2. How can we reduce greenhouse gases in agriculture?
3. Explain the significance of the membrane capture technique for reducing carbon from the atmosphere.

Model Question Paper

APJ Abdul Kalam Technological University
M.Tech Degree Examination
Branch: **Civil Engineering**
Specialisation: **Environmental Engineering**

Subject: **221ECE075 MITIGATION AND ADAPTATION STRATEGIES IN CLIMATE CHANGE**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. What does the Paris outcome do to support the efforts of developing countries?
2. What are the impacts of climate change on crop production?
3. Demonstrate any one seasonal forecast method to control climate change.
4. How do biofuels help to control climate change?
5. Illustrate carbon dioxide sequestration method to mitigate climate change.

(5 x 5 marks = 25 marks)

PART B

(Answer any **FIVE** questions, Each question carries 7 marks)

6. What are the environmental indicators of climate change? Explain.
7. Explain the methodology to conduct the life cycle assessment of greenhouse gases.
8. Suggest modifications in National Building codes and standards as a measure to control climate change.
9. Explain any 3 sustainable energy sources. How the effective utilization of these resources affects climate-changing factors?
10. a. Differentiate between the long term and short term mitigation measures for climate change issues. (4 marks)
    b. How does the fuel efficiency in the transportation system contribute to the reduction of climate change impacts? (3 marks)
11. Write a note on the following Carbon Conversion Technologies:
    a. Gasification technology (3.5 Marks)
    b. Geological Storage (3.5 Marks)
12. How can we choose a suitable mitigation measure for a city? Explain with a case study.

(5 x 7 marks = 35 marks)

No	Topic	No. of Lectures
1	**Introduction to climate change (8 hours)**	
1.1	Atmospheric structure and composition. Causes of climate change.	1
1.2	Solar radiation and global energy budget. Climate forcing, Climate Feedback, Albedo Number	1
1.3	Environmental indicators and instrumental records	1
1.4	Human Footprints on global warming. Greenhouse gases emission scenario.	1
1.5	Ethics and Environmental Policy: International Initiatives: Climate Policies - UNFCCC, Paris Agreement, Montreal Protocol, SDG.	2
1.6	National Action Plan on climate change. State Action Plan on Climate Change. Social Movements and Global Civil Society.	2
2	**Loss and Damage Associated with Climate Change (8 hours)**	
2.1	Loss and Damage - on agriculture, Livestock, biodiversity, human health, Coasts and Estuaries.	5
2.2	Climate change vulnerability assessment	2
2.3	Economics of climate change.	1
3	**Climate Change Adaptation Needs and Practices (8 hours)**	
3.1	Geo-informatics in Climate Change Studies- Basic concepts	1
3.2	Improving preparedness – seasonal forecast and early warning- Responding to uncertainties (strategies to adapt an uncertain climate change)- Risk & recovery insurance, Food security.	3
3.3	Adapting cities for climate change: Infrastructure and planning, role of green infrastructure, changes in National Building codes and standards, ecosystem-based adaptation.	4
4	**Climate change Mitigation (6 hours)**	
4.1	Characteristics of mitigation in regional and national context; Long term and short-term mitigation options.	2
4.2	Energy Conservation and Fuel Efficiency, Renewable energy sources: Solar power, wave power, wind power, hydro power, Geothermal energy, nuclear energy and biofuels.	4
5	**Non-energy approaches to Climate Change Mitigation (10 hours)**	
5.1	Recovery – sequestration - disposal of greenhouse gases	2
5.2	Carbon Conversion Technologies: CO_2 Capture, Geological Storage, chemical absorption, membrane capture and gasification technology.	4

5.3	Mitigation of Flood related issues INTERDIS	IPLINARY-ID12
5.4	Case studies on climate disasters and mitigation	2

Text Books

1. Mark Masli, Climate Change: A Very Short Introduction, Oxford University Press, 2014.
2. Jepma C.J. and Munisinghe M, Climate Change Policy-Facts, Issues and Analysis, Cambridge University Press,1998.
3. Dessler A (2016) Introduction to Modern Climate Change. 2nd Edition. Cambridge University Press. ISBN: 978-521-17315-5

Reference Books

1. Navroz K. Dubash(2011), Handbook of Climate Change and India, Development, Politics and Governance Routledge.
2. Burroughs WJ (2007) Climate Change: A multidisciplinary approach. 2nd Edition. Cambridge University Press. Pp.390. ISBN: 978-0-521-69033-1
3. Barry RG and Chorley RJ. (2010). Atmosphere, weather and climate. 8th Edition. Routledge, New York. pp.421
4. Mitsutsune Yamaguchi (2012) Climate Change Mitigation Balanced Approach to Climate Change, Springer London Heidelberg New York ISBN 978-1-4471-4227-0
5. Wei-Yin Chen, Toshio Suzuki, Maximilian Lackner (2017) Handbook of Climate Change Mitigation and Adaptation, Springer (second edition) ISBN: 978-3-319-14409-2
6. Anil Markandya, Routledge Climate Change and Sustainable Development: Prospects for Developing Countries, 2002.
7. R.B. Singh, Disaster Management, Rawat Publication, New Delhi, 2006

SEMESTER I

PROGRAM ELECTIVE II

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE078	ENVIRONMENTAL HEALTH AND SAFETY	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: Environment Health and Safety , give practical suggestions for protecting the environment along with maintaining health and safety. It highlights the need for sanitation and safety in public and private spaces and equips the students to practise general hygiene and adopt various measures for the control of various communicable diseases. Hence this course is very beneficial as for practising Environmental engineers and students .

Course Outcomes: After the completion of the course the student will be able to

CO 1	To understand the mode of transmission and control measures of various communicable diseases
CO 2	To outline occupational and emerging diseases
CO 3	To formulate the procedures adopted for Survey and sample collection
CO 4	To discuss the Sanitation practices adopted in public spaces,
CO 5	To practice Occupational health and evaluate risk assessment

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			3				
CO 2			3				
CO 3	3	2		3	2	2	
CO 4	3	3		2	2	2	
CO 5				2	2	3	
CO 6							

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
original publications (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no. : 10 marks
Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:
The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question paper INTERDISCIPLINARY-ID1

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **221ECE078 ENVIRONMENTAL HEALTH AND SAFETY**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Discuss the etiology, mode of transmission and control measures of two viral diseases
2. Describe heavy metal toxicity on human health with two examples
3. Discuss the significance of emerging contaminants in the environment
4. Identify two Air borne pathogens and the methods for bioaerosol control
5. Outline the measures to be adopted for vector borne and zoonotic disease transmission and control
6. Summarize the major operations in a slaughterhouse

(5x5=25 marks)

PART B

(Answer **any 5** Questions)

7. Discuss three major Enteric diseases and their mode of transmission

8. Outline the importance of AMR Surveillance in the environment . Discuss the mechanisms of anti-microbial resistance exhibited by microorganisms

9. A food borne disease outbreak was reported in your community , list down the procedures to be adopted for sample collection ,following the outbreak

10. Outline the occupational health and safety practices to be adopted in a workplace

11. List down three major emerging diseases and their control measures

12. Summarize the sample processing techniques to be adopted if you are suspecting a protozoal diarrheal illness

13. The swimmers in a swimming pool are complaining about the quality of water Mention the steps to be followed to ensure water quality standards in the pool

(5x7=35 marks)

Syllabus and Course Plan (For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Communicable diseases**	
1.1	Infection and disease -Normal flora, pathogenicity, types and mode of transmission of diseases Bacterial diseases: pathogenicity, mode of transmission and control - Diarrhea, Typhoid , Cholera, TB , Plague	4
1.2	Viral diseases: pathogenicity, mode of transmission and control - Chicken pox, Measles, Mumps, Rabies, AIDS, polio, Dengue	2
1.3	Protozoal diseases: pathogenicity, mode of transmission and control - Malaria, Kala Azar, Gambia fever	2
2	**Occupational illness & Emerging diseases**	
2.1	Asbestos, Silica , Lead , Nickel ,Arsenic and Mercury toxicity	3
2.2	Pathogenicity, mode of transmission and control- COVID19, Ebola virus disease , Nipah viral diseases, Tick fever, Zika viral disease, Monkey pox	3
2.3	Antimicrobial resistance and risk factors	2
3	**Survey on food borne &water borne diseases**	
3.1	- Investigation of water and food borne diseases outbreaks-general, sanitary survey, medical survey, samples, epidemiologic reports	2
3.2	Environmental sample collection and processing-processing of soil and water samples for bacterial , viral and protozoal analysis . Risks from Pathogens in Biosolids	3
3.3	Water and Food borne illness-disease transmission and control Air borne pathogens and toxins , bioaerosol control	3
4	**Sanitation**	
4.1	Swimming Pool sanitation, Restaurant sanitation, Slaughter house sanitation, Milk plant sanitation and Sanitation of Hospitals.	4
4.2	Sanitation Related Diseases and Control Measure	2
4.3	Vector borne and zoonotic diseases-transmission and control	2
5	**Occupational health & Risk assessment**	
5.1	Accident Prevention and Elimination Plans, Fire Protection Techniques, Safety equipments	3
5.2	Radiation health -Biological effects of radiation , Bioterrorism , Emerging contaminants-pharmaceuticals and personal care products ,antibiotics, chemical household products, microplastics	3
5.3	Elements of risk assessment -hazard identification ,exposure assessment, dose response assessment, risk characterization ,microbial risk assessment	2
		40 hrs

Text Books

1. Raina.M.Maier, Ian L Pepper& Charles P Gebra, Environmental Microbiology, 2nd edition Elsevier India Pvt ltd, New Delhi, 2008.
2. P.D.Sharma,Microbiology,4th edition Rastogi publications, Meerut, 2019.
3. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi ,2006.

Reference Books

1. Environmental Engineering; Joseph A Salvato ,Nelson N Nemero, Franklin .J Agardy 5 th edition Wiley interscience publication,2003.
2. Slote.L, Handbook of Occupational Safety and Health, 2nd edition, John Willey and Sons, NewYork, 1999
3. Ernest Hodgson, A Text book of Modern Toxicology , 4 edition , John Willey and Sons, NewYork, 2010

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE079	INSTRUMENTAL AND ANALYTICAL TECHNIQUES IN ENVIRONMENTAL ENGINEERING	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: Instrumental and analytical techniques in Environmental Engineering includes studies and methods to separate, identify, and quantify parameters related with Environmental Engineering. This helps the students to create a thorough knowledge about research related activities in Environmental Engineering. This paper also covers the concepts of Chemistry related issues of Environmental Engineering. Hence this paper is very essential for Environmental Engineers and researchers.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To apply various Biochemical techniques in Environmental Engineering labs
CO 2	To analyse various biochemical parameters related with soil, water and air
CO 3	To formulate the procedures adopted for analysis of various test samples
CO 4	To discuss the various nanotechnology techniques for Environmental analysis
CO 5	To practice suitable novel methods for Environmental research applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1		3			3	2	
CO 2				3			3
CO 3		3	3	2	3	1	
CO 4		3		3		3	2
CO 5	3		3		3		3

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	14
Analyse	20
Evaluate	19
Create	7

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
Original publications (minimum 10 publications shall be referred): 15 marks
Course based task/Seminar/Data collection and interpretation: 15 marks
Test paper, 1 no.: 10 marks
Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **221ECE079 INSTRUMENTAL AND ANALYTICAL TECHNIQUES IN ENVIRONMENTAL ENGINEERING**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1) Discuss the importance of super fluid chromatography. How it is different from other chromatography techniques

2) Describe the working principle of AAS.Draw a neat, labelled diagram showing its working

3) Describe about nanocomposites. How is it useful in wastewater treatment?

4) Describe about the extraction of available ions and organic contaminants in soil

5) Describe the detailed procedure of GC-MS. Mention its applications

5×5 =25 marks

PART B

(Answer **any 5** Questions)

6) Point out nanochemistry applications in Environmental Engineering

7) Describe the principle of nephelometry. Mention the applications of fluorimetry

8) Explain Beer Lambert law. With a neat labelled diagram explain the working of a spectrophotometer

9) Suggest a suitable method for removal of heavy metals from wastewater sample

10) Explain air sampling techniques and analytical methods for monitoring SO_2 and NO_2

11) Explain the detailed procedure of SDS- PAGE. Mention its applications.

12) Discuss about any advanced method used for chemical compound identification.

5×7 =35 marks

Syllabus and Course Plan

(For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in the third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Introduction to Environmental Chemical analysis**	
1.1	Soils: Sampling and storage, Pre-treatment, Extraction of organic contaminants, extraction of available ions-Dissolution technique for the determination of total metal concentration in soil- Determination of pH, Cation Exchange Capacity (CEC), total and available metal ions	3
1.2	Air: Air sampling techniques and analytical methods for monitoring SO_2, NO_2, CO, H_2S and Suspended Particulate Matter (SPM).	3
1.3	Water and Wastewater: Sampling - grab and composite sampling, preservation, storage, pre-treatment	2
2	**Principles and applications of Analytical Techniques**	
2.1	Principles and applications (any three for each) of selected analytical methods used in environmental chemical analysis: Titrimetry, Gravimetry, Colorimetry	3
2.2	Principle, instrumentation and applications of Amperometric titrations (sulphate, Magnesium, lead) Conductometry- Measurement of conductance, TDS, conductometric titration-acid-base, precipitation (chloride estimation).	2
2.3	Principle and applications of Nephelometry and Turbidimetry, Turbidimetric titration (Ba^{2+} Vs Sulphate) Potentiometry – acid base titrations	2
3	**Spectrophotometry and X-ray Techniques**	
3.1	Principle, Instrumentation and applications of UV Visible spectrophotometry, IR Spectrophotometry	3
3.2	Principle, instrumentation and applications of Atomic Absorption Spectroscopy (AAS), Atomic Emission Spectrophotometry-Flame photometry, Inductively Coupled Plasma Mass Spectrometry (ICP-MS)	2
3.3	Basic principles and applications of X-Ray Fluorescence spectroscopy (XRF), X-Ray Diffraction studies and X-Ray Photoelectron spectroscopy (XPS)	3
4	**Advanced separation techniques**	

4.1	General principle of chromatography, Definitions-Elution, Retention time, Retention volume, Normal and Reverse phase chromatography, Retention factor. Theory, instrumentation and applications Gas Chromatography, High-Pressure Liquid Chromatography (HPLC), Gel permeation Chromatography (GPC), and Ion-exchange chromatography	4
4.2	Electrophoresis and its applications, capillary electrophoresis. Gel electrophoresis: SDS- PAGE,	3
4.3	Isoelectric focusing, 2-D gel electrophoresis and their applications in Environmental Engineering	2
5	**Nanotechnology techniques used in Environmental Engineering**	
5.1	Nanometerials-Definition, classification, characteristics. Nanocomposites. Air purification using nanomaterials. Wastewater purification with nanobubbles, nanosorbents, nano filtration systems for heavy metals.	3
5.2	Nano biosensors -glucose biosensors, alcohol biosensors. Nano particles for degradation of organic pollutants.	2
5.3	Metal/Metal oxide nanoparticles for water treatment, Anti-microbial activity of silver nanoparticles-mechanism, Zerovalent Iron nanoparticles-synthesis, heavy metal removal Silica nanoparticles-synthesis, functionalisation and applications, Carbon nano tubes, Dendrimers, Quantum dots and nano sponges- definition, synthesis and environmental applications.	3
		40 hrs

Text Books

1. S.K. Banerjee –Environmental Chemistry, 2004.
2. Chatwal and Anand Instrumental methods of analysis, Dhanpat Rai, 2001
3. Clair N. Sawyer, PeryL. Mc Carty, Chemistry for Environmental Engineering, McGraw Hill, 2002
4. Maheshwar Sharon, Madhuri Sharon (2012). “Bionanotechnology”. CRC PressINC, ISBN: 1439852146, 9781439852149.

