MATHEMATICS – 4 th semester

(All branches except Electrical, Electronics, Computer science, Information Technology and Applied Electronics)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MAT 202	PROBABILITY,STATISTICS AND NUMERICAL METHODS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces students to the modern theory of probability and statistics, covering important models of random variables and techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluationg definite integrals solving systems of linear equations, and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisite: A basic course in one-variable and multi-variable calculus.

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

CO 1	Understand the concept, properties and important models of discrete random variables and,using them, analyse suitable random phenomena.
CO 2	Understand the concept, properties and important models of continuous random variables and,using them, analyse suitable random phenomena.
CO 3	Perform statistical inferences concerning characteristics of a population based on attributes of samples drawn from the population
CO 4	Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2					2		1
CO 2	3	2	2	2	2					2		1
CO 3	3	2	2	2	2					2		1
CO 4	3	2	2	2	2					2		1
CO 5	3	2	2	2	2					2		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Let X denote the number that shows up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X.

2. An equipment consists of 5 componets each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least 3 of the componets are operational, what is the probability that it functions properly?

3. X is a binomial random variable $B(n, p)$ with $n = 100$ and $p = 0.1$. How would you approximate it by a Poisson random variable?

4. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X,Y)

Course Outcome 2 (CO2)

1. What can you say about $P(X = a)$ for any real number a when X is a (i) discrete random variable? (ii) continuous random variable?

2. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twise the length of the other?

3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?

4. X and Y are independent random variables with X following an exponential distribution with parameter μ and Y following and exponential distribution with parameter λ. Find $P(X + Y \leqslant 1)$

Course Outcome 3(CO3):

1. In a random sample of 500 people selected from the population of a city 60 were found to be left-handed. Find a 95% confidence interval for the proportion of left-handed people in the city population.

2. What are the types of errors involved in statistical hypothesis testing. Explain the level of risks associated with each type of error.

3. A soft drink maker claims that a majority of adults prefer its leading beverage over that of its main competitor's. To test this claim 500 randomly selected people were given the two beverages in random order to taste. Among them, 270 preferred the soft drink maker's brand, 211 preferred the competitor's brand, and 19 could not make up their minds. Determine whether there is sufficient evidence, at the 5% level of significance, to support the soft drink maker's claim against the default that the population is evenly split in its preference.

4. A nutritionist is interested in whether two proposed diets, *diet A* and *diet B* work equally well in providing weight-loss for customers. In order to assess a difference between the two diets, she puts 50 customers on diet A and 60 other customers on diet B for two weeks. Those on the former had weight losses with an average of 11 pounds and a standard deviation of 3 pounds, while those on the latter lost an average of 8 pounds with a standard deviation of 2 pounds. Do the diets differ in terms of their weight loss?

Course Outcome 4(CO4):

1. Use Newton-Raphson method to find a real root of the equation $f(x) = e^{2x} - x - 6$ correct to 4 decimal places.

2. Compare Newton's divided difference method and Langrange's method of interpolation.

3. Use Newton's forward interpolation formula to compute the approximate values of the function f at $x = 0.25$ from the following table of values of x and $f(x)$

x	0	0.5	1	1.5	2
f(x)	1.0000	1.0513	1.1052	1.1618	1.2214

4. Find a polynomial of degree 3 or less the graph of which passes thorugh the points (-1,3), (0,-4), (1,5) and (2,-6)

Course Outcome 5 (CO5):

1. Apply Gauss-Seidel method to solve the following system of equations
$$4x_1 - x_2 - x_3 = 3$$
$$-2x_1 + 6x_2 + x_3 = 9$$
$$-x_1 + x_2 + 7x_3 = -6$$

2. Using the method of least squares fit a straight line of the form $y = ax + b$ to the following set of ordered pairs (x, y) :
   (2,4), (3,5), (5,7), (7,10), (9,15)

3. Write the normal equations for fitting a curve of the form $y = a_0 + a_1 x^2$ to a given set of pairs of data points.

4. Use Runge-Kutta method of fourth order to compute $y(0.25)$ and $y(0.5)$, given the initial value problem
   $$y' = x + xy + y, y(0) = 1$$

Syllabus

Module 1 (Discrete probability distributions)   **9 hours**

(Text-1: *Relevant topics* from sections-3.1-3.4, 3.6, 5.1)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation -multiple random variables.

Module 2 (Continuous probability distributions)   **9 hours**

(Text-1:*Relevant topics* from sections-4.1-4.4, 3.6, 5.1)

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation-multiple random variables, i.i.d random variables and Central limit theorem (**without proof**).

Module 3 (Statistical inference)   **9 hours**

(Text-1:*Relevant topics* **from sections-5.4,, 3.6, 5.1,7.2, 8.1, 8.3, 9.1-9.2,9.4)**

Population and samples, Sampling distribution of the mean and proportion (for large samples only), Confidence interval for single mean and single proportions(for large samples only). Test of hypotheses: Large sample test for single mean and single proportion, equality of means and equality of proportions of two populations, small sample t-tests for single mean of normal population, equality of means (**only pooled t-test, for independent samples from two normal populations with equal variance**)

Module 4 (Numerical methods -I)   **9 hours**

(Text 2- *Relevant topics* from sections 19.1, 19.2, 19.3, 19.5)

Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (**Proof or derivation of the formulae not required for any of the methods in this module**)

Module 5 (Numerical methods -II)   **9 hours**

(Text 2- *Relevant topics* from sections 20.3, 20.5, 21.1)

Solution of linear systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, fitting staright lines and parabolas. Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams-Moulton predictor-correction method (**Proof or derivation of the formulae not required for any of the methods in this module**)

Text Books

1. (Text-1) Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, 8th edition, Cengage, 2012

2. (Text-2) Erwin Kreyszig, *Advanced Engineering Mathematics,* 10 th Edition, John Wiley & Sons, 2016.

Reference Books

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes*, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, *Introduction to probability and statistics for engineers and*

scientists, 4th edition, Elsevier, 2009.

3. T. Veera Rajan, *Probability, Statistics and Random processes,* Tata McGraw-Hill, 2008

4. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36 Edition, 2010.

Assignments

Assignments should include specific problems highlighting the applications of the methods introduced in this course in physical sciences and engineering.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Discrete Probability distributions**	**9 hours**
1.1	Discrete random variables and probability distributions, expected value, mean and variance (discrete)	3
1.2	Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	3
2	**Continuous Probability distributions**	**9 hours**
2.1	Continuous random variables and probability distributions, expected value, mean and variance (continuous)	2
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	3
3	**Statistical inference**	**9 hours**
3.1	Population and samples, Sampling distribution of single mean and single proportion(large samples)	1
3.2	Confidence interval for single mean and single proportions (large samples)	2
3.3	Hypothesis testing basics, large sample test for single proportion, single proportion	2
3.4	Large sample test for equality of means and equality of proportions of two populations	2

3.5	t-distribution and small sample t-test for single mean and pooled t-test for equality of means	2
4	**Numerical methods-I**	**9 hours**
4.1	Roots of equations- Newton-Raphson, regulafalsi methods	2
4.2	Interpolation-finite differences, Newton's forward and backward formula,	3
4.3	Newton's divided difference method, Lagrange's method	2
4.3	Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule	2
5	**Numerical methods-II**	**9 hours**
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method	2
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	4
5.4	Adams-Moulton predictor-corrector methods	1

Model Question Paper

(**2019 Scheme**)

Reg No: ....   **Total Pages: 4**
Name: ....