Reference Books

1. Holtzhauer, M. (2006) Basic Methods for the Biochemical Lab. 1st English edition. Springer.
2. Cantor, C. R. and Schimmel, P. R. (1980) Biophysical Chemistry. Part III. 1st edition. W. H. Freeman & Co.
3. Popek, E.; (2017). “Sampling and Analysis of Environmental Chemical Pollutants, A Complete Guide”. 2nd Edition, ISBN: 9780128032022, Elsevier
4. Andrew, D. E.; Lenore, S. G.; Eugene, W. R.; Arnold, E. G.; (Eds) (2005). “Standards Methods for the Examination of Water and Wastewater Analysis”. 21st Edition, APHA, Washington DC

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE080	ENVIRONMENTAL SYSTEM MODELING	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: This course aims to provide introduction to the fundamental modelling concepts and their applications in simulating the pollutant fate and transport in the natural environmental systems. The mathematics behind various environmental pollution models with their uncertainties will be discussed.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To Recognize the complex structure of environmental systems and understand the basic concepts and terminology in environmental modelling and development.
CO 2	To Mathematically formulate the fate and transport of pollutants for environmental systems.
CO 3	Simulate the fate and transport of contaminants in water, air and noise environments.
CO 4	Interpret the results for decision support and management.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3						
CO 2	3						
CO 3		3	2	2			
CO 4		3	2	2	3	2	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	10
Analyse	10
Evaluate	20
Create	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
Original publications (minimum 10 publications shall be referred): 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no.: 10 marks
Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the classification of mathematical models.
2. Explain how advection-diffusion equation is useful for modelling contaminant transport in ground water.
3. Explain how receptor models can be used for source apportionment.

Course Outcome 2 (CO2)

1. A lake with a single inflow stream has the following characteristics:
   Volume of the lake=9 $x10^6$ m^3
   Q = 2.8 m^3/s
   An industrial plant directly discharges a slow reacting pesticide triallate at 490 kg/day for 1.5 years. After that the loading is terminated. The initial pesticide concentration in the lake is zero. Assume rate constant k=0.23/year. Write a mass balance equation for traillate for the above system, if inflow=outflow.
2. Explain how the air pollution due a line source like a highway can be modelled.
3. Discuss how chemical reactions/transformations are incorporated in the transport of contaminants in ground water.

Course Outcome 3(CO3):

1. An effluent with concentration of 1250 mg/L is leaking from a landfill to an aquifer with a hydraulic conductivity of 9.8m/day, hydraulic gradient of 0.004 and an effective porosity of 0.15. What are the concentrations in monitoring wells at a distance of 25 m and 100 m away from the landfill, 300 days after the leak began. Effective Diffusion coefficient=0.75$x10^{-9}$ m^2/s. Retardation factor of effluent is 1.87.
2. A factory emits 20 g/s of SO_2 at an effective height of 80m. The wind speed = 3 m/s. At a distance of 1 km downstream, σy and σz are 150 m and 87 m respectively. What are the SO_2 concentrations at the centerline of the plume and at a point 60 meters to the side and 20 meters below the centreline.
3. The initial BOD of a river just below a sewage outfall is 25 mg/L. The oxygen deficit just upstream from the outfall is 2 mg/L. The deoxygenation rate coefficient is 0.4/day, and the reaerationrate coefficient is 0.7/day. The river is flowing at a speed of 30 km /day. (a) Find the critical distance downstream at which DO is a minimum(b) Find the minimum DO. Assume a saturation DO of 9 mg/L.

Course Outcome 4 (CO4):

1. A lake with a single inflow stream has the following characteristics:
   Volume of the lake=9 $x10^6$ m^3
   Q = 2.8 m^3/s
   An industrial plant directly discharges a slow reacting pesticide triallate at 490 kg/day for 1.5 years. After that the loading is terminated. The initial pesticide concentration in the lake is zero. Assume rate constant k=0.23/year.

a. Write a mass balance equation for traillate for the above system, if inflow=outflow
b. If the lake is at steady state, compute the in-lake traillate concentration.
c. Determine the maximum concentration of the pesticide
d. Determine the time required for the concentration of triallate to reduce to 100µg/L after termination of loading.

2. An industry applied for a discharge permit to discharge 15000 m^3/day of sewage into a stream. The effluent discharge has a BOD_5 of 150 mg/L, temperature of 25°C and a DO of 4.2 mg/L. The stream characteristics upstream of the point of discharge are as follows:
   Flow rate= 15000 m^3/day
   Temperature= 22°C
   BOD_5= 3 mg/L &
   DO= 8.0 mg/L. Mixing of the effluent and the stream is instantaneous and the velocity of the combined flow was evaluated as 0.2 m/s. 5 kilometers from the point of discharge the stream meets a river having a discharge of $4.5x10^5$ m^3/day, BOD_5= 5 mg/L, DO= 8.0 mg/L and temperature of 23°C. What limitations must the agency impose on the discharge permit if the water quality standard for BOD_5 in the river is 3 mg/L? Decay coefficient for BOD is 0.23/day.
3. A stack emitting 80 g/s of NO_2 has an effective stack height of 100 m. The wind speed is 4 m/s at 10 m, assume stability condition D. Given σy=150m and σz=87m. Estimate the ground level NO_2 concentration:
   a. Directly downwind at a distance of 2 km
   b. Maximum ground level concentration
   c. At a point located 2 km downwind and 0.1 km off the downwind axis
   d. If the ambient air quality standard for NO_2 is 80 µg/m^3, assess whether the emission violates the Ambient air quality standard at 2km downstream to point of discharge.

Model Question Paper

221ECE080

Reg.Number…….
Name……..…….

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **221ECE080 ENVIRONMENTAL SYSTEMS MODELING**

Time: 2.5 Hours **Max. Marks: 60**

PART A
Answer All Questions

1. A model can never represent the reality. Explain
2. What is the significance of maximum mixing depth in air pollution engineering?
3. Explain briefly the applications of Streeter Phelps Model.
4. What are the major causes of saline water intrusion in aquifers?
5. What do you mean by Equivalent Continuous Sound Pressure Level?

5 x 5 marks = 25 marks

PART B
Answer any 5 Questions

6. What are the different classifications of mathematical models?
7. A thermal power plant uses coal that contains 5% sulphur and burns at the rate of 5 tonnes per hour and discharges effluents through a stack 200 m high and 1 m inside diameter. The other parameters are: wind speed at the effective stack gas velocity=8.5 m/s.

   Air temperature = 35 °C

   Barometric Pressure = 1000 mbar

   Stack gas velocity = 10m/s

   Stack gas temperature = 150 °C

   The atmospheric stability class is C.

   a. Determine the ground level concentration of SO_2 at a distance 2 km downwind from the stack along the plume axis.

b. Assuming an effective stack height of 85 m but with the same wind velocity, determine the ground-level concentration at this distance.
c. Determine concentration at the plume centre line.

8. What is receptor modelling? What are the different types of receptor models? Explain briefly its uses.

9. A town located downstream to a SEZ has filed a complaint that the discharge of effluent from the Industrial area is restricting its use of the water in the river. The CPCB criterion for the section of river under consideration is 5 mg/L of DO. If the town that filed the complaint is 16 km downstream from the point of discharge is this complaint valid? What is the critical DO and at what distance downstream does it occur? Is the assimilative capacity of the river restricted? The following data can be used to make your decision.

Parameter	Effluent Discharge	River water (upstream to point of discharge)
Flow, m^3/s	0.15	1.08
BOD_5@20°C, mg/L	128	11.4
DO, mg/L	1.00	7.95
Temperature	22°C	20°C
Velocity, m/s	-	0.4
K_1@20°C	0.23	
K_2@20°C	0.43	

The saturated DO concentration of the river water at different temperatures is given as follows

Temperature°C	18	20	22	23	24	25	26
Cs (mg/L)	9.54	9.17	8.99	8.83	8.53	8.38	8.22

Temperature coefficients (θ) for K_1 is 1.04 and for K_2 is 1.02.

10. A lake has the following characteristics:

Volume = I x 10^6 m^3

Surface Area = I x 10^5 m^2

Water residence time = 0. 75 yr

A soluble pesticide is input to the lake at a rate of 10 X 10^6 mg/year. The in-lake concentration is 0. 8 μg/L.

(a) Determine the inflow concentration (assume inflow = outflow).

(b) Determine the transfer function.

(c) If the only removal mechanism (other than flushing) is volatilization, compute the flux of the pesticide out the lake's surface and to the atmosphere.

11. Chloride enters an aquifer as a line source with a concentration of 600 mg/L. The aquifer properties are as follows. Hydraulic Conductivity=$2.5x10^{-5}$m/s; Hydraulic

gradient=0.001; Effective Porosity=0.25; Effective Diffusion coefficient=0.75×10^{-9} m^2/s. Determine the chloride concentration at a distance of 25m from the source after 1 year,2 years and three years. Fig 1 can be used to calculate the error function.

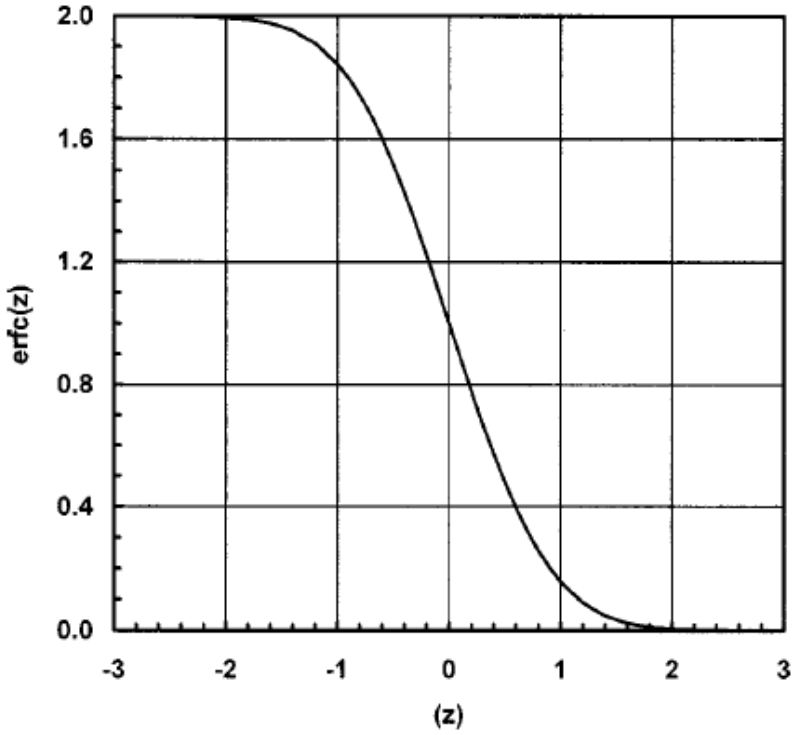

Fig 1: Graphical representation of the complementary error function erfc(*z*)

12. (a) Discuss the need for environmental noise modelling
    (b) Explain noise mapping methodology

5 x 7 marks = 35 marks

Syllabus and Course Plan

INTERDISCIPLINARY-ID1

(For 3 credit courses, the content can be for 40 hrs and 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Module 1: Total Lecture Hours - 6**	
1.1	Role of models in environmental pollution studies- Environmental management and modelling -modelling principles	2
1.2	Types of models-classification of mathematical models-deterministic, stochastic, continuous, discreet, static, dynamic, linear and non-linear	2
1.3	Model building framework-model calibration, validation, verification and sensitivity analysis-model scales, error and uncertainty	2
2	**Module II: Total Lecture Hours- 9**	
2.1	Air pollution modelling: Transport and dispersion of air pollutants-Atmospheric stability-lapse rates and dispersion-plume behaviour-maximum mixing depth	2
2.2	Estimating concentrations from point sources – dispersion modelling- Gaussian Plume Model – determination of dispersion parameters.	3
2.3	Receptor models-Chemical Mass Balance (CMB) and Positive Matrix Factorization (PMF) models	2
2.4	Box models- line source model-area source model-puff model	2
3	**Module III: Total Lecture Hours-9**	
3.1	Water quality modelling: historical development of water quality models	1
3.2	River hydrology and flow– low flow analysis – Discharge of pollutants into rivers-Behaviour of conservative and non-conservative substances-transport-advection, diffusion and dispersion	2
3.3	Dissolved oxygen in rivers, Streeter-Phelps equation, modification to Streeter-Phelps Equation	3
3.4	Modelling lake water quality-mass balance for well mixed lakes-steady state solution-transfer function and residence time - dynamic state analysis (simple cases only)	3
4	**Module IV: Total Lecture Hours- 9**	
4.1	Groundwater modelling: use of ground water models ground water flow modelling-Darcy's law-ground water flow equations for homogenous, heterogenous, isotropic and anisotropic conditions	3

4.2	Mass transport of solutes-transport and transformation of contaminants in groundwater-the transformation processes–the non-reactive processes, the reactive processes-simulation of transport and transformation processes, formulation of the governing equations, initial and boundary conditions-solutions for simple cases.	3
4.3	Seawater intrusion- Ghyben–Herzberg Principle – basic concepts and modelling	3
5	**Module V: Total Lecture Hours- 7**	
5.1	Environmental noise - noise generation mechanisms- need for noise modelling	2
5.2	Modelling inputs-sound propagation factors- Equivalent Continuous Sound Pressure Level (Leq)	2
5.3	Noise mapping methodology-modelling traffic noise	3

Textbooks

1. ARAL, Mustafa Aral. Environmental modeling and health risk analysis *(*ACTS/RISK). Springer Science & Business Media, 2010.
2. R.W. Boubel, D.L. Fox, D.B. Turner & A.C. Stern, Fundamentals of Air Pollution Academic Press, New York, 1994
3. Steven C. Chapra, Surface Water Quality Modeling, The McGraw-Hill Companies, Inc., New York, 1997.
4. Todd David Keith, Ground water Hydrology, Fourth edition, John Wiley and Sons, New York, 2004.
5. Murphy, Enda, and Eoin A. King. Environmental noise pollution: Noise mapping, public health, and policy. Elsevier, 2022.

Reference Books

1. Nirmalkhandan N. (2001) Modeling Tools for Environmental Engineers and Scientists, CRC Press, Boca Raton, Florida.
2. Schnelle K.B. and Dey P.R. (1999) Atmospheric Dispersion Modelling Compliance Guide, McGraw-Hill.
3. Thomann R.V. and Mueller J.A. (1987) Principles of Surface Water Quality Modelling and Control, Harper & Row, New York.
4. Randall J. Charbeneau, Ground water Hydraulics and Pollutant transport, Prentice Hall, Upper Saddle River, 1999.
5. Canter LW. Environmental impact assessment. Impact Assessment. 1982 Jun 1;1(2):6-40.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE081	ECOLOGICAL ENGINEERING	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: This course aims to expose the students to the fundamental concepts of ecology, biodiversity and the need for its conservation. After this course, students will be able to assess the value of biodiversity and able to analyse the impact of human activities on the ecosystem and suggest mitigation measures to restore the ecosystem

Course Outcomes: After the completion of the course, the student will be able to

CO 1	To point out the basic concept and functions of an ecosystem
CO 2	To evaluate various elements of biodiversity and able to identify the impacts on biodiversity
CO 3	To judge community organization and various biogeochemical cycles involved in a community
CO 4	To summarise the effects of pollutants on the ecosystem
CO 5	To analyse various biodiversity indices

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3		2			3	
CO 2			3	3	2		
CO 3	2		3		3		
CO 4	3		2			3	
CO 5			2	3	3		

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	10
Analyse	10
Evaluate	20
Create	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Micro project/Course based project : 20 marks

Course-based task/Seminar/Quiz : 10 marks

Test paper, 1 no. : 10 marks

The project shall be done individually. Group projects are not permitted. Test paper shall include a minimum of 80% of the syllabus.

End Semester Examination Pattern: 60 marks

The end semester examination will be conducted by the respective college. There will be two parts; Part A and Part B. Part A contain 5 numerical questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem-solving and quantitative evaluation), with a minimum of one question from each module of which student shall answer any five. Each question can carry 7 marks. The total duration of the examination will be 150 minutes.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. To understand the basic components and structure of ecosystems

2 To explain the structure and functions of ecosystem

3. To assess the relevance of echo technology to human civilization

Course Outcome 2 (CO2):

1. To evaluate various elements of biodiversity and able to identify the impacts on biodiversity

2. To measure Biodiversity depletion its causes and consequences

3. To organize Biodiversity conservation activities

Course Outcome 3 (CO3):

1. To discuss various biogeochemical cycles involved in a community

2. Explain Ecological Succession and different steps involved in ecological Succession

3. To outline Ecological Niche and various interactions between species:

Course Outcome 4 (CO4):

1. To summarise the effects of pollutants on the ecosystem

2. To propose various ecotechnological methods for waste treatment and ecosystem restoration

Course Outcome 5 (CO5):

1. To quantify various biodiversity parameters

2. To demonstrate the concepts and principles of eco-informatics-concepts and principles

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **Environmental Engg, Environmental Engg and Management**

Subject: **221ECE081 ECOLOGICAL ENGINEERING**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Give an illustrated account of the structure and function of an ecosystem.
2. Explain Ecological efficiencies and discuss the different elements of biodiversity?
3. "Carbon cycle" has a major role in the ecosystem justify?
4. What are organochlorine pesticides? Summarize the impacts of pesticides on the ecosystem?
5. Illustrate the principle and application of ecoinformatics

(5x5 = 25 marks)

PART B

(Answer **any 5** Questions)

6. What are biodiversity hotspots? Discuss various biodiversity hotspots in India and explain their importance?
7. Differentiate Geographic speciation and Sympatric speciation
8. Explain the importance of biogeochemical cycles in the ecosystem?
9. Discuss the general effects of air, water and land pollutants, on the environment?
10. Describe ecological succession mentioning the various processes involved in it and the types of ecological succession
11. Discuss the pollution removal techniques adopted for wetland ecosystems
12. Compare the species diversity indices of Simpson and Shannon-Wiener

(5x7=35 marks)

(For 3 credit courses, the content can be for 40 hrs and 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Fundamentals of Ecology**	**8 hrs**
1.1	Components of Ecosystem-Structure-function and size of the ecosystem Scope and application of ecotechnology- Relevance of echo technology to human civilization- -	**2**
1.2	Natural eco-systems ecological Food chains, Food webs and Ecological pyramids- Structure and functions of an ecosystem - Producers, consumers and decomposers Productivity and ecological efficiencies	**2**
1.3	Ecosystem degradation - Resource utilisation- - important types of ecosystems in India (e.g., Wetland ecosystem including estuaries, tidal marshlands, swamps, lakes etc.) Aquatic ecosystems (ponds, lakes, streams, rivers, estuaries, oceans)-	**4**
2	**Biodiversity**	**8 hrs**
2.1	Types and elements of biodiversity- Composition and levels of biodiversity- Biodiversity Hotspots - Concepts of diversity- Diversity in ecosystems and habitat classification	**4**
2.2	Biodiversity depletion-causes and consequences- Human impacts on biodiversity. Biodiversity and its conservation ecosystems - speciation and extinctions	**4**
3	**Community organization and Energy flow**	**8hrs**
3.1	Nutrient cycles-Energy Flow- Biogeochemical Cycles-Trophic Relations-Food chain,	**3**
3.2	The energy cycle - Integration of cycles in nature- Ecological Succession-Kinds of Succession (Hydrarch and Xerarch)	**2**
3.3	Community Organization: Ecological Niche-Interactions between species: Competition-Predation-Mutualism-Commensalism-Parasitism-Allelopathy	**3**
4	**Effects of pollutants on ecosystem**	**8hrs**
4.1	General effects of air, water and land pollutants, biological interactions with pollutants. Ecosystem responses to deoxygenating, nutrient enrichment, pesticides, hydrocarbons etc.	**4**
4.2	Ecotechnology for waste treatment-wetlands and ponds. Restoration, Reclamation, and Regeneration of Degraded or Destroyed Ecosystems.	**4**
5	**Applied Ecology**	**8hrs**
5.1	Estimating Abundance: -Mark and Recapture Method -Quadrat and Line Transects-Distance and Removal Methods-Trapping and Collection Techniques-Census technique for Avifauna and Wildlife	**2**
5.2	Species Diversity measures: -Species Richness-Species Heterogenicity (Simpson's Indices, Shannon-Wiener Indices)- Vegetational Profile assessments- Taxonomy and Biosystematics	**2**
5.3	Eco-informatics-concepts and principles	**2**

Text Books

1. Krebs C J (1989), Ecological methodology, Harper Collins Pub. New York
2. Kurian Joseph & R. Nagendran, Essential Environmental studies, Pearson Education, New Delhi,2004.
3. Michael P (1990), Ecological methods for laboratory and Field Investigations, Tata McGraw Hill Publishing Company Limited, New Delhi.
4. Mitsch, J.W & Jorgensen, S.E, Ecological Engineering-An Introduction to Ecotechnology, John Wiley & Sons, New York 1989.
5. Rana.S.V.S.(2005)Essentials of Ecology and Environmental Science,Prentice Hall of India,New Delhi.

Reference Books

1. Etnier, C. and Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers, NewYork, 1997.
2. Eugene P Odeum, Garry W Barrett, Fundamentals of Ecology, Brooks Cole, 1997.
3. Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and Practice, Lewis Publishers, New York, 2003.

SEMESTER II

Discipline : INTERDISCIPLINARY

Stream : ID1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222TCE007	SOLID AND HAZARDOUS WASTE MANAGEMENT	DISCIPLINE CORE 2	3	0	0	3

Preamble: Solid and Hazardous Waste Management covers the concepts related to various solid wastes, their origin, characteristics, treatment and the legal aspects. This course also addresses the various functional elements that constitute the integrated solid waste management systems. This provide safe recycling and disposal options for special wastes that may pose harm to the environment and /or to public health and safety. This also make the students aware of advanced principles related to the separation, processing and transform technologies of Solid and Hazardous Wastes.

Course Outcomes: After the completion of the course the student will be able

CO 1	To understand the sources, types and characteristics of solid waste
CO 2	To analyse the different solid waste collection systems
CO 3	To evaluate the adequacy of the different transfer and transportation means and methods
CO 4	To apply the scientific knowledge in the analysis and design of landfills and integrated waste management facilities
CO 5	To understand the different disposal methods for hazardous and biomedical wastes.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2	3	1	3	1	
CO 2	2	2	3	3	3	3	2
CO 3	3	3	3	2	3	3	2
CO 4	2	2	3	3	3	2	2
CO 5	3	3	3	3	3	3	1
CO 6							

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	20
Evaluate	15

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Micro project/Course based project: 20 marks

Course based task/Seminar/Quiz: 10 marks

Test paper, 1 no. : 10 marks

The project shall be done individually. Group projects are not permitted. Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern: 60 marks

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **Environmental Engineering**

Subject: **220CE207 SOLID AND HAZARDOUS WASTE MANAGEMENT**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer all questions)

1. What are the components that make municipal solid waste?

2. Calculate the number of collection vehicles a community would need if it has a total of 4000 services (customers) that are to be collected once per week during working days in a city. Assume that a truck can serve about 300 customers before the truck is full and a trip to the landfill is necessary.

3. Discuss the choice and capacities of containers used in onsite handling of solid waste

4. What are the transfer and transport operations?

5. Which are the factors affecting the selection of a landfill site? (5X5=25)

PART B

(Answer any **5** questions)

6 Find approximate chemical formula of the organic component of the sample composition of a solid waste as set out in the following table. Use chemical composition obtained to estimate energy content of this solid waste. 7

Component	**% by mass**
Garden trimmings	10
Food waste	25
Timber	4
Paper	38
Cardboard	13
Rubber	4
Tin cans	6

7 Discuss the different waste collection systems with neat sketches 7

8	a	A binary separator has a feed rate of 1 ton/h. It is operated so that during any 1 hour, 700 kilograms reports as output (1) and 300 kg as output (2). Of the 700 kg the x constituent is 650 kg, while 70 kg of x ends up in output 2. Find the recoveries and the effectiveness of separation using different methods.	4
	b	Explain the design considerations of aerobic composting	3
9	a	Estimate production of CO2 and CH4 during the anaerobic decomposition of municipal solid waste, MSW using the chemical composition approximation of organic fraction of refuse as described by C99H149O59N.	4
	b	Discuss in detail the working of any **two** types of incinerators with neat sketches	3
10		A material recovery facility has to be constructed so as to achieve a maximum reduction in the waste reached at the collection facility. Discuss the various available methods for the recovery of materials.	7
11	a	Explain the life cycle of a landfill.	4
	b	Assume that refuse has the following components and bulk densities:	3

Component	% by weight	Uncompacted bulk density (lb/ft3
Miscellaneous paper	50	3.81
Garden waste	25	4.45
Glass	25	18.45

Assume that the compaction in the landfill is 44.4 lb/ft3. Estimate the percent volume reduction achieved during compaction of the waste. Estimate the overall uncompacted bulk density if the miscellaneous paper is removed

12	Discuss the classification procedure of hazardous wastes with suitable examples	7

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Solid waste management**	
1.1	Legal and Organizational foundation - Definition of solid waste-waste generation in a technological society- major legislation, monitoring responsibilities	4
1.2	Sources and types of solid waste- sampling and characterization-Determination of composition of MSW, Energy content. Storage and handling of solid waste. Generation of solid wastes, Factors affecting waste generation and composition	4
2	**Collection and storage of solid wastes**	
2.1	Collection and transport of solid waste- Collection of Solid waste- Type of waste collection systems, analysis of collection system-Collection routes, Alternative techniques for collection system.	4
2.2	Transfer and Transport: Need for transfer operation, transport means and methods, transfer station types and design requirements	4
3	**Separation and Processing and Transformation of Solid Waste:**	
3.1	Unit operations used for separation and processing, Materials Recovery facilities, Mechanical volume reduction– chemical volume reduction- mechanical size reduction-	4
3.2	Waste transformation through combustion and composting , Aerobic composting, Anaerobic methods for materials recovery and treatment- Recycling of plastic materials and metals.Energy recovery options – Incinerators, RDF.	4
4	**Landfills**	
4.1	Landfills: Site selection, design and operation,	3
4.2	Drainage and leachate collection systems – requirements and technical solutions, designated waste landfill remediation –	3
4.3	Landfill gas, Integrated waste management facilities, Landfill closure.	2

5	**Hazardous waste management**	
5.1	Hazardous waste –Definition and Identification, Classification, Regulations, Handling and Storage,Collection, Transportation , Stabilization and Solidification, Thermal methods, Secure Landfill.	3
5.2	Waste minimization and resource recovery Treatment and remedial actions, Physico-chemical processes ,Biological methods,	2
5.3	Biomedical waste disposal.Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection,design and operation – remediation of hazardous waste disposal sites	3

Text Books

1. Technobanoglous et al –Integrated Solid Waste Management, McGraw-Hill

2. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw-Hill, New York, 1993

References

1. Charles A. Wentz – Hazardous Waste Management, McGraw- Hill

2. Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000

3. Vesilind, Worrell, Reihhart, Solid Waste Engg, RCRA Orientn Mnaula 2006, US EPA

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222TCE008	BIOLOGICAL WASTEWATER TREATMENT	PROGRAM CORE 3	3	0	0	3

Preamble: Biological wastewater treatment covers the different biological methods of wastewater treatment and related issues. The course is designed to create awareness among the students about the importance of wastewater treatment, and also to develop skill in the basic design of unit operations and unit processes in the biological wastewater treatment. This course also gives awareness to the student about the management of the sludge resulting from the treatment of wastewater.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To understand the objectives and types of biological treatment processes, and role of micro-organisms in wastewater treatment plant
CO 2	To explain the Menten and Monod models of treatment kinetics and methods of evaluation of kinetics constants.
CO 3	To synthesize the details of activated sludge treatment systems, apply in its modelling, design of TF and to identify the process description of sequencing batch reactor
CO 4	To analyse the process design considerations of tricking filter, different types of aerated lagoon and stabilization pond .
CO 5	To understand various treatment and disposal methods of sludge from biological treatment processes.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		3	3	2	1	
CO 2	2		3	3	2	1	
CO 3	2		3	2	3	3	2
CO 4	2		3	2	3	3	2
CO 5	2		3	2	3	3	1

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	20
Analyse	20
Evaluate	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Micro project/Course based project : 20 marks

Course based task/Seminar/Quiz : 10 marks

Test paper, 1 no. : 10 marks

The project shall be done individually. Group projects not permitted. Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern: 60 marks

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A contain 5 questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with minimum 1 question from each module, having 5 marks for each question. Students shall answer any five. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student shall answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **Environmental Engineering**

Subject: **222TCE008 BIOLOGICAL WASTEWATER TREATMENT**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **all** questions)

1. The rate of BOD reduction in aeration of a synthetic wastewater decreased by 20% when the temperature of the fermentation tank was lowered from 20 to 16^{o}C. Determine the temperature coefficient**.**
2. Define net specific growth rate of bacteria with the help of MONOD's model.
3. Write a note on sludge production and process control in ASP.
4. Explain the classification of Trickling filters.
5. What are the various methods of stabilization of sludge? (5X5=25)

PART B

(Answer **any 5** questions)

6	a	" All proteins are not enzymes." Explain your views with respect to this statement.	4

	b	Calculate μ_{max} for the given population assuming exponential growth	3

Time (d)	Biomass (mg/L)
0	50
1	75
2	111
3	166
4	248
5	369

7	a	With neat sketches explain the Monod equation for bacterial growth	4
	b	Distinguish between Yield coefficient and decay coefficient	3
8		Discuss the advantages of a Sequencing Batch Reactor with that of a conventional ASP. Explain in detail its working and design with neat sketches.	7
9		Determine the values of kinetic constants using the following data derived from bench scale using a CSTR without recycle	7

	1	2	3	4	5
S0	300	300	300	300	300
S	7	13	18	30	41
θc	3.2	2	1.6	1.1	1.1
X	128	125	133	129	121