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION
(Month & year)
Course Code: MAT

Course Name: PROBABILITY, STATISTICS AND NUMERICAL METHODS

(Common to all branches except (i) Electrical and Electronics, (ii) Electronics and Communication, (iii) Applied Electronics and Instrumentation (iv) Computer Science and Engineering (v) Information Technology)

Max Marks :100   Duration : 3 Hours

PART A
(**Answer *all* questions. Each question carries 3 marks**)

1. Suppose X is binomial random variable with parameters $n = 100$ and $p = 0.02$. Find $P(X < 3)$ using Poisson approximation to X. (3)

2. The diameter of circular metallic discs produced by a machine is a random variable with mean 6cm and variance 2cm. Find the mean area of the discs. (3)

3. Find the mean and variance of the continuous random variable X with probability density function (3)
$$f(x) = \begin{cases} 2x - 4, & 2 \le x \le 3 \\ 0 & \text{otherwise} \end{cases}$$

4. The random variable X is exponentially distributed with mean 3. Find $P(X > t + 3 | X > t)$ where t is any positive real number. (3)

5. The 95% confidence interval for the mean mass (in grams) of tablets produced by a machine is [0.56   0.57], as calculated from a random sample of 50 tablets. What do you understand from this statement? (3)

6. The mean volume of liquid in bottles of lemonade should be at least 2 litres. A sample of bottles is taken in order to test whether the mean volume has fallen below 2 litres. Give a null and alternate hypothesis for this test and specify whether the test would be one-tailed or two-tailed. (3)

7. Find all the first and second order forward and backward differences of y for the following set of (x, y) values: $(0.5, 1.13), (0.6, 1.19), (0.7, 1.26), (0.8, 1.34)$ (3)

8. The following table gives the values of a function $f(x)$ for certain values of x. (3)

x	0	0.25	0.50	0.75	1
$f(x)$	1	0.9412	0.8	0.64	0.5

Evaluate $\int_0^1 f(x)dx$ using trapezoidal rule.

9. Explain the principle of least squares for determining a line of best fit to a given data (3)

10. Given the initial value problem $y' = y + x$, $y(0) = 0$, find $y(0.1)$ and $y(0.2)$ using Euler method. (3)

PART B
(Answer one question from each module)
MODULE 1

11. (a) The probability mass function of a discrete random variable is $p(x) = kx, x = 1, 2, 3$ where k is a positive constant. Find (i)the value of k (ii) $P(X \leq 2)$ (iii) $E[X]$ and (iv) $\text{var}(1 - X)$. (7)

    (b) Find the mean and variance of a binomial random variable (7)

OR

12. (a) Accidents occur at an intersection at a Poisson rate of 2 per day. what is the probability that there would be no accidents on a given day? What is the probability that in January there are at least 3 days (not necessarily consecutive) without any accidents? (7)

    (b) Two fair dice are rolled. Let X denote the number on the first die and $Y = 0$ or 1, according as the first die shows an even number or odd number. Find (i) the joint probability distribution of X and Y, (ii) the marginal distributions. (iii) Are X and Y independent ? (7)

MODULE 2

13. (a) The IQ of an individual randomly selected from a population is a normal distribution with mean 100 and standard deviation 15. Find the probability that an individual has IQ (i) above 140 (ii) between 120 and 130. (7)

    (b) A continuous random variable X is uniformly distributed with mean 1 and variance 4/3. Find $P(X < 0)$ (7)

OR

14. (a) The joint density function of random variables X and Y is given by (7)

$$f(x, y) = \begin{cases} e^{-(x+y)}, & x > 0, \quad y > 0 \\ 0 & \text{otherwise.} \end{cases}$$

Find $P(X + Y \leq 1)$. Are X and Y independent? Justify.

    (b) The lifetime of a certain type of electric bulb may be considered as an exponential random variable with mean 50 hours. Using central limit theorem, find the approximate probability that 100 of these electric bulbs will provide a total of more than 6000 hours of burning time. (7)

MODULE 3

15. (a) The mean blood pressure of 100 randomly selected persons from a target population is 127.3 units. Find a 95% confidence interval for the mean blood pressure of the population. (7)

    (b) The CEO of a large electric utility claims that 80 percent of his 1,000,000 customers are very satisfied with the service they receive. To test this claim, the local newspaper surveyed 100 customers, using simple random sampling. Among the sampled customers, 73 percent say they are very satisfied. Based on these findings, do you think that the CEO is making a false claim of high satisfaction levels among his customers? Use a 0.05 level of significance. (7)

OR

16. (a) A magazine reported the results of a telephone poll of 800 adult citizens of a country. The question posed was: "Should the tax on cigarettes be raised to pay for health care reform?" The results of the survey were: Out of the 800 persons surveyed, 605 were non-smokers out of which 351 answered "yes" and the rest "no". Out of the remaining 195, who were smokers, 41 answered "yes" and the remaining "no". Is there sufficient evidence, at the 0.05 significance level, to conclude that the two populations smokers and non-smokers differ significantly with respect to their opinions? (7)

(b) Two types of cars are compared for acceleration rate. 40 test runs are recorded for each car and the results for the mean elapsed time recorded below: (7)

	Sample mean	Sample standard deviation
Car A	7.4	1.5
Car B	7.1	1.8

determine if there is a difference in the mean elapsed times of the two car models at 95% confidence level.

MODULE 4

17. (a) Use Newton-Raphson method to find a non-zero solution of $x = 2\sin x$. Start with $x_0 = 1$ (7)

(b) Using Lagrange's interpolating polynomial estimate $f(1.5)$ for the following data (7)

x	0	1	2	3
$y = f(x)$	0	0.9826	0.6299	0.5532

OR

18. (a) Consider the data given in the following table (7)

x	0	0.5	1	1.5	2
$f(x)$	1.0000	1.0513	1.1052	1.1618	1.2214

Estimate the value of $f(1.80)$ using newton's backward interpolation formula.

(b) Evaluate $\int_0^1 e^{-x^2/2}dx$ using Simpson's one-third rule, dividing the interval $[0, 1]$ into 8 subintervals (7)

MODULE 5

19. (a) Using Gauss-Seidel method, solve the following system of equations (7)

$$20x + y - 2z = 17$$
$$3x + 20y - z = -18$$
$$2x - 3y + 20z = 25$$

(b) The table below gives the estimated population of a country (in millions) for during 1980-1995 (7)

year	1980	1985	1990	1995
population	227	237	249	262

Plot a graph of this data and fit an appropriate curve to the data using the method of least squares. Hence predict the population for the year 2010.

OR

20. (a) Use Runge-Kutta method of fourth order to find $y(0.2)$ given the initial value problem (7)

$$\frac{dy}{dx} = \frac{xy}{1 + x^2}, \quad y(0) = 1$$

Take step-size, $h = 0.1$.

(b) Solve the initial value problem (7)

$$\frac{dy}{dx} = x + y, \quad y(0) = 0,$$

in the interval $0 \leq x \leq 1$, taking step-size $h = 0.2$. Calculate $y(0.2), y(0.4)$ and $y(0.6)$ using Runge-Kutta second order method, and $y(0.8)$ and $y(1.0)$ using Adam-Moulton predictor-corrector method.

****

CET202	Engineering Geology	Category	L	T	P	Credits	Year of Introduction
		PCC	3	0	1	4	2020

Preamble: Goal of this course is to introduce to the students the basics of earth processes, materials, groundwater and the geological characteristics of such processes and materials which are relevant to the Civil Engineering applications.

Prerequisites: Nil

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

CO1	Recall the fundamental concepts of surface processes, subsurface process, minerals, rocks, groundwater and geological factors in civil engineering constructions.
CO2	Identify and describe the surface processes, subsurface process, earth materials, groundwater and geological factors in civil engineering constructions.
CO3	Apply the basic concepts of surface and subsurface processes, minerals, rocks, groundwater and geological characteristics in civil engineering constructions.
CO4	Analyze and classify geological processes, earth materials and groundwater.
CO5	Evaluation of geological factors in civil engineering constructions.

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					1	2					
CO2	3											
CO3	3											
CO4	3	2										
CO5	3	1	3			3	3	2				2

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	9 (3 marks for each question in which one question from third module)	6	15
Understand	6	9 (3 marks for each question in which one question from third module)	15
Apply	14 +14 + 7 (Question for 7 marks is from third module)	14 +14 + 7 (Question for 7 marks is from third module)	70
Analyse			
Evaluate			

Mark distribution

Total Marks	CIE marks	ESE marks	Test 1 &2 Duration	ESE Duration
150	50	100	1.5 hours	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10marks

Continuous Assessment Test (2 numbers): 25 marks

Assignment/Quiz/Courseproject: 15 marks

End Semester ExaminationPattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: To recall the fundamental concepts of surface processes, subsurface process, minerals, rocks, groundwater and geological factors in civil engineeringconstructions).