10	a	Design a single stage high rate trickling filter for average incoming flow of 5.0 million liters per day. BOD_5 of primary effluent 220 mg/L, final effluent BOD_5 desired is 30mg/L. Assume the recirculation ratio as 1:4.	4
	b	Compare low rate and high rate trickling filters	3
11		Design an oxidation pond for serving a population of 5000 persons. Assume the rate of water supply as 150l/c/d and 5 day BOD of sewage as 250mg/l.	7

12 a Determine the liquid volume before and after digestion and % reduction for 500kg of primary sludge having the following characteristics 4

	Primary	Digested
Solids (%)	6	12
Volatile matter (%)	65	65 (destroyed)
Specific gravity of fixed solids	2.5	2.5
Specific gravity of volatile solids	1.0	1.0

b Discuss the different methods of sludge conditioning 3

Syllabus and Course Plan

No	Topic	No. of Lectures
1		
1.1	Objectives of biological treatment – Role of enzymes in wastewater treatment, Enzyme kinetics, Factors affecting rate of reactions, Types of biological processes for wastewater treatment	4
1.2	Different microbial metabolisms – Bacterial growth patterns	4
2		
2.1	Microbiological treatment kinetics and flow regimes – Michaelis-Menten and Monod models	3
2.2	Rate of biomass growth with soluble substrates – Kinetic coefficients – Effect of temperature – Oxygen requirements – Biomass yield – Observed yield	3
2.3	Kinetic constants evaluation of biological treatment--problems	2
3		
3.1	Aerobic biological treatment – Attached growth and suspended growth treatment systems – Modeling suspended growth treatment process	2
3.2	Activated sludge process – Description – Various types – Methods of aeration – Microbiology – Process analysis – Process design considerations –Design of ASP-- Operational difficulties – Modifications	4

3.3	Sequencing Batch Reactor – Process description and operation—Design.	2
4		
4.1	Trickling filter – Filter classifications – Microbiology – Process design considerations – Design of physical facilities – Necessity of Recirculation – NRC Equation – Design of Trickling filter--Operational difficulties, High rate trickling filters-Problems	4
4.2	Aerated lagoons – Types – Process design considerations.	2
4.3	Stabilization ponds – Classification – Design considerations.	2
5		
5.1	Sludge treatment and disposal – Characteristics of sludge – Sludge processing – Preliminary operations – Thickening – Stabilization	3
5.2	Aerobic sludge digestion - Anaerobic sludge digestion – Composting of sludge	2
5.3	Conditioning of sludge– Dewatering - Heat drying - Incineration-- Wet air oxidation – Land application-- conveyance, storage and disposal by dilution.	3

Text Books

1.Metcalf & Eddy, Inc. Wastewater Engineering, Treatment and Reuse. 5th Edition, Tata McGraw-Hill, New Delhi, 2010
2.Mark J. Hammer and Mark J Hammer Jr., Fourth Edition, Water and Wastewater Technology, Prentice Hall of India Pvt. Ltd.

Reference Books

1. Benefield, L.D. and Randall C.W. Biological Processes Design for wastewaters, Prentice- Hall, Inc. Eaglewood Cliffs, 1982.

2. Grady Jr. C.P.L and Lin H.C. Biological wastewater treatment: Theory and Applications, Marcel Dekker, Inc New York, 1980.
3. Hammer- Water and Waste Water Technology, John Wiley and Sons
4. Quano- Principles of Waste Water Treatment,Vol. I, Oxford and IBH
5. Eckenfelder and Conner – Biological waste Treatment

6. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
7. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222PCE100	MINI PROJECT	PROJECT	0	0	4	2

Mini project can help to strengthen the understanding of student's fundamentals through application of theoretical concepts and to boost their skills and widen the horizon of their thinking. The ultimate aim of an engineering student is to resolve a problem by applying theoretical knowledge. Doing more projects increases problem solving skills.

The introduction of mini projects ensures preparedness of students to undertake dissertation. Students should identify a topic of interest in consultation with PG Programme Coordinator that should lead to their dissertation/research project. Demonstrate the novelty of the project through the results and outputs.The progress of the mini project is evaluated based on three reviews, two interim reviews and a final review. A report is required at the end of the semester.

Evaluation Committee - Programme Coordinator, One Senior Professor and Guide.

Sl. No	Type of evaluations	Mark	Evaluation criteria
1	Interim evaluation 1	20	
2	Interim evaluation 2	20	
3	Final evaluation by a Committee	35	Will be evaluating the level of completion and demonstration of functionality/ specifications, clarity of presentation, oral examination, work knowledge and involvement
4	Report	15	the committee will be evaluating for the technical content, adequacy of references, templates followed and permitted plagiarism level(not more than 25%)
5	Supervisor/Guide	10	
	Total Marks	100	

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222LCE006	ENVIRONMENTAL MONITORING LAB II	LABORATORY 2	0	0	2	1

Preamble: The objective of this course is to enable students to familiarise themselves with various analytical techniques in Environmental Engineering. The course is also designed to make students familiar with different modelling techniques related to Environmental Engineering.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To have an understanding of the various analytical techniques in Environmental Chemistry for the analysis of soil samples
CO2	To have an understanding of the various techniques for air quality analysis
CO 3	To apply modelling techniques in Environmental Engineering practices

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	3	3	3	3	2	1
CO 2		3	3	3	2		1
CO 3		3	3	3	2	2	3
CO 4							
CO 5							

Mark distribution

Total Marks	CIE
100	100

Continuous Internal Evaluation Pattern:

The laboratory courses will be having only Continuous Internal Evaluation and carries 100 marks. Final assessment shall be done by two examiners; one examiner will be a senior faculty from the same department.

Syllabus and Course Plan

Note: Any ten experiments are mandatory

No	Topic	No. of lab hours
1	Analysis of Organic Carbon in soil	2
2	Analysis of Nitrates in soil	2
3	Analysis of Sulphates in soil	2
4	Analysis of soil pH & Chloride content	2
5	Analysis of sediments -pH ,ORP, heavy metals	2
6	Analysis of Calcium and Potassium in a given water sample	2
7	Analysis of Sodium and Lithium in a given water sample	2
8	Analysis of Noise pollution	2
9	Analysis of air quality parameters - PM 2.5 & PM 10	3
10	Estimation of Carbohydrates	2
11	Estimation of Proteins	2
12	Estimation of Chlorophyll	2
13	Estimation of DNA	2
14	Introduction to modelling techniques-Air quality & water quality	3
15	Introduction to modelling techniques- Climate change & Life Cycle Analysis	3
16	Introduction to modelling techniques- Water supply&Sewer design	3
		36 hrs

Reference Books

1.APHA (2017) Standard methods for the examination of water and waste water, 23rdedn. American Public Health Association, Washington, DC

2. MamtaTomar (1999),Quality Assessment of Water and wastewater ,Lewis Publishers

3. F.W. Fifield and P.J. Haives Blackie (2000) Environmental Analytical Chemistry, Academic & Professional Glasgow.

4 N.Gray, M Calvin and S C Bhatia (2019) Instrumental Methods of Analysis, CBS Publishers and distributors, New Delhi.

SEMESTER II

PROGRAM ELECTIVE III

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE072	AIR QUALITY MANAGEMENT	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: This course highlights the sources, effects and significance of different air pollutants. It also covers methods of sampling, analysis and control methods of specific air pollutants. The course is designed so as to enhance the knowledge in air pollution studies.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To identify industrial and vehicular sources of ambient air pollutants, indoor air pollutant sources, specific effects on health, vegetation, materials & atmosphere.
CO 2	To determine the dispersion ability of air pollutants in the atmosphere based on meteorological and atmospheric stability conditions, development of models.
CO 3	To check the ambient air quality based on NAAQS, evaluate air quality index
CO 4	To conduct air sampling and analyse ambient air, indoor air and stack gas emissions
CO 5	To suggest suitable air pollution control methods/ devices/techniques based on the air pollutants present

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		2	2	1	1	
CO 2	2		2	2	2	2	
CO 3	1		1	1	1		
CO 4	1		2	2	2	2	
CO 5	1		2	2	2	2	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
original publications (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no. : 10 marks
Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:
The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **AIR QUALITY MANAGEMENT**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Give an account of classification of air pollutants.
2. Differentiate environmental lapse rate from adiabatic lapse rate.
3. Account for the concept of ambient air quality standards and emission standards.
4. Bring out the significance of stack monitoring.
5. Prepare a note on working of a bioscrubber and its role in air pollution control.

(5x5=25 marks)

PART B

(Answer **any 5** Questions)

6. Identify any industry in your locality which is a potential source of air pollutants affecting human health . Discuss the identified main air pollutants and their impacts on human health and plant life
7. State the assumptions made in Gaussian plume model for air pollutant dispersion. Estimate the total sulphur dioxide concentration at 1 km. along the plume centre line of a stack of 250m effective height, of a power plant consuming 10,000 tons of 1% sulphur coal per day. The average speed of wind at 10 m above ground level is 3 m/s Assume unstable atmospheric condition and σ_y = 140m and σ_Z =125 m
8. Justify the concept of Air Quality Index. Discuss any two methods for evaluating it.
9. Suggest suitable control measures for the major air pollutants in a city which is notorious for traffic congestion in roads.
10. Bring out the significance of controlling indoor air pollution. Name any four source of indoor pollution and suggest suitable methods to improve indoor air quality.
11. Comment on the objectives and methods of air sampling. Being an environmental engineer, point out any six important factors that is to be considered while selecting a suitable air sampling method.
12. Enlist various methods of controlling sulphur dioxide emissions and compare any two methods

(5x7=35 marks)

Syllabus and Course Plan

Module	Contents	Hours Allotted
I	Air pollutants, sources-Industrial and vehicular sources of air pollution, Classification of air pollutants, Effects of air pollutants on health, vegetation, materials & atmosphere, Case studies on air pollution episodes, Behaviour and fate of air pollutants.	8
II	Dynamics of air pollution dispersion- Effects of meteorology, Wind profile, Topographic effects, temperature profile, Lapse rate, Inversion, Atmospheric stability, Mixing height, Transport and diffusion of stack emission, Stack plume patterns. Classification of air quality models, Gaussian plume model to determine the ground level concentration of air pollutant-assumptions and limitations, Effective stack height.	8
III	Air pollution legislation and regulation, NAAQMS, National ambient air quality standards, Air quality emission standards, Air pollution indices, Economics of air pollution control. Sources, types and control of Indoor pollutants, Sick building syndrome, indoor air pollution modeling	8
IV	Air sampling-Instruments for sampling ambient particulate and gaseous pollutants- Principles and working , Stack monitoring, Analysis of particulate and gaseous air pollutants.	8
V	Control of air pollutants- Factors affecting the selection of control equipment, Equipments for particulate and gaseous emission control- sulphur dioxide, nitrogen oxides, hydrocarbons., Automobile emission control techniques, Biological air pollution control techniques, Bioscrubbers.	8

Text Books

1. Rao, C.S., Environmental Pollution Control Engineering, New Age International Publishers January 2018. ISBN-10 9386649896, ISBN-13 978-9386649898
2. Nevers N. D., Air Pollution Control Engineering, Mc. Graw Hill International Edition.
3. Aruthur C. Stern Air Pollution, 3rd Edition, Volume1- Air Pollutants, their Transformation and Transport, Academic Press, 2006.

Reference Books

1. Wark K., Warner C. F. and Davis W., Air Pollution Its Origin and Control, 3rd edition, Harper and Row, New York.
2. Rao M. N., Air Pollution, Tata McGraw Hill, New Delhi.
3. Griffin R. D., Principles of Air Quality Management, CRC Press, Boca Raton, USA
4. Boubel R. W., Fox D.L., Turner D.B., Stern A. C., Fundamentals of Air Pollution, Academic Press, 2005.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE073	ADVANCED WASTE WATER TREATMENT TECHNOLOGIES	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: The course aims to enrich the understanding of need and applications of advanced wastewater treatment systems

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compare and appraise conventional and advanced techniques for the wastewater treatment
CO 2	Choose the most suitable sorption technique based on the contaminant characteristics
CO 3	Demonstrate various advanced oxidation techniques relate to the nature of contaminants.
CO 4	Analyse the performance of thin film filters in comparison with in-depth filters
CO 5	Apply the principle of membrane separation for bioreactors

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1		2					
CO 2	3	2		2	2	1	
CO 3	3	2	2	2	2	1	3
CO 4	3	2		2	1	1	
CO 5	3	2	2	2	1	1	3

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	20
Evaluate	15

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer-reviewed Original publications (minimum 10 publications shall be referred) : 15 marks

Course based task/Seminar/ Data collection and interpretation : 15 marks

Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem-solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Highlight the need of advanced wastewater treatment technologies in the environmental engineering field.
2. Enlist the applications of electrocoagulation.
3. Discuss the iron exchange reactions for the synthetic resins.

Course Outcome 2 (CO2):

1. What inference can be made when the adsorption data fits both langmuir and freundlich isotherm models?
2. “Nanoparticles can be used for the heavy metal removal from wastewater” Justify the statement

3. How can we select a suitable desorption technique for the regeneration of sorbents?

Course Outcome 3(CO3):

1. Illustrate wet air oxidation process for wastewater treatment.
2. Differentiate between fenton and photo-fenton process.
3. Explain the significance of hydrogen peroxide in wastewater treatment.

Course Outcome 4 (CO4):

1. Compare the principle of ultrafiltration and nano-filtration.
2. "Reverse osmosis can be used for brine water treatment" Illustrate.
3. Differentiate between in-depth filters and surface filters.

Course Outcome 5 (CO5):

1. What are the limitations of MFC? How can we overcome these limitations?
2. How membrane fouling can be controlled effectively in a working membrane reactor?
3. Specify the required characteristics of membrane used for heavy metal removal.

Model Question Paper

APJ Abdul Kalam Technological University
M.Tech Degree Examination
Branch: **Civil Engineering**
Specialisation: **Environmental Engineering**

Subject: **222ECE073 ADVANCED WASTE WATER TREATMENT TECHNOLOGIES**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Explain the significance of advanced treatment technologies with an example.
2. How can we modify an ordinary carbon source to an activated carbon suitable for treating wastewater contaminated with dye?
3. Recommend a suitable catalytic oxidation process for the treatment of agricultural field effluent.
4. How pervaporation can be applied in wastewater treatment
5. Specify the required characteristics of membrane used for heavy metal removal.

(5 x 5 marks = 25 marks)

PART B

(Answer any **FIVE** questions, each question carries 7 marks)

6. "Coupling of adsorption and photocatalysis demonstrated to be an efficient process to overcome the limitations presented by the separated techniques" Justify the statement with an example.
7. Compare gamma ray and electron beam processes for the treatment of sanitary wastewater.
8. Demonstrate the advantages of ozone based process over wet air oxidation process.
9. Compare Reverse Osmosis and Electrodialysis in the tertiary treatment of wastewater.
10. A brackish water having TDS concentration of 3000gm/m^3 is to be desalinized using a thin film composite membrane having a flux rate coefficient of 1.5 x 10^{-6}s/m and a mass transfer rate coefficient of 1.8 x 10^{-6}m/s. The product water is to have a TDS of not more than 200 gm/m^3. The flowrate is to be 0.010 m^3/s. The net operating pressure will be 2500kPa. Assume the recovery rate will be 90 percent. Estimate the rejection rate and the concentration of the concentrate stream.
11. Compare the working principle of MBR and MFC.
12. What are the mechanisms of Fouling of membranes? How Fouling can be controlled effectively in a working membrane reactor?

(5 x 7 marks = 35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Introduction (6 hours)**	
1.1	Limitations of conventional wastewater treatment methods	1
1.2	Purpose and benefits of advanced wastewater treatment	1
1.3	Chemical clarification, Electrocoagulation, Demineralization, ion exchange, Ammonia stripping	4
2	**Sorption Techniques (8 hours)**	
2.1	Types of sorbents, Sorption kinetics and isotherm models	2
2.2	Activated carbon adsorption and regeneration, Manufacture of activated carbon, characteristics of carbon used in wastewater treatment	2
2.3	Biosorption Photo-catalytic adsorbents - nanoparticles Applications: Removal of chemical fertilizers, heavy metals	3
2.4	Desorption Techniques	1
3	**Advanced oxidation(8 hours)**	
3.1	UV-Hydrogen peroxide process, Electro-chemical Oxidation processes	2
3.2	Ozone based processes, Wet Air Oxidation (WAO),	2
3.3	Fenton and photo-fenton process, Catalytic oxidation processes	2
3.4	Gamma ray, X-ray and electron beam based processes	2
4	**Filtration Techniques (8 hours)**	
4.1	Filtration, theory and performance of in-depth filters, Filter problems and their solutions, Types of in-depth filters, surface filters.	4
4.2	Microfiltration – Ultrafiltration - Nanofiltration – Reverse Osmosis – Electrodialysis - Pervaporation	4
5	**Membrane Reactors (10 hours)**	
5.1	Membrane manufactures – Membrane Module / Element designs – Membrane System components – Design of Membrane systems	4

5.2	Membrane Bioreactors-Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles	4
5.3	MFC: principle, components, Applications, Limitations	2

Reference Books

1. Russell. L. Culp and Gorden. L. Culp, Handbook of Advanced Wastewater treatment, Van Nostrand Reinhold c, New York, 1974.
2. Metcalf and Eddy Inc., Wastewater Engineering Treatment DisposalReuse Tata McGraw Hill Publishing Company, 1981.
3. Ronald L. Droste, Theory and practice of water and wastewater treatment, John Willy and sons (ASIA) Pvt Ltd, 1997
4. Hammer- Water and Wastewater Technology, John Wiley and Sons, New York, 1986

Reference Books

1. Simon Parsons (2004), Advanced oxidation processes for water and wastewater treatment, IWA Publishing
2. Serpil Edebali (2019), Advanced Sorption process application,Intechopen publishing
3. Mulder, M., Basic Principle of Membrane Technology, Kluwer Academic Publishers, 1996
4. Water Environment Federation (WEF), Membrane Systems for Wastewater Treatment, McGraw-Hill, USA, 2005
5. Noble, R.D. and Stern, S.A., Membrane Separations Technology: Principles and Applications, Elservier, 1995
6. Advanced wastewater treatment technologies, http://gcpcenvis.nic.in/Books/Advanced_Wastewater_Treatment_Technologies.pdf

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE074	INDUSTRIAL EFFLUENT MANAGEMENT	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: The aim of this course is to educate students about the various terms used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial wastewater. Students will also gain knowledge about the nature of effluents discharged from various typical industries and how the same is managed with minimum impact on the environment

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply the fundamental knowledge in environmental engineering to identify the various sources of industrial wastewater generation, conduct sampling of streams, analyse the mechanism of natural purification and to evaluate the outcome of pollution [K3, K4]
CO 2	Identify and evaluate and a well-operating, cost-effective industrial wastewater treatment system for a new project using a systematic approach and suggest suitable pollution prevention methods [K3, K4]
CO 3	Examine the possibility of adopting suitable contaminant removal methods for industrial effluents [K4]
CO 4	Analyse the common industrial processes such as rinsing, degreasing, descaling and deinking and suggest suitable waste minimization methods [K4]
CO 5	Prepare process flowcharts, categorize waste generation sources and identify suitable treatment methods and pollution prevention methods for specific industries based on the nature of waste [K3, K4]

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2	3	2		2	3	
CO 2	2	3	3	2	2	3	3
CO 3	2	3	3	2	3	3	3
CO 4	2	3	3	2	2	2	3
CO 5	2	3	2	2	3	2	3

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	10
Apply	30
Analyse	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Evaluation shall only be based on application, analysis or design-based questions (for both internal and end semester examinations).

Continuous Internal Evaluation: 40 marks

Continuous Internal Evaluation Pattern:

- Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred) : 15 marks
- Course based task/Seminar/Data collection and interpretation : 15 marks
- Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination: 60 marks

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College.

There will be two parts; Part A and Part B.

Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions.

Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **222ECE074 INDUSTRIAL EFFLUENT MANAGEMENT**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Assume that treated effluent from a food processing industry is discharged into a stream. Which all data are to be collected while sampling and state the reason for the same.

2. How can waste strength reduction be achieved by process/equipment changes? Illustrate with an example

3. State the advantages and disadvantages when a combined treatment of industrial and municipal effluents is implemented for an industry

4. How do conventional de-inking processes contribute to pollution loads? Explain with one example

5. What are the typical problems associated with effluents from diary industries? (5x5 = 25 marks)

PART B

(Answer **any 5** Questions)

6. Identify the various types of pollutants that can originate from the various industrial processes and discuss how they affect the streams

7. “Most of the industrial wastes can be discharged into streams after adequate pretreatment”. Substantiate this statement based on self-purification capacity of streams and comment on water quality classes in India

8. Discuss how you will arrive at pilot scale investigations while evaluating industrial waste treatment systems?

9. The effluent from a food processing industry comprises of high concentration of biodegradable organics, oil and grease, above effluent discharge standards. Suggest suitable measures to remove these pollutants

10. "Pickling and rinsing are the common process in metal-based industries". Identify the various sources of water pollution from such processes and enumerate their effects

11. "A single meat processing industry contributes to water-borne wastes of various compositions and concentrations" substantiate on this statement based on a suitable flow chart.

12. Compare the effluent characteristics and effluent production of a paper industry with that of a paper recycling industry with suitable flow charts

(5x7=35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Industrial pollution – sources, sampling, characteristics and effects (8 h)**	
1.1	Types of industries and industrial pollution, Sources and characteristics of industrial wastes, Population equivalent, Disposal by dilution – Streeter Phelps formulations - numerical problems	4
1.2	Effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health,	2
1.3	Stream sampling – Frequency, number of samples, sampling points, methodology, data to be obtained, precautions, time of sampling, statistical handling of data, overall objectives	2
2	**Development of industrial effluent treatment system and pollution prevention (8 h)**	
2.1	Approach for development of industrial effluent treatment system (11 step methodology) with suitable examples (basic concept only) - Analysis of manufacturing process, pollution prevention program, wastewater characterisation study, second level waste minimization program, selection of candidate technologies, bench scale investigations, pilot scale investigations, preliminary designs, economic comparisons, final design	3
2.2	Waste volume reduction – Classification of wastes. immaculate housekeeping, substitution of materials, conservation of wastewater, production changes - recycle and reuse of effluents	2
2.3	Waste strength reduction - changing manufacturing processes/equipment, segregation of waste streams, flow equalization, proportioning of waste, pH control/neutralisation, by-product recovery, waste exchange	3
3	**Effluent treatment methods (8h)**	

3.1	Removal of suspended and colloidal solids	1
3.2	Removal of inorganic and inorganic dissolved solids	2
3.3	Removal of heavy metals, oil, grease, biodegradable organics, toxic organics, cyanide, fluoride	3
3.4	Sludge handling and disposal	1
3.5	Combined treatment of industrial and municipal effluents	1
4	**Typical industrial processes and effluent management (8 h)**	
4.1	Chemical descaling, degreasing, die casting	2
4.2	Electroplating, rinsing, deinking	2
4.3	Food processing, meat processing	2
4.4	Environmental standards related to prevention and control of industrial effluents from – Electroplating and anodising industries, Meat industry, Food processing industry, Tannery, Large Pulp and Paper industry, (Ref: The Environment (Protection) Rules, 1986 - Schedule-I: Standards for Emission or Discharge of Environmental Pollutants from various Industries)	2
5	**Specific industries and effluent management (8 h)**	
5.1	Sources and characteristics of industrial effluents, waste water treatment flow sheets and waste minimization strategies for selected industries - Textile, Tannery, Dairy, Pulp and Paper, Paper recycling	5
5.2	Case study of any two industries mentioned in 5.1	3

Text Books

1. N.L. Nemerrow –Theories and practices of Industrial Waste Treatment, Addison-Wesley Publishing Company, 1963 ISBN-10: 0201052601 ISBN-13 : 978-0201052602

2. Woodard & Curran, Inc., Industrial Waste Treatment Handbook, Butterworth-Heinemann 2nd edition 2006, ISBN: 9780080459868; ISBN: 9780750679633

3. W. Wesley Eckenfelder, Industrial Water Pollution Control, McGraw Hill Series (In Water Resources and Environmental Engineering) ISBN-10 0070393648; ISBN-13 978-0070393646

Reference Books:

1. Freeman, H.M, Industrial Pollution Prevention Handbook", McGraw Hill", latest edition
   ISBN-10: 0070221480; ISBN-13 : 978-0070221482

2. Dr. Ruth Hillary, "Environmental Management Systems and Cleaner Production", Wiley, New York, Latest edition
   ISBN-10 : 9780471966623; ISBN-13 : 978-0471966623

3. Paul L. Bishop, "Pollution Prevention: Fundamentals and Practice", McGraw-Hill International, latest edition.
   ISBN-10 : 0073661473; ISBN-13 : 978-0073661476

4. James G. Mann and V.A. Liu, “Industrial Water Reuse and Wastewater Minimization”, McGraw Hill, 1999.
ISBN-10⁀: ⁀0071348557; ISBN-13⁀: ⁀978-0071348553

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE075	GEO ENVIRONMENTAL ENGINEERING	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: Geo environmental Engineering is a multidisciplinary subject which deals with Geotechnical and Environmental Engineering aspects. The subject has gone far beyond the conventional problems and the Environmental Engineers should be well informed about the geotechnical aspects while dealing with contaminated land. To take up these challenges, knowledge of soil behaviour, soil properties, soil chemistry, etc related to soil mechanics is needed. The subject also offers an understanding of the microbial processes in the environment, microbial communities and microbial interactions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To understand the basic geotechnical applications in Environmental Engineering
CO 2	To understand the basic concepts of landfill and to deal with the issues related to landfilling
CO 3	To learn about the landfill liners and cover system
CO 4	To deal with investigation of contaminated site and slurry ponds
CO 5	To make aware about the remediation of contaminated land and geotechnical reuse of waste

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1	1	1	1		2	1
CO 2	3	2	3	1	1	1	3
CO 3	3	2	2	2		2	3
CO 4	3	2	2	2		1	2
CO 5	3	2	3	2		2	2

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	15
Analyse	20
Evaluate	25

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred) : 15 marks

Course based task/Seminar/Quiz : 15 marks

Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern: 60 marks

The end semester examination will be conducted by the college. There will be two parts; Part A and Part B. Part A contain 5 questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student shall answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Model Question paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **Environmental Engineering**

Subject: **222ECE075 GEOENVIRONMENTAL ENGINEERING**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer all **5** questions)

1. Briefly describe the significance of soil water waste interaction (5)

2. Explain how the quantity of leachate can be estimated (5)

3. Explain the vertical barriers in containment system (5)

4. Differentiate between ex situ and in situ methods of soil remediation. Enlist the various insitu soil remediation techniques (5)

5. Explain the various processes involved in the planning of site remediation (5)

PART B

(Answer any **5** questions)

1) Explain the importance of micro organisms present in soil (7)
2) Explain the mechanisms by which soil contaminants can be released from soil (7)
3) Describe the various methods by which contaminated soil can be bioremediated(7)
4) Explain the methods of leachate control in landfills (7)
5) Describe the various aspects to be considered while planning and designing landfill (7)
6) Explain the two types of embankments for slurry disposal. (7)
7) Explain the requirements and components of landfill cover system. (7)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Introduction**	
1.1	Introduction to Geoenvironmental Engineering, Sources and impact of contamination, Factors governing soil pollution, Biogeochemical cycle	2
1.2	Soil- water-waste interaction, fate of contaminants	2
1.3	Soil formation, composition, structure and properties of soil	3
1.4	Soil microbiology- importance of micro organisms	1
2	**Leachate**	
2.1	Landfill – capacity, layout, construction, landfill sections, design of landfill	2
2.2	Leachate – quantity and quality, generation and control, collection and removal system, management	2
2.3	Landfill gas- generation and control, landfill gas monitoring	1
2.4	Settlement of landfills –mechanisms-mechanical compression, raveling, physicochemical changes, biochemical decomposition, factors affecting settlement	2
2.5	Closure rehabilitation and expansion of landfills	1
3	**Liners and cover system**	
3.1	Liner systems – types, composite clay liner, geomembranes and composite liners, geosynthetic clay liners	2
3.2	Landfill cover system -requirements, components, types	2
3.3	Containment system- displacement barriers, trench barriers, covers and horizontal barriers	2
3.4	Flow and transport through barriers, stability of waste containment systems	2
4	**Contaminated land**	
4.1	Contaminated land – site investigation, sampling techniques, assessment and treatment selection	2
4.2	Characterization of contaminated sites, contaminant release mechanism- Vapourisation, dusting, leaching	2
4.3	Slurry disposal on land and ponds, dry waste in mounds	2
4.4	Slurry ponds - planning and design, environmental control	2
5	**Soil remediation**	
5.1	Remediation of contaminated soil- Exsitu and in situ remediation, bioremediation, phytoremediation, thermal remediation, pump and treat method, electrokinesis	3
5.2	Geotechnical reuse of waste materials,	2
5.3	Soil Improvement using solid wastes – case studies	2
5.4	Waste dump -impact and remediation	1

Text Books

1. Reddi L.N and Inyang HI (2000) Geoenvironmental Engineering: Principles and Applications, Marcel Dekker Inc Publication.
2. R. N. Yong (2000) Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate, Mitigation Lewis Publication
3. Hari D. Sharma, Krishna R. Reddy (2004) Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies, Publisher: John Wiley & Sons Inc.
4. Sarsby R.,Environmental Geotechnics, Thomas Telford, 2000
5. Daniel, D.E. (1993). Geotechnical Practice for Waste Disposal. Chapman, and Hall, London.

Reference Books

1. Koerner, R.M. (2005). Designing with Geosynthetics, Fifth Edition. Prentice Hall, New Jersey.
2. Dr. G V Rao and Dr. R S Sasidhar (2009) Solid waste Management and Engineered Landfills, Saimaster Geoenvironmental Services Pvt. Ltd. Publication.
3. Ayyar TSR (2000) Soil engineering in relation to environment, LBS centre for Science and Technology, Trivandrum.
4. Donald L. Wise, Debra J. Trantolo, Hilary I. Inyang, Edward J. Cichon (2000) Remediation Engineering of Contaminated Soils, Publisher: Marcel Dekker Inc

SEMESTER II

PROGRAM ELECTIVE IV

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE078	ENVIRONMENTAL BIOTECHNOLOGY AND BIOREMEDIATION	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: This course highlights the significance of Molecular biology in Environmental monitoring. It also outlines the importance of Biotechnology in Environmental practices like biodegradation and bioremediation. Hence this course is very beneficial as for practising Environmental engineers and students .