1. Define weathering of rocks

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: To identify and describe the surface processes, subsurface process, earth materials, groundwater and geological factors in civil engineering constructions.)

1. Explain the classification of soil

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes 3, 4 and5.

1. **a)** Classify weathering and discuss the engineering classification of weathered rock masses (7 marks)

    b) Write your comments on the relevance of geology in civil engineering constructions (7 marks)

Model Question Paper

QP CODE:

RegNo.:_____

Name:_____

**PJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER
B.TECH DEGREE EXAMINATION**, MONTH & YEAR

Course Code: CET 202

ENGINEERING GEOLOGY

Max.Marks: 100   Duration: 3hours

Part A

(Answer all questions; each question carries 3 marks)

1. Define weathering ofrocks

2. Explain soil erosion and classification ofsoils

3. Describe earthquakes and write notes on seismograph andseismogram

4. Illustrate the elastic rebound theory with adiagram

5. Define Ghyben Herzberg relation in sea waterintrusion

6. Explain Darcy's Law with a neatdiagram

7. Write down the physical properties and chemical composition of givenminerals

   a. Calcite

   b. Gypsum

8. Describe the different types of igneous rocks based on theirorigin

9. Illustrate the major parts of the fold with a neatdiagram

10. Distinguish between clinometer compass and Brunton compass

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11. **a)** Discuss the relevance of geology in civil engineering constructions (7marks)

    b) Give an account on classification of weathering with suitable diagrams and examples (7 marks)

12. Describe the geological work of rivers. Discuss different landform features produced by weathering and river action with suitable diagrams. (14 marks)

Module -2

13. Comment on the relation of earthquakes with plate tectonics. Give an account on different plates with earthquake prone area (14 marks)

14. Discuss the various types of seismic waves and their relevance in the study of internal structure of earth. (14marks)

Module -3

15. Discuss the vertical distribution of groundwater. Give an account of the water bearing properties of rocks and hydrological cycle with neat diagrams. (14marks)

16. a) Elucidate application of electrical resistivity survey in ground water exploration. (8 marks)

b) Give a brief account on different ground water recharge methods (6 marks)

Module -4

17. Distinguish between metamorphic and sedimentary rocks with respect to their structure with diagrams (14marks)

18. a) Elucidate various physical properties of minerals for their identification. (9marks)

b) Give an account on hardness of minerals with Moh's hardness scale (5 marks)

Module -5

19. a) Enumerate the geological factors to be considered for selecting a dam site (9 marks)

b) Discuss the geological conditions suitable and unsuitable for construction of tunnels (5marks)

20. Distinguish between folds and faults. Give an account on classification of folds with neat diagrams (14 marks)

ENGINEERING GEOLOGY

Syllabus

Module	Contents	Hours
Module 1 External Earth Processes	Relevance of Geology in Civil Engineering, **Surface Processes of the earth**- a) Weathering of rocks-Types of weathering, Processes of Origin of Products of weathering like sand, clay, laterite and soil, soil profile, Soil erosion and soil conservation measures. Engineering significance of weathering. b) Geological processes by rivers. c) Landslides-types, causes and controlling measures, Coastal Processes-Geological work by waves and currents and coastal protectionmeasures	9
Module 2 Internal Earth Processes	**Internal Processes of the earth**- a) Earthquakes- Plate Tectonics, Origin of earthquakes, Seismic waves, Rating of earthquakes, types of earthquakes, Seismic zones of India. Basics of seismic safety factor, Interior of the earth as revealed by propagation of seismic waves.	9
Module 3 Groundwater	**Hydrogeology**-Occurrence of groundwater, aquifers and types of aquifers, confining beds, porosity and vertical distribution of groundwater. Darcy's Law.Permeability/hydraulic conductivity. Problems created by groundwater to civil engineering structures, Methods to control groundwater problems, Electrical resistivity survey for groundwater exploration. Seawater intrusion in Coastal area.Ghyben Herzberg relation.	9
Module 4 Earth Materials	**Mineralogy**-Physical properties of minerals, physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum. **Petrology**-Igneous, sedimentary and metamorphic rocks, Igneous rocks-Chemical and mineralogical classification and structure. Sedimentary rocks-types based on mode of formation and structures Metamorphic rocks-structures only. Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite. Rock types of Kerala. Rockcycle	9
Module 5 Secondary Structures of Rocks	**Structural Geology**– Attitude of rocks – Dip and Strike. Terminology, brief classification and engineering significance of folds, faults and joints. Geological part of site investigation for the construction of dams, reservoirs and tunnels. Toposheet.Structuralmapping.Clinometer compass and Brunton compass.	9

Textbooks

1. Duggal S.K, Pandey H.K and Rawat N (2014) Engineering Geology, Mcgraw Hill Education NewDelhi

2. Gokhale KVGK (2015) Principles of Engineering Geology, BS Publications, Hyderabad

3. Singh P (2014) Engineering and General Geology, SK Kataria and sons, NewDelhi

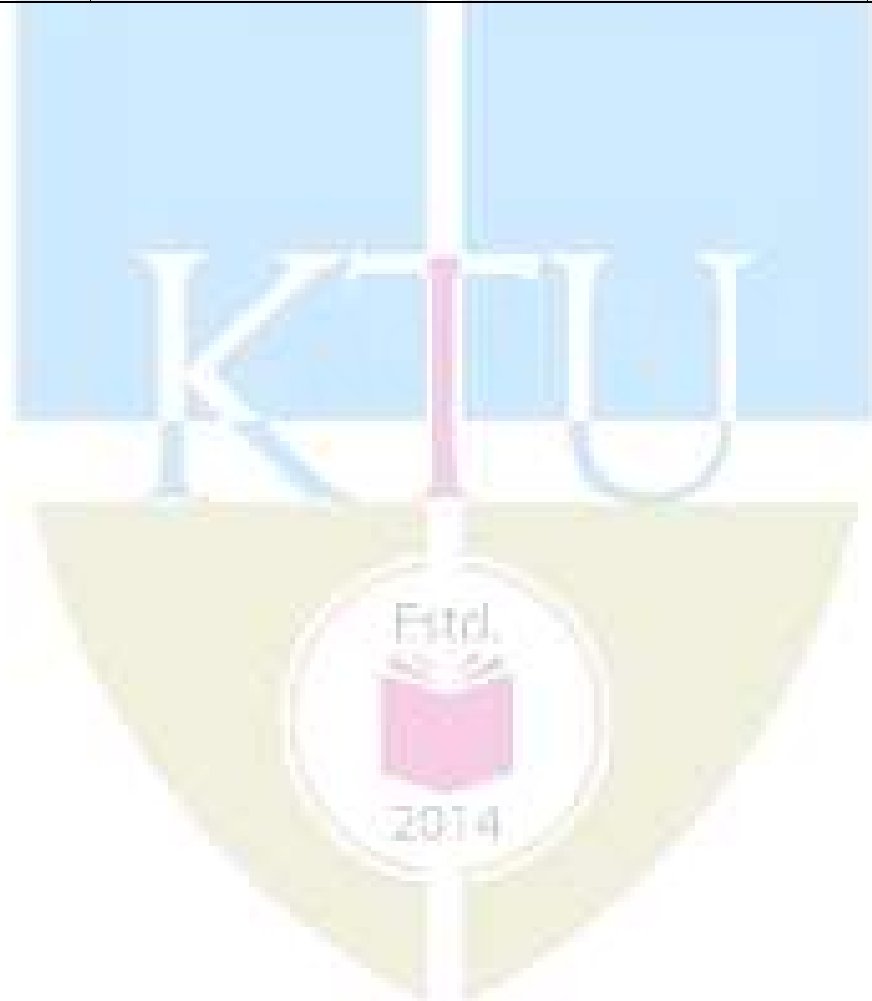4. SubinoyGangopadhyay (2017) Engineering Geology, OxfordUniversity

References

1. David K Todd & Larry W Mays (2011) Groundwater Hydrogeology, Wiley India Pvt Ltd.

2. Gokhale N.W. (2015) Manual of Geological Maps, CBS Publishers, NewDelhi

3. Gribble CD (2005) Rutleys Elements of Mineralogy,Springer

4. Marland P Billings (2016), Structural Geology, Pearson education

Course Contents and Lecture Schedule:

Module	Topic	No. of hours
Module 1	Weathering of rocks-Types of weathering, Processes of Origin of Products of weathering like sand, clay, laterite and soil	3
	Soil profile, Soil erosion and soil conservation measures. Engineering significance of weathering.	2
	Geological processes by rivers. Landslides-types, causes and controlling measures	2
	Coastal Processes-Geological work by waves and currents and coastal protection measures	2
Module 2	Earthquakes- Plate Tectonics, Origin of earthquakes, Seismic waves, Rating of earthquakes, types of earthquakes	4
	Seismic zones of India. Basics of seismic safety factor	2
	Interior of the earth as revealed by propagation of seismic waves.	3
Module 3	Occurrence of groundwater, aquifers and types of aquifers, confining beds, porosity and vertical distribution of groundwater.	2
	Darcy's Law.Permeability/hydraulic conductivity. Problems created by groundwater to civil engineering structures	3
	Methods to control groundwater problems	1
	Electrical resistivity survey for groundwater exploration.	2
	Seawater intrusion in Coastal area. Ghyben Herzberg relation.	1
Module 4	Physical properties of minerals, physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum	4

	Igneous, sedimentary and metamorphic rocks, Igneous rocks-Chemical and mineralogical classification and structure. Sedimentary rocks-types based on mode of formation and structures Metamorphic rocks-structures only. Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite. Rock types of Kerala. Rock cycle	5
Module 5	Attitude of rocks – Dip and Strike. Terminology	1
	Brief classification and engineering significance of folds, faults and joints	3
	Geological part of site investigation for the construction of dams, reservoirs and tunnels	3
	Toposheet, Structural mapping. Clinometer compass and Brunton compass	2

CET 204	GEOTECHNICAL ENGINEERING - I	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	4	0	0	4	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of soil mechanics and laboratory tests to determine the basic, index and engineering properties of soils. After this course, students will be able to identify and classify the soil and to recognize practical problems in real-world situations and respond accordingly.

Prerequisite : Nil

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

CO 1	Explain the fundamental concepts of basic and engineering properties of soil
CO 2	Describe the laboratory testing methods for determining soil parameters
CO 3	Solve the basic properties of soil by applying functional relationships
CO 4	Calculate the engineering properties of soil by applying the laboratory test results and the fundamental concepts of soil mechanics
CO 5	Analyze the soil properties to identify and classify the soil

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	10	15	20
Apply	25	25	50
Analyse	5		10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance   : 10 Marks

Continuous Assessment Test (2 numbers)   : 25 Marks

Assignment/Quiz/Course project   : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. The fundamental concepts of basic properties and index properties of soil
2. The fundamental concepts of engineering properties of soils related to Permeability, consolidation, compaction & shear strength
3. Concepts of Total, neutral and effective stress; and vertical stress below loaded areas
4. Concepts of Slope stability

Course Outcome 2 (CO2):

1. The laboratory testing methods for determining basic and index soil properties
2. The laboratory testing methods for determining engineering properties related to Permeability, consolidation, compaction & shear strength

Course Outcome 3 (CO3):

1. Solve the basic properties of soil by applying functional relationships

Course Outcome 4 (CO4):

1. Calculate the engineering properties of soil related to Permeability, consolidation, compaction & shear strength by applying the laboratory test results
2. Calculate the settlement of footings due to consolidation and application of time rate of consolidation settlement
3. Calculate the engineering properties of soil by applying the concepts of soil mechanics related to total , neutral and effective stress; and vertical stress below loaded areas
4. Calculate the stability of slopes

Course Outcome 5 (CO5):

1. Identify and classify the soil by analysing the basic and index properties of soil

Model Question Paper

QP CODE:

Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 204
Course Name : GEOTECHNICAL ENGINEERING - I

Max. Marks: 100   Duration: 3 hours

Part A
(*Answer all questions; each question carries 3 marks*)

1. Draw a three phase block diagram and define (i) Void Ratio, (ii) Water Content and (iii) Degree of saturation

2. Explain the procedure for Specific Gravity test using Pycnometer.

3. Define (i) Liquid Limit, (ii) Plastic Limit & (iii) Shrinkage Limit

4. Differentiate between Coefficient of Permeability and Coefficient of Percolation.

5. Explain Total Stress, Neutral Stress and Effective Stress.

6. List the assumptions of Boussinesq's theory.

7. Define pre consolidation pressure. Explain the method for the estimation of pre consolidation pressure.

8. Differentiate between Consolidation and Compaction.

9. Explain Mohr Coulomb shear strength theory.

10. What are the different types of slope failures?

PART B
(*Answer one full question from each module, each question carries 14 marks*)

Module – 1

11. (a) Derive the relation between bulk unit weight, specific gravity, void ratio and degree of saturation from the fundamentals.   (5 Marks)

    (b) A sample of wet silty clay soil weighs 1.26 kN. The following data were found from lab tests on the sample. Density γ = 21 kN/m3, Water content w = 15%, Specific Gravity G = 2.7. Determine (i) Dry density, (ii) Void Ratio, (iii) Porosity (iv) Degree of Saturation, (v) Saturated unit weight (vi) Submerged unit weight and (vii) Volume of soil.   (9 Marks)

12. (a) Explain different types of soil structures. (5 Marks)

(b) 1000 cm3 core cutter weighing 9.46 N was used to find out the in-situ unit weight of soil in an embankment. The weight of core cutter with in-situ soil was noted to be 27.7 N. Laboratory tests on the sample indicated water content of 10% and specific gravity of solids of 2.63. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation. Also calculate the saturated unit weight and the corresponding water content if the embankment is saturated during rain without change in volume. (9 Marks)

Module – 2

13. (a) What is the use of particle size distribution curve? With the help of particle size distribution curve define the following terms (i) well graded soil (ii) poorly graded soil and (iii) gap graded soil. (5 Marks)

(b) Tests on a fined grained soil sample indicated the following properties:

Liquid Limit = 52%, Plastic Limit = 32% and Shrinkage Limit = 17%. Classify the soil as per IS Code. If the specimen of this soil shrinks from a volume of 10 cm^3 at Liquid Limit to 6 cm^3 at the shrinkage limit, calculate the specific gravity of solids. (9 Marks)

14. (a) Explain the factors affecting permeability of soil. (5 Marks)

(b) A soil sample of height 6 cm and area of cross section 100 cm^2 was subjected to constant head permeability test with head of 36 cm and 90 cc of water passes through the specimen during a test interval of 5 min. Compute the coefficient of permeability of the soil sample.
If the same sample is subjected to falling head permeability test and found that head drops from 60 cm to 20 cm in 4 min. Determine the cross sectional area of the stand pipe. (9 Marks)

Module – 3

15. (a) Explain Quick Sand Condition and Critical Hydraulic Gradient. (5 Marks)

(b) A sand deposit of 8 m thick was loaded with a uniform surcharge of 10 kN/m^2. Water table (WT) is at 3 m below GL. Density of sand is 18 kN/m^3 above WT and 19 kN/m^3 below WT. Draw Total, Neutral and Effective Stress Diagrams up to 8 m below GL. Take γ_w = 10 kN/m^3. (9 Marks)

16. (a) A concentrated load of 500 kN is applied at ground surface. Compute the vertical pressure (i) at a depth of 5m below the load, (ii) at a distance of 3m at the same depth. Use Boussinesq's theory. (7 Marks)

(b) A water tank is founded on a circular ring type of foundation. The ring is of 2.5m width and its external diameter is 10m. Compute the vertical stress at 4m depth beneath the centre of the foundation, if pressure on the foundation is 100kPa. (7 Marks)

Module – 4

17. (a) A 8 m thick clay layer with double drainage settles by 120 mm in 2 years. Cv = 1.5 x 10^{-3} cm^2/sec. Calculate the likely ultimate consolidation settlement and find out how long it will take to undergo 90% of this settlement. (5 Marks)