Course Outcomes: After the completion of the course the student will be able

CO 1	To understand the fundamentals of Molecular Biology
CO 2	To outline the process Microbiology of Waste treatment
CO 3	To analyse the fundamentals of biodegradation
CO 4	To formulate the engineering strategies for bioremediation
CO 5	To apply biotechnological practices in Environmental Engineering

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			3				
CO 2			3				
CO 3	3	2		3	2	2	
CO 4	3	3		2	2	2	2
CO 5				2	2	3	1
CO 6							

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	10

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
original publications (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:
The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **222ECE078 ENVIRONMENTAL BIOTECHNOLOGY AND BIOREMEDIATION**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Outline the applications of Genetic engineering
2. Describe the process parameters influencing denitrification
3. Discuss the methodology adopted for microtox assay
4. Explain the mechanism of biodegradation of synthetic detergents
5. Summarize the major aspects of phytoremediation

(5x5=25)

PART B

(Answer **any 5** Questions)

6. Discuss the mechanism of protein synthesis with suitable diagram
7. Identify the major environmental factors contributing to the biodegradation of organic pollutants
8. Describe the engineering strategies adopted for engineered in situ bioremediation
9. Discuss the environmental risks associated with the release of genetically engineered microorganisms
10. List down two major techniques for remediating a site contaminated with heavy metals
11. Summarize the technique and the environmental application of PCR
12. Outline the role of immobilized enzymes in wastewater treatment process with suitable examples

(5X7=35)

Syllabus and Course Plan (For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Introduction to Molecular Biology**	
1.1	Introduction to microbial genetics - genetic code, DNA replication and protein synthesis.	4
1.2	Recombinant DNA technology-vectors ,restriction enzymes	2
1.3	Applications of Genetic engineering	2
2	**Waste management**	
2.1	Microbiology of Nitrification and denitrification.	2
2.2	Aerobic and anaerobic process microbiology-activated sludge process, aerobic stabilisation ponds, trickling filters , composting ,vermicomposting and methanogenesis.	4
2.3	Immobilisation of microbial cells and enzymes, immobilised enzymes in wastewater treatment process	2
3	**Biodegradation**	
3.1	Microbes and organic pollutants ; Relationship between contaminant structures, toxicity and biodegradability, environmental factors affecting biodegradation, Aerobic vs anaerobic degradation	4
3.2	Biodegradation of hydrocarbons, phenols, PAH, PCB, synthetic detergents, Salicylate, organophosphates , pesticides and herbicides.	4
4	**Bioremediation**	
4.1	Bioremediation- in situ bioremediation-bioventing, water circulation system biosparging ,intrinsic in situ bioremediation . Ex situ bioremediation- land farming ,composting, biopiles and bioreactors	5
4.2	Phytoremediation , phycoremediation , mycoremediation	3
5	**Applications of Biotechnology**	
5.1	Genetically engineered microbes in biotreatment of wastes- two examples. Release of genetically engineered microbes and environmental risks.	2
5.2	Environmental applications of molecular techniques - PCR ,DNA Probe, FISH .Toxicity assay using microorganisms – Microtox assay	3
5.3	Biosurfactants , biomining ,biosorption, Biofuels - biohydrogen , bioethanol , microbial fuel cell	3
		40 hrs

Text Books

1) Raina.M.Maier, Ian L Pepper & Charles P Gebra, Environmental Microbiology, 2nd edition Elsevier India Pvt ltd, New Delhi, 2008
2) P.D.Sharma, Microbiology,4th edition Rastogi publications, Meerut, 2019
3) Introduction to Environmental Biotechnology, A.K Chatterji , PHI Learning Pvt Ltd ,New Delhi , Third Edition, 2011

Reference Books

1. Wastewater Microbiology , Gabriel Bitton , John Wiley & Sons, Third edition ,2005
2. Environmental Biotechnology Theory and Application, Gareth M. Evans Judith C. Furlong, John Wiley & Sons, Second edition ,2012

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE079	ENVIRONMENTAL TOXICOLOGY	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: Environmental Toxicology course includes various chemicals and its effects on ecosystems, also examines their impact at the population and community level. This helps the students to create a thorough knowledge about research related activities in Ecotoxicology and Environmental Engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	To study the effects of various chemicals on Environment
CO 2	To analyse various toxicants related with soil, water and air.
CO 3	To discuss various health hazards due to toxicants
CO 4	To study various industrial chemicals
CO 5	To discuss various biochemical mechanisms related with toxicity

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1		3			3	2	
CO 2				3			3
CO 3		3	3	2	3	1	
CO 4		3		3		3	2
CO 5			3		3		3
CO 6	3	2	3	3	3	3	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	14
Analyse	20
Evaluate	19
Create	7

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
original publications (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question paper

No. of Pages:...2.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION,

Branch: Civil Engineering

Stream(s): Environmental Engineering

Course Code & Name: 222ECE079 Environmental Toxicology

Part A

Answer all questions

1) Discuss the terms teratogenicity, carcinogenicity and mutagenicity in toxicity testing

2) Outline the mode of action of fungicides and insecticides

3) Explain the mechanism of photolysis for the environmental degradation of pesticides

4) Discuss the importance of radiation symbols in radioactivity

5) Examine the role of glutathione and superoxide dismutase as antioxidants (5×5 =25)

Part B

Answer any 5 questions

6) Summarize the various measures adopted by your body in response to an oxidative stress

7) Researchers have reported that certain food additives can cause serious health hazards. Substantiate your statement with examples

8) Outline the bioaccumulation process in living organism with special mention to PCB, DDT and Dioxin

9) Summarise the significance of toxicity testing and explain the terms LD50 and LC50

10) Heavy metals and chemicals cause environmental pollution and they have significant biochemical effects as well. Analyse the environmental and biochemical effects of toxic metals and chemicals

11) Outline the chemical structure of pesticides and their classification based on target organism

12) Discuss the effects of toxic industrial chemicals like Formaldehyde, Phosgene and Hydrogen cyanide

(5×7 =35)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Introduction to Ecotoxicology**	
1.1	Toxicology: Definition and scope, acute and chronic toxicity, selective toxicity, synergism and antagonism	3
1.2	Toxicity testing: Bioassay – Definition, purpose, criteria for selection of test organism methodology, estimation of LC50 and LD50, limitation and importance of bioassay, acute toxicity (single), Sub acute toxicity, chronic toxicity,	3
1.3	Teratogenicity, carcinogenicity and mutagenicity.General awareness about Toxicity symbols, Pesticide Toxicity Labels, Fire diamonds (nfpa 704 system)	2
2	**Pesticides, herbicides and insecticides**	
2.1	Pesticides – classification based on target organism and chemical structures (organochlorines, organophosphorus, carbamates and pyrethroids),	3
2.2	Mode of action of herbicides (photosynthesis inhibition and amino acid biosynthesis inhibition) fungicides (Ergosterol and biosynthesis inhibition) and insecticides (cholinesterase inhibition, chitin synthesis inhibitors).	2
2.3	Toxic organic compounds- PCBs, PAHs, PBDEs, Dioxins and Furans – origin and adverse effects	2
3	**Environmental effects of toxicants**	
3.1	Bioaccumulation- Health hazards due to hexachlorobenzene, polychlorinated biphenyls, Dioxins and DDT,	4
3.2	Environmental degradation of pesticides – photolysis and microbial degradation	2
3.3	Bio-transformation, and bio-magnification: Principles, receptor sites absorption and storage of xenobiotics, types of bio- transformations, Influence of ecological factors on the effects of toxicity	2
4	**Toxic metals and chemicals in the Environment**	
4.1	Industrial chemicals (Ammonia, Formaldehyde, Phosgene, Hydrogen cyanide, sulphuric acid, chlorine, Ethylene oxide, Food additives (Aspartame, Monosodium glutamate, sodium nitrite, Trans Fat, butylayedhydroxytolune, Propyl Gallate, Tartrazine)	4
4.2	Source of contaminants, fate, effects and its action in target organs. Normal and abnormal responses to xenobiotics	2

4.3	Toxic metals and chemicals in the environment and biochemical aspects of As, Cd, Pb, Hg, CO,O_3, PAN. Radiation pollution and toxicity – origin and health hazards, Radon pollution, Radiation symbol	2
5	**Antioxidants and oxidative stress**	
5.1	Lipid peroxidation – Introduction to the process of lipid peroxidation, ROS & RNS, Mechanism of reactive oxygen species production, The key role of superoxide anion radical, Hydrogen peroxide and hydroxyl radicals in toxicity of xenobiotics	3
5.2	Oxidative stress – Definition of oxidative stress, Toxicological consequences of oxidative stress, Oxidative stress and protein damage, Oxidative stress and DNA damage, Oxidative stress and lipid damage : Antioxidative defence mechanisms –	2
5.3	Enzymatic and Non enzymatic antioxidants, Role of glutathione, Superoxide dismutase, Metallothionein and α-tocopherol as antioxidants	3
		40 hrs

Text Books

1.Jorgenson, S.E.; Halling S, B.; Mahler, H.; (1998). "Handbook of Estimation Methods in Ecotoxicology and Environmental Chemistry". Lewis publishers, CRC press, LLC Boca Raton.

2.Jorgensen, S.E.; (1994). "Fundamentals of Ecological Modelling". Elsevier Science B.V., Amsterdam.

3.Jorgensen, S.E.; Nielsen S.N.; Jorgensen, L.A.; (1991). "Handbook of Ecological Parameters and Ecotoxicology". Elsevier science Publishers B.V., Amsterdam.

4. Moriarty F.; (1998). "Ecotoxicology. The Study of Pollutants in Ecosystems". Academic Press Ltd., London.

Reference Books

1. Newman, M.C.; Jagoe, C.H.; (Ed) (1996). "Ecotoxicology ; A Hierarchial Treatment". CRC Press Inc. Lewis publishers, Boca raton.

2. Richardson, M.; (Ed) (1995). "Environmental Toxicology Assessment". Taylor and Francis Ltd ., London.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE080	CONTAMINANT TRANSPORT AND REMEDIATION	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: Goal of this course is to learn the mechanism of contaminant transport and estimation of extent of contamination by modelling and for selecting appropriate remedial measures

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the fundamental Concepts of Groundwater Flow, Transport and Contamination
CO 2	Explain the governing processes and identify factors controlling transport and fate of contaminants in soil and groundwater
CO 3	Demonstrate conceptual understanding of the contamination of the soil and groundwater media
CO 4	Identify most suitable remediation technologies for addressing groundwater contamination problems

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2	1	1			
CO 2	3	2	2	1			
CO 3	3	2	2	2	2	2	2
CO 4	3	2	2	2	2	2	

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	10
Understand	15
Apply	20
Analyse	15
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

Original publications (minimum 10 publications shall be referred) :15 marks

Course based task/Seminar/Data collection and interpretation :15 marks

Test paper, 1 no. :10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain different types of aquifers.

2. A tracer test is conducted to determine the hydraulic conductivity of an unconfined aquifer. The water levels in the two observation wells 30m apart are 16.3 and 13.2 m. The tracer injected in the first well arrives at the second observation well in 150 hours. Compute the hydraulic conductivity of the unconfined aquifer, if the porosity of the formation is 0.20.

3. Explain (i) intrinsic permeability and (ii) hydraulic conductivity

Course Outcome 2 (CO2)

1. Explain the terms related to contaminant transport: (i) Sorption and (ii) Dilution

2. Compute the coefficient of longitudinal dispersivity for the given aquifer properties: hydraulic conductivity = $2x10^{-5}$ m/s, hydraulic gradient = 0.001, effective porosity = 0.25 and an effective diffusion coefficient = $0.55x10^{-9}$ m^2/s

3. Derive 2D advection – dispersion equation of contaminant transport

Course Outcome 3(CO3):

1. Differentiate point source and non-point source pollutants

2. Illustrate with a case study, the steps involved in the development of a groundwater model

3. Write the solute transport equation. List out the assumptions in the development of the governing equation.

Course Outcome 4 (CO4):

1. How can the basin method be used as both groundwater recharge method and for municipal waste removal?

2. Illustrate any two groundwater remediation measures.

3. Explain how natural attenuation reduces contaminant transport.

Model Question Paper

A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **Environmental Engineering**

222ECE080 Contaminant Transport and Remediation

Time : 2.5 Hours Max. Marks: 60

PART A

(Answer **All** Questions)

1. Illustrate (i) Leaky aquifer and (ii)Perched aquifer.
2. Explain (i) effective porosity (ii) primary porosity and (ii) secondary porosity.
3. Define retardation factor. How is it related to sorption capacity?
4. List out the assumptions in the development of ADE.
5. Explain Monitored natural attenuation. (5 x 5 marks = 25 marks)

PART B

(Answer **any 5** Questions)

6. a) The average flow velocity at a point in an aquifer was found to be 0.68 m/day by means of a point dilution test. If the slope of the piezometric surface at the same point is 0.018 and the aquifer material has a porosity of 0.23, determine the hydraulic conductivity of the aquifer at that point. (5 marks)

   b) Explain transmissibility and storativity (2 marks)

7. Derive 1D form of Richard's equation. (7 marks)

8. Explain the process involved in natural attenuation of soil in contaminant transport

9. Explain the following recharging methods
   (i) Ditch and furrow method (3 marks)
   (iii) Flooding method (2 marks)
   (iv) Pit method (2 marks)

10. Explain any two types of groundwater models. Specify its application in modelling with suitable case study.

11. Explain the concepts of
    (i) Physical scale models (1.5 marks)
    (ii) analog models (1.5 marks)
    (iii) mathematical models (1.5 marks)

(iv) porous media models (2.5 marks)

12. Explain various methods of hydraulic containment of groundwater to prevent contamination (7 marks)

(5 x 7 marks = 35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Characteristics of unsaturated zone (8 hours)**	
1.1	Introduction to water movement in the subsurface - origin, age, distribution, types of aquifers. Darcy's law, hydraulic head and fluid potential, hydraulic conductivity and permeability, heterogeneity and anisotropy of hydraulic conductivity, porosity and void ratio, compressibility and effective stress, transmissivity and storativity.	3
1.2	Steady State and transient flow - formulation of the governing equations, limitations of the Darcian approach. Ground water and well hydraulics - steady flow to a well fully penetrating an aquifer (confined and unconfined), unsteady radial flow to a well fully penetrating an aquifer (confined, unconfined and leaky), effect of well bore storage.	3
1.3	Equations of groundwater flow – Problems, Limitations of Darcian Approach-hydrodynamic dispersion	2
2	**Groundwater resource (8 hours)**	
2.1	Resource evaluation: development of ground water resources-Exploration of Aquifers-the response of ideal aquifers to pumping-Measurement of parameters-Laboratory tests	3
2.1	Multiple well systems, partially penetrating wells, bounded aquifers, characteristic well losses, specific capacity. Slug tests	2
2.2	Saline water intrusion in coastal aquifers: occurrence, shape and structure of the interface, upconing.	3
3	**Groundwater contamination (9 hours)**	
2.1	Introduction to groundwater contamination. Sources of Groundwater Contamination, Contaminant transport through porous media; Advection and Dispersion transport, 2-D / 3-D Advection Dispersion equation for Conservative Contaminant - Estimation of dispersion coefficient (Problems)	3
2.2	Chemical Reactions - Equilibrium controlled sorption - Estimation of retardation factor by batch, column and field study	3
2.3	Solute transport: non reactive constituents in homogeneous media-transport in fracture media-hydrochemical behaviour of contaminants. Reactive Transport – First order decay; Decay and Adsorption – Ion exchange reactions- Reaction and Transport of Trace Metals	3

4	**Groundwater and transport modelling (8 hours)**	
4.1	Groundwater modelling – Inverse modelling in groundwater – Artificial recharge of aquifers - Groundwater budget - Groundwater resource estimation.	2
4.2	Contaminant transport modelling - Model development, model input parameters, initial and boundary conditions, model calibration, model validation	3
4.3	Introduction to Groundwater modelling software : USGS-MOC model: VISUAL MODFLOW/MT3DMS/FEFLOW - Sensitivity analysis and case study for leachate transport	3
5	**Remediation measures (7 hours)**	
5.1	Control measures of saline water intrusion. Artificial recharge and induced infiltration	2
5.2	Soil methods: Soil washing, Soil Vapour extraction, Subsurface barriers, Soil flushing, Stabilization, Bioremediation, Bioventing, Phytoremediation, Encapsulation, Aeration, Natural attenuation	3
5.3	Groundwater methods: Air sparging, Pump and treat method, Groundwater circulation wells, Passive reactive barrier, bioslurping, biosparging, UV oxidation.	2

Text Books

1. Randall J. Charbeneau-Ground water Hydraulics and Pollutant Transport
2. Allen Freeze R. and John A. Cherry -Ground water. Prentice Hall.Inc
3. D. K. Todd and L. W. Mays, Groundwater, 3rd ed., John Wiley & Sons, Inc., 2004.