(b) A 3m square footing at a depth of 2m from ground level carries a net load intensity of 150 kN/m^2. If a compressible clay layer 3m thick exists at a depth of 5m below the footing, determine the settlement of the footing due to consolidation of clay layer. Assume the water table at a depth of 3m below GL. For sand, density = 18 kN/m^3 above water table and

19 kN/m^3 below water table. For clay layer, LL = 65%, w_n = 40% and G = 2.7. Take γ_w = 10 kN/m^3. (9 Marks)

18. (a) Explain the field compaction methods. (5 Marks)

(b) The following are results of a standards proctor compaction test performed on a sample of soil

Water Content %	6	8	10	12	14	16
Bulk Density (kN/m^3)	17.7	19.8	21	21.3	20.9	20.2

Plot the water content – dry density curve and obtain Moisture content and Maximum dry density. Also plot the zero air voids curve. Take G = 2.65. (9 Marks)

Module – 5

19. (a) A cylindrical specimen of soil fails under axial vertical stress of 150 kN/m^2, when it is laterally unconfined. Failure plane makes an angle of 53° with the horizontal. Determine shear strength parameters c & ϕ. (5 Marks)

(b) Determine the shear strength parameters using the following data using graphical method:

Sample	Confining Pressure σ_c (kN/m^2)	Deviator Stress σ_d (kN/m^2)
1	100	600
2	200	750
3	300	900

(9 Marks)

20. (a) Explain the Swedish circle method for the analysis of slopes for a c-ϕ soil. (5 Marks)

(b) Determine factor of safety of vertical foundation trench 5m deep if c = 50 kN/m^2, ϕ = 25°, γ = 17 kN/m^3. Assume Taylor's stability no. Sn = 0.166. (9 Marks)

SYLLABUS

Module 1

Nature of soil and functional relationships : Introduction to soil mechanics – Soil types – Major soil deposits of India - 3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight - Relationship between basic soil properties - Numerical problems

Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle - Determination of Field density by sand replacement method & Core Cutter method - Numerical problems

Soil Structure and their effects on the basic soil properties – Sensitivity and Thixotropy

Module 2

Index properties : Sieve analysis – Well graded, poorly graded and gap graded soils - Stoke's law – Hydrometer analysis [no derivation required for percentage finer and diameter] – Relative Density - Numerical problems - Consistency – Atterberg Limits and indices – Plasticity charts - laboratory tests for Liquid Limit, Plastic Limit & Shrinkage Limit - Numerical problems

IS classification of soil - Numerical problems

Permeability of soils : Darcy's law – Factors affecting permeability – Laboratory tests: Constant head and falling head permeability tests - Numerical problems - Average permeability of stratified deposits   - numerical problems

Module 3

Principle of effective stress - Total, neutral and effective stress – Pressure diagrams - Numerical problems - Pressure diagrams in soils saturated by capillary action – Quick sand condition – Critical hydraulic gradient

Stress distribution : Introduction - Boussinesq's equations for vertical pressure due to point loads and line loads – Assumptions and Limitations - Numerical problems - Vertical pressure due to uniformly distributed loads beneath strip, circular and rectangular shapes [no derivation required] - Numerical problems

Approximate methods for vertical stress-distribution of contact pressure beneath footings : Equivalent Point Load method & 2:1 Distribution Method - Numerical problems - Pressure Isobars - Pressure bulbs – Newmark's charts (Construction procedure not required) and their use.

Module 4

Consolidation - Definition – Concepts of Coefficient of compressibility and volume compressibility - e-log p curve - Compression index, Recompression index and Pre consolidation Pressure - Normally consolidated, over consolidated and under consolidated soils - Estimation of magnitude of settlement of normally consolidated clays - Numerical problems

Terzaghi's theory of one-dimensional consolidation (no derivation required) - average degree of consolidation – Time factor - Coefficient of consolidation - Numerical problems - Laboratory consolidation test – Determination of Coefficient of Consolidation - Practical Applications

Compaction of soils - Difference between consolidation and compaction - IS Light & Heavy Compaction Tests – OMC and MDD - Zero Air voids line - Numerical problems - Control of

compaction - Field compaction methods - Proctor needle for field control

Module 5

Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion - Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses - Numerical problems

Brief discussion of Laboratory tests - Triaxial compression test - UU, CU and CD tests - Total and effective stress strength parameters - Unconfined compression test, Direct shear test and vane shear test – Applicability - Numerical problems

Stability of finite slopes - Toe failure, base failure, slip failure - Swedish Circle Method : $\phi=0$ analysis and c-ϕ analysis - Friction circle method - Taylor's Stability number - Stability charts - Numerical Problems

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.
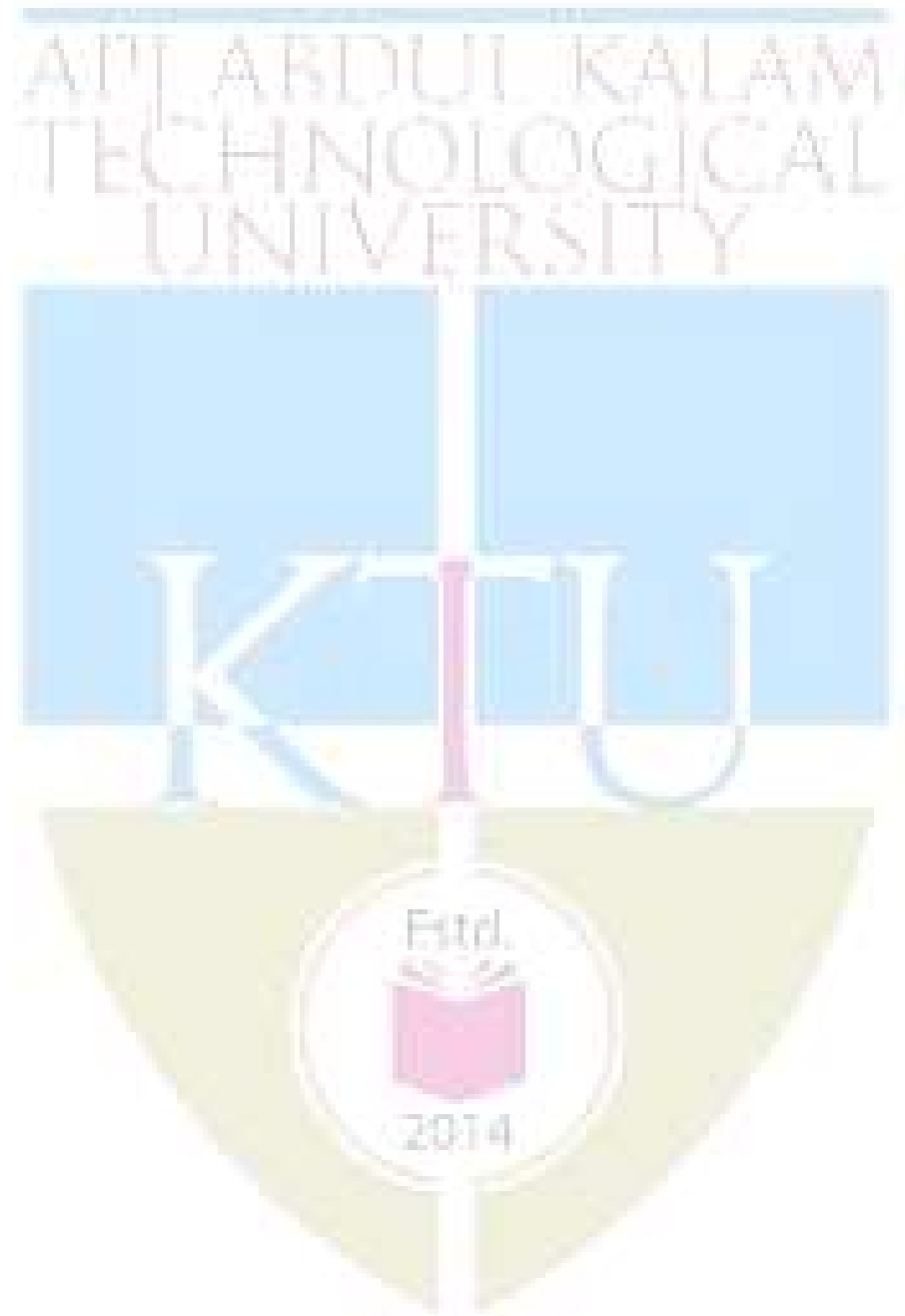
References:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.
4. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
6. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**9**
1.1	**Nature of soil and functional relationships** : Introduction to soil mechanics – Soil types – Major soil deposits of India	CO 1	1
1.2	3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight	CO 1	1
1.3	Relationship between basic soil properties	CO 1 & CO 3	1
1.4	Numerical problems	CO 3	2
1.5	Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle	CO 2	1
1.6	Determination of Field density by sand replacement method & Core Cutter method	CO 2	1
1.7	Numerical problems	CO 3 & CO 4	1
1.8	Soil Structure and their effects on the basic soil properties – Sensitivity and Thixotropy	CO 1 & CO 5	1
2	**Module 2**		**9**
2.1	**Index properties** : Sieve analysis – Well graded, poorly graded and gap graded soils	CO 1 & CO 2	1
2.2	Stoke's law – Hydrometer analysis [no derivation required for percentage finer and diameter] – Relative Density	CO 1 & CO 2	1
2.3	Numerical problems	CO 4	1
2.4	Consistency – Atterberg Limits and indices – Plasticity charts - laboratory tests for Liquid Limit, Plastic Limit & Shrinkage Limit	CO 1 & CO 2	1
2.5	Numerical problems	CO 4	1
2.6	IS classification of soil - Numerical problems	CO 1 & CO 5	1
2.7	**Permeability of soils** : Darcy's law – Factors affecting permeability – Laboratory tests: Constant head and falling head permeability tests	CO 1 & CO 4	1
2.8	Numerical problems	CO 4	1
2.9	Average permeability of stratified deposits - numerical problems	CO 1 & CO 4	1
3	**Module 3**		**9**
3.1	**Principle of effective stress** - Total, neutral and effective stress – Pressure diagrams	CO 1	1
3.2	Numerical problems	CO 4	1
3.3	Pressure diagrams in soils saturated by capillary action – Quick sand condition – Critical hydraulic gradient	CO 1	1
3.4	**Stress distribution** : Introduction - Boussinesq's equations for vertical pressure due to point loads and line loads – Assumptions and Limitations	CO 1	1

3.5	Numerical problems	CO 4	1
3.6	Vertical pressure due to uniformly distributed loads beneath strip, circular and rectangular shapes [no derivation required]	CO 1	1
3.7	Numerical problems	CO 4	1
3.8	Approximate methods for vertical stress-distribution of contact pressure beneath footings : Equivalent Point Load method & 2:1 Distribution Method - Numerical problems	CO 1 & CO 4	1
3.9	Pressure Isobars - Pressure bulbs – Newmark's charts (Construction procedure not required) and their use.	CO 1	1
4	**Module 4**		**9**
4.1	**Consolidation** - Definition – Concepts of Coefficient of compressibility and volume compressibility - e-log p curve - Compression index, Recompression index and Pre consolidation Pressure	CO 1	1
4.2	Normally consolidated, over consolidated and under consolidated soils - Estimation of magnitude of settlement of normally consolidated clays	CO 1 & CO 4	1
4.3	Numerical problems	CO 4	1
4.4	Terzaghi's theory of one-dimensional consolidation (no derivation required) - average degree of consolidation – Time factor - Coefficient of consolidation	CO 1 & CO 4	1
4.5	Numerical problems	CO 4	1
4.6	Laboratory consolidation test – Determination of Coefficient of Consolidation - Practical Applications	CO 2 & CO 4	1
4.7	**Compaction of soils** - Difference between consolidation and compaction - IS Light & Heavy Compaction Tests – OMC and MDD - Zero Air voids line	CO 1, CO2 & CO 4	1
4.8	Numerical problems	CO 4	1
4.9	Control of compaction - Field compaction methods - Proctor needle for field control	CO 1	1
5	**Module 5**		**9**
5.1	**Shear strength of soils**- Practical Applications - Mohr-Coulomb failure criterion	CO 1	1
5.2	Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses	CO 1 & CO 4	1
5.3	Numerical problems	CO 4	1
5.4	Brief discussion of Laboratory tests - Triaxial compression test - UU, CU and CD tests - Total and effective stress strength parameters	CO 2 & CO 4	1
5.5	Unconfined compression test, Direct shear test and vane shear test – Applicability	CO 2 & CO 4	1
5.6	Numerical problems	CO 4	1
5.7	**Stability of finite slopes** - Toe failure, base failure, slip failure	CO 1	1
5.8	Swedish Circle Method : $\phi=0$ analysis and c-ϕ analysis - Friction circle method	CO 1 & CO 4	1

| 5.9 | Taylor's Stability number - Stability charts - Numerical Problems | CO 1 & CO 4 | 1 |

CET206	TRANSPORTATION ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	4	0	0	4	2019

Preamble

Objective of the course is to introduce the principles and practice of Highway, Railway, Harbour and dock, Tunnel and Airport Engineering.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
CO 1	Apply the basic principles of Highway planning and design highway geometric elements
CO 2	Apply standard code specifications in judging the quality of highway materials; designing of flexible pavements
CO 3	Explain phenomena in road traffic by collection, analysis and interpretation of traffic data through surveys; creative design of traffic control facilities
CO 4	Understand about railway systems, tunnel, harbour and docks
CO 5	Express basics of airport engineering and design airport elements

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1		1	3	1		2		1
CO 2	3	1	3	1		1	1	1		1		1
CO 3	3	2	2	1					1	2		2
CO 4	2						2	1				2
CO 5	3	3	3			3		2				

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	5	5	20
Analyse	5	5	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance   : 10 marks
Continuous Assessment Test (2 numbers)   : 25 marks
Assignment/Quiz/Course Project   : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

1 **Course Outcome 1 (CO1):** While aligning a highway in a built up area, it was necessary to provide a horizontal curve of radius 300 m for a design speed 65Km/hr, length of wheel base-6m and pavement width 10.5m. Assume rate of introduction of super elevation as 1 in 100 and super elevation is provided by rotating about centre line. Design super elevation, extra widening of pavement and length of transition curve.

2 **Course Outcome 2 (CO2):** Design a flexible pavement for two lane single carriage way for present traffic 1200 commercial vehicles per day, period of construction= 3 yrs, annual traffic growth = 7.5%, Design CBR = 7%, Design life = 15 yrs. Use IRC method.

3 **Course Outcome 3 (CO3):** Traffic in a congested multilane highway lane is observed to have an average spacing of 200 ft,and an average headway of 3.8s. Estimate the rate of flow, density and speed of traffic in this lane.

4 Course Outcome 4 (CO4):
Sketch the component parts of a permanent way and mark the salient points

5 **Course Outcome 5 (CO5):** The total length of a runway is 1000 m. The elevation at distance 0,200 m, 400 m, 600 m, 800 m and 1000 m are 100.0 m, 99.2 m, 101.0 m, 101.8 m, 101.4 m and 101.0 m respectively. What will be the effective gradient of runway?