References

4. C. W. Fetter, Applied Hydrogeology, 4th ed., Prentice Hall, Inc. 2001.
5. C. W. Fetter, Contaminant Hydrogeology, 2nd ed., Waveland Press, 2008.
6. P. A. Domenico and F. W. Schwartz, Physical and Chemical Hydrogeology, 2nd ed., John
7. Wiley & Sons, Inc., 1998.
8. F. W. Schwartz and H. Zhang, Fundamentals of Groundwater, John Wiley & Sons, Inc., 2003.
9. 7. A. K. Rastogi, Numerical Groundwater Hydrology, Penram International Publishing (India)
10. Pvt. Ltd., 2007.
11. VedatBatu, Applied Flow and Solute Transport Modeling in Aquifers, Taylor and Francis/ CRC
12. Press, 2006.
13. E. Scott Bair, Terry D. Lahm, Practical Problems in Groundwater Hydrology, Pearson Prentice Hall, 2006.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE081	ADVANCED HYDROLOGY	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: This course aims to provide introduction to the fundamental hydrological concepts and their applicationswith a focus on the concepts required for hydrological modeling over varying spatial (catchment to global) and temporal scales.

Course Outcomes: After the completion of the course the student will be able to

CO 1	To Recognize the complex structure of environmental hydrologic systems and understand the basic concepts and terminology involved.
CO 2	To Mathematically formulate processes in the hydrologic cycle in different environments and solve problems dealing with water balance.
CO 3	Simulate and Apply hydrologic analyses to engineering designs.
CO 4	Interpret the results for decision support and management.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3						
CO 2	3						
CO 3		3		2	1		
CO 4		3		2	1	1	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	10
Analyse	10
Evaluate	20
Create	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
Original publications (minimum 10 publications shall be referred): 15 marks
Course based task/Seminar/Data collection and interpretation: 15 marks
Test paper, 1 no.: 10 marks
Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the College. There will betwo parts; Part A and Part B. Part A contain 5 numerical questions (such questionsshall be useful in the testing of knowledge, skills, comprehension, application,analysis, synthesis, evaluation and understanding of the students), with 1 questionfrom each module, having 5 marks for each question. Students shall answer allquestions. Part B contains 7 questions (such questions shall be useful in the testingof overall achievement and maturity of the students in a course, through long answerquestions relating to theoretical/practical knowledge, derivations, problem solvingand quantitative evaluation), with minimum one question from each module of whichstudent shall answer any five. Each question can carry 7 marks. Total duration of theexamination will be 150 minutes.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Draw the engineering representation of hydrologic cycle and explain salient features.
2. The water table of a tube well in a particular area of our country is decreasing day by day. What may be the reasons for this reduction? How can you solve this problem?
3. Explain Synthetic Unit Hydrograph. How we can develop a unit hydrograph by Snyder's method?

Course Outcome 2 (CO2):

1. A lake has an area of 15 km^2. Observation of hydrological variables during a certain year has shown that:
   P = 700 mm/year
   Average inflow Q_{in}= 1.4 m^3/s
   Average outflow Q_{out}= 1.6 m^3/s. Assume that there is no net water exchange between the lake and the groundwater. Determine the evaporation during this year.
2. Apipe for discharging storm-water from a parking lot (area =2500 m^2) in an urban area is to be constructed. The maximum rainfall that canoccur is assumed to have an intensity of 60 mm/hr .Determine the

correspondingdischarge (m3/s) and the dimension (diameter) of the pipe if the water velocityin the pipe is assumed to be 1 m/s.

3. Astorm with 10 cm precipitation produced a direct surface runoff of 5.8 cm in the equivalent depth unit. The time distribution of the storm is given in Table below. Estimate the ϕ-index of the storm and the excess rainfall hyetograph.

Time from start (hr)	1	2	3	4	5	6	7	8
Incremental rainfall in each hour (cm)	0.4	0.9	1.5	2.3	1.8	1.6	1.0	0.5

Course Outcome 3(CO3):

1. How can you estimate confined aquifer parameters when a radial unsteady flow occurs in the aquifer for a pumping rate of Q m^3/s.?
2. Athunderstorm of 1-hr duration with 20 mm excess rainfall volume resulted in the following direct surface runoff (DSRO) hydrograph at the outlet of the catchment. Find out the UH of 1 mm excess rainfall volume and 1-hr duration.

Time (hr)	*DSRO (m^3/s)*	*Time (hr)*	*DSRO (m^3/s)*
0	0	12	91.6
1	61.0	13	61.4
2	314.6	14	40.6
3	561.0	15	26.4
4	673.4	16	17.0
5	645.0	17	11.0
6	584.2	18	7.0
7	475.0	19	4.4
8	365.4	20	2.8
9	269.8	21	1.6
10	192.8	22	1.0
11	134.4		

3. The following are the rain gauge observations during a storm. Construct: (a) mass curve of precipitation, (b) hyetograph, (c) maximum intensity-duration curve and develop a formula, and (d) maximum depth-duration curve

Time since commencement	Accumulated rainfall (cm)

of storm(min)	
5	0.1
10	0.2
15	0.8
20	1.5
25	1.8
30	2.0
35	2.5
40	2.7
45	2.9
50	3.1

Course Outcome 4 (CO4):

1. For a catchment with an area 20 km^2, an average precipitation of *732* mm/year and a total evaporation of *550*mm/year have been observed during a 10-year period. Within the catchment, there is an old waste dump; and at the discharge point, high phosphorous (P) contents have been found, *0.25* mg/l of P. What is the annual mass transport of phosphorous in the water out from the catchment?
2. In an area underlain by an unconfined aquifer having hydraulic conductivity of 30 m/day, the distance between observation wells located on the banks of a canal and drain is 3.0 km and heads recorded in them are 60m and 50m above impermeable base. Calculate the quantity of seepage into the drain.
3. A newly graduated hydrologic engineer is to investigate why the community's groundwater supply varies so much during the year. It is extremely cold and there is much snow on ground when the engineer goes out to have a look at the groundwater wells in the area. The engineer finds that the water levels are all very low. In a well, not far from a small river, it is noticed
   that the water level is much lower than in the river.
   (a) How can it be explained that the groundwater level is lower than that of the river?
   (b) If the engineer had been out during other seasons (spring, summer, autumn), what could the relationship between water levels in the river and groundwater have looked like?
   (c) The engineer suspects that the storage term in the water balance plays a key role in the explanation. What is the storage term and how does it vary for different seasons?

Model Question Paper

222ECE081

Reg.Number……Name……

A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY
M.TECH DEGREE EXAMINATION, ……..2022
FIRST SEMESTER
Environmental Engineering
Advanced Hydrology

Time: 2.5 HoursMax. Marks: 60

PART A
Answer All Questions

1. Give a brief explanation for transportation components and flow components of hydrologic cycle.
2. Write a note on DAD curves. What are the applications of DAD curve?
3. Define Specific retention and Storage coefficient
4. What are the major causes of saline water intrusion in aquifers?
5. What are the impacts caused by groundwater pollution?

5 x 5 marks = 25 marks

PART B
Answer any 5 Questions

6. The normal annual rainfall depths recorded at five rain gauge stations A, B, C, D and E are 910, 1070, 1410, 810 and 590 mm respectively. Determine the optimum number of rain gauge stations to be established in the drainage basin if it is desired to limit the error in the mean value of rainfall to 10%. What is the percentage accuracy of existing network in the estimation of average depth of rainfall over the basin? The location of five rain gauge stations and the areas of different zones caused by the isohyets are as given in the following table. Indicate the distribution of the additional rain gauge stations required if any.

Zone	I	II	III	IV	V	VI	Total
Area (km^2)	415	905	2855	1755	725	555	7210
Rain gauge stations	1	1	1	1	1	…	5

7. Find the ordinates of a flood hydrograph resulting from a storm with rainfall of 2.5, 6.85 and 3.75 cm each during successive 3 hours. The ordinates of a 3 hour unit hydrograph are given below. Assume an initial loss of 5 mm, infiltration index ϕ= 2.5 mm per hour and base flow of 12 cumec.

Time (hrs)	03	06	09	12	15	18	21	24	03	06	09	12	15	18	21	24
Ordinates of UH (cumec)	0	115	370	510	395	315	252	231	172	127	96	64	43	25	12	0

8. For a catchment with an area 20 km^2, an average precipitation of *732* mm/year and a total evaporation of *550*mm/year have been observed during a 10-year period. Within the catchment, there is an old waste dump; and at the discharge point, high phosphorous (P) contents have been found, *0.25* mg/l of P. What is the annual mass transport of phosphorous in the water out from the catchment?
9. A 30 cm well penetrates completely an infinite non-leaky artesian aquifer having T=600 m^2/day, S = 0.0004. The well is continuously pumped at the rate of 60 m^2/hr. Assuming a well loss coefficient of 0.5 min^2/m^5, and index n = 2.3, determine the specific capacity and the drawdown in the pumping well after 1 year of drought. What is the well efficiency?
10. Develop an expression for the calculation of discharge for steady radial flow in a confined and unconfined aquifer. Also mention the assumptions.
11. Develop an equation relating the radial steady state discharge from a well in a confined aquifer and unconfined aquifer. Also derive a relation for finding aquifer parameters
12. Write a note on saline water intrusion in aquifers and its control measures. Explain Ghyben-Herzberg relation.

5 x 7 marks = 35 marks

Syllabus and Course Plan

(For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Module 1: Total Lecture Hours –Introduction and Hydrological Processes-12 hours**	
1.1	Fundamental Hydrology-Hydrological cycle-components of hydrologic Cycle-Systems concept- Hydrologic system model, Hydrologic model Classification-Water Balance	4
1.2	Precipitation – Rainfall characteristics- types and forms of precipitation-Rainfall data and its processing- frequency analysis-probability distribution and its application hydrology- Development of a design storm, Depth-Area Adjustment, Average areal rainfall, Estimating missing rainfall data.	4
1.3	Infiltration – Process, Factors affecting infiltration, Measurement, Modelling – Richard's equation, Green-Ampt model Evaporation and Transpiration – Factors affecting evaporation, Measurement, Transpiration, Evapotranspiration, Penman equation.	4
2	**Module II: Total Lecture Hours- Hydrologic Analysis & Design-10 hours**	
2.1	Hydrograph analysis – Baseflow separation, Estimation of initial abstraction, Separation of losses and rainfall excess, separation of losses using infiltration capacity curves, Introduction to unit hydrograph, Rainfall excess reciprocal method, S-hydrograph method.	3
2.2	Design precipitation Depth-Intensity Duration-Frequency relationships-Design Hyetographs from Storm Event Analysis	3
2.3	Rainfall-Runoff Relationships -Total runoff in relation to total rainfall- Relationships for Peak Runoff Computations-Linear and Nonlinear Rainfall-Runoff Relationship-Extension of Stream Flow Record	2
2.4	Flood Routing- Channel Routing- Basic Equations-Muskingum Method of Routing(Fundamentals only)	2
3	**Module III: Total Lecture Hours-Principles of Groundwater Flow- 8 hours**	
3.1	Vertical distribution of ground water, types of aquifers, storage coefficients, Darcy's law, permeability, determination of hydraulic conductivity	4
3.2	Well hydraulics- steady radial flow to a well, unsteady radial flow in confined, unconfined and leaky aquifers,	4

	multiple well systems, specific capacity	
4	**Module IV: Total Lecture Hours- Wells-6 hours**	
4.1	Open wells – Design of open well –yield test.- Methods of construction-dug wells	2
4.2	Tube wells–design-screened wells-gravel packed wells-selection of screen size-yield of a well-	2
4.3	Well loss- determination of well loss by step pumping method.	1
4.4	Well development- testing wells for yield-failure of tube wells. Cavity wells and Infiltration galleries	1
5	**Module V: Total Lecture Hours- Basin Management & Pollution-5 hours**	
5.1	Concept of basin management- Need, Various Aspects and Approaches of Planning and Management.	1
5.2	Pollution of ground water, salt water intrusion in aquifers, Ghyben- Herzberg relation,	1
5.3	Geophysical exploration techniques, artificial recharge of ground water	2

Text Books

1. Ojha, C. S. P., Berndtsson, R., &Bhunya, P. (2008). *Engineering hydrology* (p. 440). Oxford: Oxford university press.
2. Chow , V.T., D.R. Maidment and L.W. Mays, Applied Hydrology, McGraw Hill Book company, Singapore, 1988.
3. Singh, V.P. Elementary Hydrology. Prentice Hall of India, New Delhi, 1994.
4. Todd, David Keith, and Larry W. Mays. *Groundwater hydrology*. John Wiley & Sons, 2004.

Reference Books

1. McCuen, R. H. Hydrologic analysis and design, Prentice Hall, Eaglewood Cliffs, New Jersey, 1989.
2. Subramanya, K. Engineering Hydrology, Tata Mcgraw Hill, Newdelhi,1994
3. RaghunathH.M.. -Hydrology H.M Wiley Eastern Ltd Newdelhi,1985

SEMESTER II

INTERDISCIPLINARY ELECTIVE

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE099	CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT	INTERDISCIPLINARY ELECTIVE	3	0	0	3

Preamble: The aim of this course is to educate students about the basic aspects of climate change and its effects, and sustainable practices that can be adopted to reduce carbon emissions. Students will gain knowledge in diverse domains of climate change.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Outline the changes that have occurred in the climate of earth over the years and analyse the mechanisms.
CO 2	Apply national and international agreements and standards in accounting greenhouse gases and mitigating climate change.
CO 3	Analyse the impacts of climate change on the natural and social environment and demonstrate how it affects the environment, locally and globally
CO 4	Demonstrate the various options to mitigate the effects of climate change or adapt to it
CO 5	Evaluate sustainable practices which can be implemented in various sectors of development and suggest green solutions.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2	2	2	1	2	2	
CO 2	2	3	2	2	3	2	3
CO 3	3	3	2	2	3	2	2
CO 4	3	3	2	2	2	2	3
CO 5	3	3	2	2	3	2	3

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	10
Apply	30
Analyse	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Evaluation shall only be based on application, analysis or design-based questions (for both internal and end semester examinations).