Syllabus

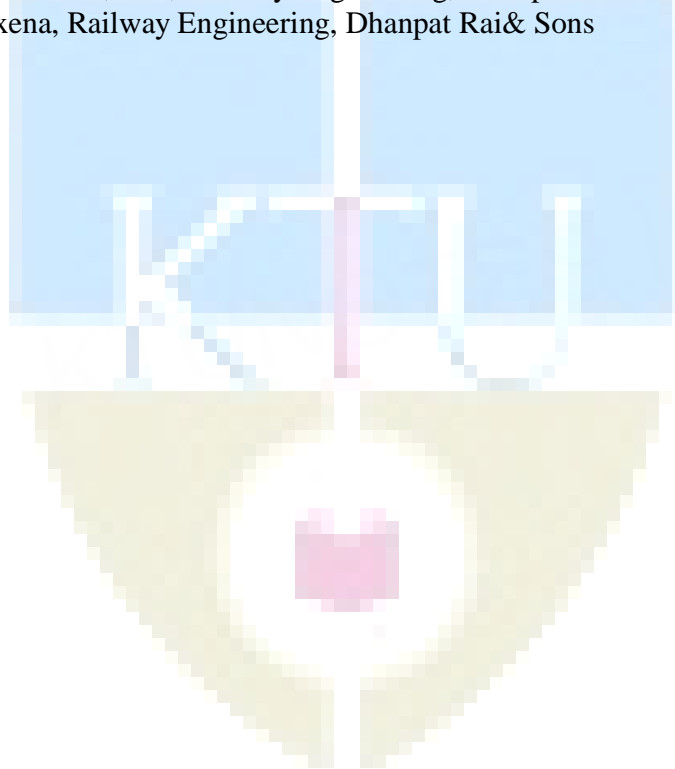| Module	Contents	Hours
1	Introduction to Transportation Engineering, Classification of roads, Typical cross sections of roads in urban and rural area, Requirements and factors controlling alignment of roads Introduction to geometric design of highways, Design controls and criteria, Design of highway cross section elements, Design of horizontal alignment - Stopping sight distance, Overtaking sight distance, super elevation, transition curve, length and shift of transition curve, extra widening. Vertical alignment (introduction only)	10
2	Introduction to highway materials, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil. Introduction of flexible and rigid pavements, Factors influencing the design of flexible pavements, Design of flexible pavements by CBR method and IRC 37: 2018. Construction of bituminous pavements	9
3	Introduction to traffic engineering, Traffic characteristics, Capacity and Level of Service, Design Speed, Traffic surveys, Types of road intersections, Traffic control devices (introduction only), Design of isolated signals by Webster's method.	7
4	Railway Engineering - Component parts of a railway track - functions, concept of Gauges, coning of wheels, cant deficiency, compensation of gradients Tunnel Engineering: Tunnel – sections, tunnel surveying - alignment, transferring centre grade into tunnel. Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only)	8
5	Introduction to Airport Engineering, Components of airport, selection of site for airport. Runway orientation, basic runway length and corrections required, Taxiways and aprons.	8

Text Books

1. Khanna, S.K. and Justo C.E.G., Highway Engineering, Nem Chand & Bros., 2015
2. Kadiyali, L. R. and N.B Lal, Principles and Practices of Highway Engineering, Khanna Publishers, 2013
3. Khanna, S. K. and Arora. M. G., Airport Planning and Design, Nemchand& Bros
4. Mundrey J. S, Railway Track Engineering, Tata McGraw Hill, 2009

5. Rangawala, S.C. , Railway Engineering, Charotor Publishing House

6. Rao G. V, Principles of Transportation and Highway Engineering, Tata McGrawHill, 1996

7. Srinivasan,R., Harbour, Dock & Tunnel Engineering, Charotor Publishing House, 28e, 2016

References

1. Horonjeff R. and McKelvy, F., Planning and Design of Airports, McGraw Hill, 5e, 2010

2. IRC: 37-2018, Guidelines for the Design of Flexible Pavements, IRC 2018, New Delhi

3. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier, 1997

4. Rangwala, S. C., Airport Engg. Charotar Publishing Co., 16e, 2016

5. Yoder, E. J and Witczak, M. W, Principles of Pavement Design, John Wiley & Sons, 1991

6. Bindra, S.P., A course in Docks and Harbour Engineering, Dhanpat Rai& Sons

7. Chandra, S. and Agarwal, M.M., Railway Engineering, Oxford University Press, New Delhi, 2008

8. Saxena, S. C and Arora, S. P, Railway Engineering, Dhanpat Rai& Sons, 7e, 2010

9. Subhash C. Saxena, Railway Engineering, Dhanpat Rai& Sons

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 10
1.1	Introduction to Transportation Engineering, Classification of roads, Typical cross sections of roads in urban and rural area, Requirements and factors controlling alignment of roads.	CO1	2
1.2	Introduction to geometric design of highways, Design controls and criteria, Design of highway cross section elements	CO1	2
1.3	Design of horizontal alignment - Stopping sight distance, Overtaking sight distance, super elevation, transition curve, length and shift of transition curve, extra widening. Vertical alignment (introduction only)	CO1	6
2	**Module 2**		Total: 9
2.1	Introduction to highway materials, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil.	CO2	3
2.2	Introduction of flexible and rigid pavements, Factors influencing the design of flexible pavements, Design of flexible pavements by CBR method and IRC 37 : 2018	CO2	3
2.3	Construction of bituminous pavements	CO2	3
3	**Module 3**		Total: 7
3.1	Introduction to traffic engineering, Traffic characteristics, Capacity and Level of Service, Design Speed, Traffic surveys, Types of road intersections,	CO3	4
3.2	Traffic control devices (introduction only), Design of isolated signals by Webster's method.	CO3	3
4	**Module 4**		Total: 8
4.1	Railway Engineering - Component parts of a railway track - functions, concept of Gauges, coning of wheels, cant deficiency, compensation of gradients	CO4	4
4.2	Tunnel Engineering: Tunnel – sections, tunnel surveying - alignment, transferring centre grade into tunnel.	CO4	2
4.3	Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only)	CO4	2
5	**Module 5**		Total: 8
5.1	Introduction to Airport Engineering, Components of airport, selection of site for airport.	CO5	3
5.2	Runway orientation, basic runway length and corrections required, Taxiways and aprons.	CO5	5

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **CET 206**

Course Name: **TRANSPORTATION ENGINEERING**

Model Question Paper

Marks:100   Duration: 3 hrs

PART A
(Answer all questions. Each question carry three marks)

1. With a sketch, explain typical cross sectional layout of a two lane road in urban areas.
2. What is meant by reaction time? What is its role in Geometric design of highways?
3. Outline the IRC 37- 2018 recommendations for determining the thickness of Flexible pavements.
4. Differentiate flexible and rigid pavements
5. How would you draw the fundamental diagram of traffic flow
6. Explain grade separated intersections and discuss the advantages and limitations
7. Analyse the concept of cant deficiency with suitable explanations
8. Write short note on Littoral Drift
9. Enumerate the various factors which would be kept in view while selecting suitable site for an airport.
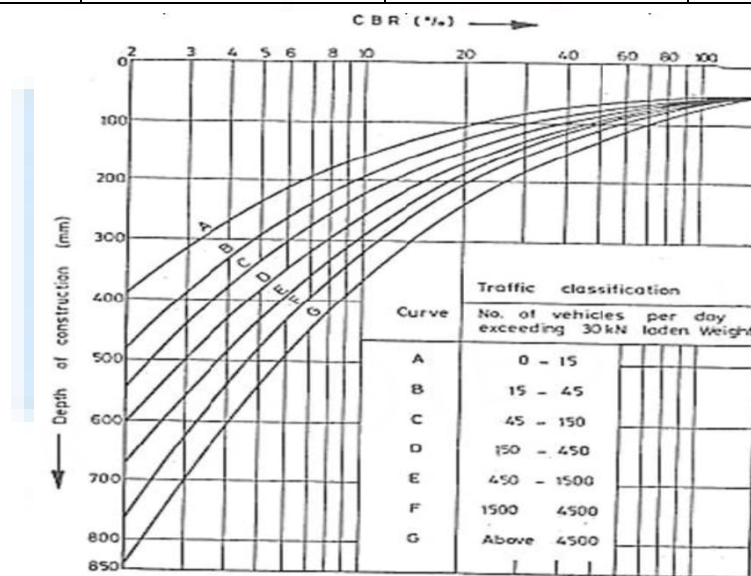10. What are taxiways?

PART B
(Answer one full question from each module)

11. a) Enumerate the factors governing the width of carriage way. State the IRC specifications for width of carriage way for various classes of roads.   (10)
    b) Write a brief note on classification of highways in India.   (4)

OR

12. a) Calculate the stopping sight distance on a highway for a design speed of 100 kmph.   (6)
    b) What is super elevation? Explain the design steps of super elevation.   (8)

13a) Explain the construction practices of the following bituminous base courses.