Continuous Internal Evaluation: 40 marks

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no.: 10 marks
Test paper shall include minimum 80% of the syllabus.
End Semester Examination: 60 marks

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College.
There will be two parts; Part A and Part B.
Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions.
Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.
Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **222ECE099 CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT**

Time: 2.5 Hrs

Max. Marks: 60

PART A

(Answer **All** Questions)

1. "Keeling curve is a warning signal for global warming". Justify this statement
2. Can Gandhian principles serve as the base for building up a sustainable planet? State your views
3. Relate sea water intrusion into ground water and climate change, based on one example
4. Write a note on carbon capture technologies
5. "Green computing technologies can lead to lower carbon emissions". Comment on this statement with reference to global digital developments

(5x5 = 25 marks)

PART B

(Answer **any 5** Questions)

6. Assume that two processes are taking place in an industry. Process 1 generates 15 tons of CO_2 into the atmosphere while Process 2 generates 15 tons of methane into the atmosphere. Compare the contribution of these two emissions to global warming for a time duration of next 10 years. Also assess the effect of these emissions after 100 years on global warming of the planet.

7. Identify two major drivers of climate change. Discuss the mechanisms through which these drivers contribute to global warming

8. How can Paris Agreement serve as a framework for guiding the global efforts to combat climate change? Discuss in detail, stating the NDCs

9. "Climate change alters the water cycle on our planet". Discuss the statement, stating the various pathways

10. "Oceans are the most important components of climate change". Discuss the statement in detail

11. Identify any two measures by which renewable energy sources can be utilised in farming and livestock sector. Explain how it can be implemented

12. Analyze any four possibilities for sustainable water management in a region like Kerala with long coastal line and high annual average rainfall

(5x7=35 marks)

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Climate and climate change – basic concepts (8 h)**	
1.1	History of Earth's climate system– glacial and interglacial cycles – ice age - Milankovitch cycles Components of the terrestrial Climate System and their interactions	2
1.2	Science of Climate Change: Drivers of climate change- Greenhouse effect - greenhouse gases and their mechanism, concept of global warming potential (GWP)	2
1.3	Aerosols – reflective and black carbon, Energy balance, Albedo effect - Forcings and feed-back processes in climate system, radiative forcing, water vapour feedback, Carbon cycle and its role in climate change	2
1.4	Keeling curve - Human induced climate change – Emission scenarios – Shared socio economic pathways	2
2	**International Legal and Policy Frameworks to Address Climate Change (8h)**	
2.1	Brief history of international climate change negotiations - United Nations Framework Convention on Climate Change (UNFCCC). - the key provisions of the UNFCCC, organisational structure, and different Party groups under the Convention - COPs	2
2.2	Gandhian principles in climate change	1
2.3	Kyoto Protocol - Key commitments by Parties. - overview of main negotiation issues. Evolution of negotiations over the past years (from a two-track to a one-track approach) - Carbon trading	2
2.2	Paris agreement – Plans for climate action (NDCs) - Implementation	1
2.3	IPCC Assessment Report (latest AR) – summarize working group contributions – deviations from the previous report, models used and new predictions, major links between natural world and human induced actions, mitigation and adaptation recommendations	2
3	**Impacts of climate change (8 h)**	
3.1	Impact on oceans, coastal regions, sea water intrusion	2
3.2	Impact on polar regions, melting of ice caps, sea level rise. Impact on biodiversity	2
3.3	Impact on agriculture and impacts due to agriculture	2
3.4	Any one 2 case studies (water-related) on climate change impacts	2

4	**Mitigation and adaptation strategies in climate change**	
4.1	Conventional mitigation technologies – Renewable energy, fuel switching, efficiency gains, nuclear power, carbon capture storage and utilization	2
4.2	Negative emissions technologies – carbon capture and sequestration methods, Carbon dioxide Removal (CDR) Methods	2
4.3	Adaptation – Nature based solutions – Climate resilient infrastructure -	2
4.4	Case study – Room for the river project	2
5	**Sustainable development (8 h)**	
5.1	Sustainable development, SDGs, Sustainable cities and communities –basic aspects. 2 cities as case studies	4
5.2	Green technologies – Green technologies for sustainable water management, ZLD processes in industries	2
5.3	Sustainable Energy - Energy production from biomass and wastes, energy conservation - Green computing	2

Text Books

1. David Archer, The Climate Crisis - An Introductory Guide to Climate Change (Cambridge University Press 2014; ISBN: 9781107321243)

2.The Royal Society, National Academy of Sciences, Climate Change Evidence and Causes, National Academies Press 2014; ISBN:9780309302029, 0309302021

3.Steven Earle, A Brief History of the Earth's Climate Everyone's Guide to the Science of Climate Change; Publisher:New Society Publishers, 2021. ISBN:9781771423489, 177142348X

4.Dash Sushil Kumar, Climate Change – An Indian Perspective, Cambridge University Press India Pvt. Ltd, 2007

Reference Books:

1.David Archer, Global Warming: Understanding the Forecast, 2 nd ed. (Wiley, 2011; ISBN 978-0-470-94341-0).

2.Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, 2003

3.Roger A. Pielke, Jr., The Climate Fix (Basic Books, 2010; ISBN 978-0-465-02519-0)

Learning Websites

i. https://unfccc.int/
ii. https://www.ipcc.ch › reports

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE102	ENVIRONMENTAL HEALTH AND SAFETY	INTERDISCIPLINARY ELECTIVE	3	0	0	3

Preamble: Nil

Environment Health and Safety , give practical suggestions for protecting the environment along with maintaining health and safety. It highlights the need for sanitation and safety in public and private spaces and equips the students to practise general hygiene and adopt various measures for the control of various communicable diseases. Hence this course is very beneficial as for practising Environmental engineers and students .

Course Outcomes: After the completion of the course the student will be able to

CO 1	To understand the mode of transmission and control measures of various communicable diseases
CO 2	To outline occupational diseases
CO 3	To formulate the procedures adopted for Survey and sample collection
CO 4	To discuss the Sanitation practices adopted in public spaces,
CO 5	To practice Occupational health and evaluate risk assessment

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			3				
CO 2			3				
CO 3	3	2		3	2	2	
CO 4	3	3		2	2	2	
CO 5				2	2	3	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	10
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
original publications (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:
The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

Subject: **222ECE102 ENVIRONMENTAL HEALTH AND SAFETY**

Time: 2.5 Hrs Max. Marks: 60

PART A

(Answer **All** Questions)

1. Discuss the etiology, mode of transmission and control measures of two viral diseases
2. Describe heavy metal toxicity on human health with two examples
3. Outline the measures to be adopted for vector borne and zoonotic diseased transmission and control
4. Summarize the major operations in a slaughterhouse
5. Discuss the significance of emerging contaminants in the environment

(5x5=25 marks)

PART B

(Answer **any 5** Questions)

6. Discuss two major Enteric diseases ,their pathogenicity ,mode of transmission and control measures

7. Outline the significance of managing biosolids in the environment
8. 8. A food borne disease outbreak was reported in your community , list down the procedures to be adopted for sample collection ,following the outbreak
9. Outline the occupational health and safety practices to be adopted in a laboratory
10. Analyze the basic steps to be followed for risk assessment of contaminants in the environment

11. Summarize the significant role played by normal flora in human body for preventing diseases

12. The swimmers in a swimming pool are complaining about the quality of water Mention the steps to be followed to ensure water quality standards in the pool

(5x7=35 marks)

Syllabus and Course Plan (For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	**Communicable diseases**	
1.1	Infection and disease -Normal flora, pathogenicity, types and mode of transmission of diseases	2
1.2	Bacterial ,Viral and Protozoal diseases-pathogenicity, mode of transmission and control - Cholera, Typhoid, Tuberculosis , Rabies, AIDS, Dengue, Covid 19, Nipah, Malaria	6
2	**Occupational illness**	
2.1	Asbestos, Silica , Lead , Nickel ,Arsenic and Mercury toxicity	4
2.2	Land application of biosolids and animal wastes- Class A and Class B biosolids , Biological Concerns with Biosolids- Antibiotic Resistant Bacteria and endotoxins , Risks from Pathogens in Biosolids, pathogens in animal manure	4
3	**Survey on food borne water borne diseases**	
3.1	Investigation of water and food borne diseases outbreaks- general, sanitary survey, medical survey, samples, epidemiologic reports	4
3.3	Water and Food borne illness-disease transmission and control Air borne pathogens and toxins , bioaerosol control Vector borne and zoonotic diseases-transmission and control	4
4	**Sanitation**	
4.1	Swimming Pool sanitation, Restaurant sanitation, Slaughterhouse sanitation, Milk plant sanitation and Sanitation of Hospitals.	6
4.2	Sanitation Related Diseases and Control Measures	2
5	**Occupational health & Risk assessment**	
5.1	Accident Prevention and Elimination Plans in Laboratories, storage, disposal, chemical spill management in laboratories	2
5.2	Radiation health -Biological effects of radiation , Bioterrorism , Emerging contaminants-pharmaceuticals and personal care products ,antibiotics, chemical household products, microplastics	3
5.3	Elements of risk assessment -hazard identification ,exposure assessment, dose response assessment, risk characterization ,microbial risk assessment	3
		40 hrs

Text Books

1) Raina.M.Maier, Ian L Pepper& Charles P Gebra, Environmental Microbiology, 2nd edition Elsevier India Pvt ltd, New Delhi, 2008.
2) P.D.Sharma,Microbiology,4th edition Rastogi publications, Meerut, 2019.
3) R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi ,2006.

Reference Books

4) Slote.L, Handbook of Occupational Safety and Health, 2nd edition, John Willey and Sons, NewYork, 1999.
5) Environmental Engineering; Joseph A Salvato ,Nelson N Nemero, Franklin .J Agardy 5 th edition Wiley interscience publication,2003.
6) Ernest Hodgson, A Text book of Modern Toxicology , 4 edition , John Willey and Sons, NewYork, 2010

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE101	WASTE MANAGEMENT	INTERDISCIPLINARY ELECTIVE	3	0	0	3

Preamble: This course aims to provide basic concepts on handling and management of wastes of various categories. The course also introduces the various legislations and standards followed in this sector.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the sources and types of solid and liquid waste
CO 2	Understand the characteristics and characterization techniques for solid and liquid waste
CO 3	Learn various strategies for solid and liquid waste management
CO 4	Increase awareness on the legislations and pollution control standards in waste management

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			1				
CO 2			1			1	
CO 3			2		2	2	
CO 4			2			1	

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	10
Analyse	10
Evaluate	20
Create	20

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
Original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation : 15 marks
Test paper, 1 no. : 10 marks
Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A contain 5 numerical questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student shall answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is called municipal solid waste?
2. What are the various sources of hazardous wastes?
3. How liquid wastes are classified?

Course Outcome 2 (CO2):

1. How do different components of E-waste decide the strategy for its management?
2. Explain the characterization techniques for municipal solid waste.
3. How are the characteristics of sewage and septage are different?

Course Outcome 3(CO3):

1. Explain waste to energy conversion techniques for municipal solid waste.
2. Discuss disposal methods for biomedical wastes.
3. Explain nature based treatment techniques for septage.

Course Outcome 4 (CO4):

1. Discuss the highlights of Municipal Solid Wastes (Management & Handling) Rules, 2000
2. What legislations exists in India for the disposal of hazardous wastes?
3. What are the government rules in India for handling electronic wastes?

Model Question Paper

APJ Abdul Kalam Technological University

M.Tech Degree Examination

Branch: **Civil Engineering**

Specialisation: **ID1 (Environmental Engineering, Environmental Engineering and Management)**

222ECE101 Waste Management

Time: 2.5 Hours **Max. Marks: 60**

PART A
Answer All Questions

1. Explain composting.
2. What is solidification?
3. What are the components of electronic waste?
4. Compare aerobic and anaerobic processes in treating liquid waste.
5. Discuss 5 highlights of The E-waste (management & handling) rules, 2010.

5 x 5 marks = 25 marks

PART B
Answer any 5 Questions

6. Which type of energy recovery system is more efficient in the case of incinerators? Give justification for your answer.
7. Explain the five technology options available for the treatment of bio-medical waste.
8. How is the storage and processing of hazardous waste done?
9. Explain recycling process for electronic waste.
10. Explain the components and operation of sanitary landfills.
11. Explain how natural based methods are useful in septage management. What are its advantages and limitations?
12. Explain key legislations in India for managing solid waste.

5 x 7 marks = 35 marks

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Module 1: Municipal Solid Waste Management-10 hours**	
1.1	Sources and types of solid waste- sampling and characterization-	1
1.2	Unit operations for separation and processing	1
1.3	Waste transformation through combustion and anaerobic composting	2
1.4	Material recovery and recycling	2
1.5	Waste to energy conversion technologies-incineration, gasification	2
1.6	Sanitary landfills- components and operation	2
2	**Module II: Hazardous Waste Management-10 hours**	
2.1	Definition, sources and characteristics	2
2.2	Handling, storage, collection and transport of hazardous waste	2
2.3	physical, chemical and thermal treatment of hazardous waste	2
2.4	Biomedical waste disposal methods	2
2.5	Solidification, chemical fixation and encapsulation	2
3	**Module III: Electronic Waste Management-6 hours**	
3.1	E-waste -definition and components	1
3.2	E Waste management strategies- landfilling, incineration and recycling	2
3.3	Recycling processes for E Waste	3
4	**Module IV: Liquid Waste Management- 8 hours**	
4.1	Liquid waste sources, classifications and characteristics	2
4.2	Sewage treatment strategies- centralized, decentralized and onsite sanitation	2
4.3	Sewage treatment technologies- electromechanical methods(activated sludge process and trickling filters) and natural based methods (constructed wetlands and worm bio filter), anaerobic and aerobic processes	2
4.4	Septage treatment techniques-bio digester, natural based methods, composting and thermal methods	2
5	**Module V: Legislations in Waste Management-6 hours**	
5.1	Municipal Solid Wastes (Management & Handling) Rules, 2000	1
5.2	The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008	1
5.3	The Plastics (Manufacture, Usage and Waste Management) Rules, 2009	1

5.4	Bio-Medical Waste (Management and Handling) Rules, 1998	1
5.5	The E-Waste (Management and Handling Rules) 2010	1
5.6	The Water (Prevention and Control of Pollution) Act, 1974	1

Text Books

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management, McGraw-Hill International edition, New York, 1993.
2. Howard S Peavy, Donal R Rowe and George Tchobanoglous, Environmental Engineering, McGraw Hill Education;2017

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1. Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. Evans and Environmental Resources Management, Hazardous Waste Management, McGraw-Hill International edition, New York, 2001.
2. CPHEEO "Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
3. Septage management in urban India, advisory note, Ministry of Urban Development, Govt of India, 2013.
4. Nature Based Solutions for Wastewater Treatment, Edited by Katharine Cross, IWA Publishing, 2021.
5. Sandip Chatterjee, Electronics Waste Management: An India Perspective, LAP Lambert Academic Publishing, 2010