      1) Bituminous macadam
      2) Penetration macadam   (6)

b) The soil subgrade sample was obtained from the project site and the CBR tests conducted at field density gave the following readings. Draw the load penetration curve and determine the CBR value and find the total thickness of the pavement by CBR method as recommended by IRC for commercial vehicles 1500 per day, with 7% growth rate. The pavement construction is to be completed in three years after last traffic count. (Use the standard design chart provided)

(8)

Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)
0.0	0.0	3.0	60.0
0.5	6.0	4.0	70.0
1.0	17.0	5.0	77.0
1.5	30.0	7.5	89.0
2.0	42.0	10.0	100.0
2.5	55.0	12.5	115.0

OR

14 a) Explain in detail the various factors that influencing the design of flexible pavements?   (10)
b) List out the desirable properties of aggregates to be used in pavement construction. Also specify various tests for judging the suitability of aggregates.   (4)

15 a) What are the advantages and disadvantages of traffic signals?   (8)
b) What is (i) Saturation flow, (ii) Lost time, and (iii) Phase in a signal design?   (6)

OR

16 a) Define the basic terms basic capacity, possible capacity and practical capacity and analyze its importance in traffic engineering.   (6)
b) Evaluate the factors affecting level of service of a multilane highway.   (8)

17 a) Analyse various types of gradient used on railway track. What is grade compensation and
    why is it necessary?   (6)
    b) State the natural and meteorological phenomena a harbour engineer has to study and briefly
    mention the effects of these phenomena   (8)

OR

18 a) Explain the functions of rails, sleepers and ballast.   (8)
    b) What are the classifications of tunneling?   (6)

19 a) Explain in detail about the functions of taxiways and aprons.   (6)
    b) What are the factors to be considered in the orientation of runway?   (8)

OR

20 a) What are the factors affecting selection of site for airport?   (4)
    b) The length of a runway under standard conditions is 1500m. The airport is to be provided at
    an elevation of 110m above mean sea level. The airport reference temperature is 320C.
    Following data refers to the proposed longitudinal section of runway. Determine the corrected
    length of runway.   (10)

End to end of runway (m)	Grade (%)	End to end of runway (m)	Grade (%)
0 to 300	+1	1500 to 1800	+1
300 to 900	-0.2	1800 to 2100	-0.3
900 to 1500	+0.5		

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

    i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

    ii) make them understand the steps involved in the design process and

    iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

Part A : 30 marks

part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Page 1 of 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION
Course Code: EST 200
Course Name: DESIGN AND ENGINEERING
Max. Marks: 100Duration: 3 Hours
PART A
Answer all questions, each question carries 3 marks
Use only hand sketches

(1) Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6) Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design
engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse
engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span,
reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B
Answer any ONE question from each module. Each question carry 14 marks

Module 1
(11) Show the designing of a wrist watch going through the various stages of the design
process. Use hand sketches to illustrate the processes.
or
(12) Find the customer requirements for designing a new car showroom. Show how the
design objectives were finalized considering the design constraints?

Module 2

(13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20) Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Page 2 of 2

Syllabus

Module 1

<u>Design Process</u>:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

<u>Design Thinking Approach</u>:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

<u>Design Communication </u>(Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

<u>Design Engineering Concepts</u>:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

<u>Expediency, Economics and Environment in Design Engineering</u>:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
Second Series Examination		

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCN202	CONSTITUTION OF INDIA		2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

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

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance   : 10 marks
Continuous Assessment Test (2 numbers)   : 25 marks
Assignment/Quiz/Course project   : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1 Discuss the historical background of the Indian constitution.

2 Explain the salient features of the Indian constitution.

3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

1 What are fundamental rights ? Examine each of them.

2 Examine the scope of freedom of speech and expression underlying the constitution.

3 The thumb impression of an accused is taken by the police against his will. He contends

   that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

1 Explain the powers of the President to suspend the fundamental rights during emergency.

2 Explain the salient features of appeal by special leave.

3. List the constitutional powers of President.

Course Outcome 4 (CO4):

1 Discuss the constitutional powers of Governor.

2 Examine the writ jurisdiction of High court.

3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

1 Discuss the duties and powers of comptroller of auditor general.

2 Discuss the proclamation of emergency.

3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads

in the state. X challenges the levy of the tax on the ground that it violates the freedom of

interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

1 Explain the advantages of citizenship.

2 List the important principles contained in the directive principles of state policy.

3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

1 Define and explain the term constitution.

2 Explain the need and importance of Preamble.

3 What is directive principle of state policy?

4 Define the State.

5 List the functions of Attorney general of India.

6 Explain the review power of Supreme court.

7 List the qualifications of Governor.

8 Explain the term and removal of Judges in High court.

9 Explain the powers of public service commission.

10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

11 Discuss the various methods of acquiring Indian citizenship.

12 Examine the salient features of the Indian constitution.

Module 2

13 A high court passes a judgement against X. X desires to file a writ petition in the supreme

court under Art32, on the ground that the judgement violates his fundamental rights.

Advise him whether he can do so.

14 What is meant by directive principles of State policy? List the directives.

Module3

15 Describe the procedure of election and removal of the President of India.

16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

17 Discuss the powers of Governor.

18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ

petition under Art 32 of the constitution, seeking the same remedy. The Government

argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

<div align="right">(14X5=70marks)</div>

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	**Module 2**	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2

2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	**Module 3**	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	**Module 4**	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	**Module 5**	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

CEL 204	FLUID MECHANICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The course is designed to train the students to familiarize and understand the different flow measurement equipment's and their procedures. Students will be introduced to a team working environment where they develop the necessary skills of experimentation techniques for the study of flow phenomena in channels/pipes.

Prerequisite: Fluid Mechanics and Hydraulics

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

Course Outcome (CO)	Course Outcome Description
CO 1	Apply fundamental knowledge of Fluid Mechanics to corresponding experiments
CO 2	Apply theoretical concepts in Fluid Mechanics to respective experiments
CO 3	Analyse experimental data and interpret the results
CO 4	Document the experimentation in prescribed manner

Mapping of course outcomes (COs) with program outcomes (POs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	2	3	-	-	-
CO 2	2	2	-	-	-	-	-	2	3	-	-	-
CO 3	3	3	-	2	-	-	-	2	3	3	-	-
CO 4	1	-	-	-	-	-	-	2	2	3	-	-

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)	End Semester Examination (ESE) Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.

a) Preliminary work : 15 marks

b) Implementing the work/ Conducting the experiment : 10 marks

c) Performance, result and inference (usage of equipments and trouble shooting) : 25 marks

d) Viva voce : 20 marks

e) Record : 5 marks

General Instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Reference Books:

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.
3. Subramanya K., Flow in Open channels, Tata McGraw-Hill, 2009.

List of Exercises/ Experiments (Any 12 experiments out of 15 need to be performed mandatorily. Lab experiments may be given considering 12 sessions of 3 hours each)

1. Study of taps, valves, pipe fittings, gauges, Pitot tubes, water meters and current meters.

2. Calibration of Pressure gauges

3. Determination of metacentric height and radius of gyration of floating bodies.

4. Verification of Bernoulli's theorem

5. Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method.

6. Calibration of Venturimeter

7. Calibration of Orifice meter

8. Calibration of water meter.

9. Calibration of rectangular rectangular notch

10. Calibration of triangular notch.

11. Time of Emptying through orifice

12. Plotting Specific Energy Curves in Open Channel flow

13. Study of Parameters of Hydraulic Jump in Open channel Flow.

14. Determination of friction co-efficient in pipes

15. Determination of loss co-efficient for pipe fittings

CEL 202	MATERIAL TESTING LAB - I	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The course aims to enrich the understanding of the fundamental concepts of mechanics of deformable bodies through systematic experimental techniques for the estimation of various mechanical properties of engineering materials.

Prerequisite: Engineering Physics, Mechanics of Materials. Knowledge in use of Vernier caliper and micrometer screw gauge expected.

General Instructions to Faculty:

1. Any 12experimentsout of 15 need to be performed mandatorily. Virtual Lab facility [11] cannot be used to substitute the conduct of these mandatory experiments.
2. The laboratory should have possession of modern testing equipment such as strain gauges, LVDTs, load cells and data acquisition systems at least for demonstration purposes
3. Periodic maintenance and calibration of various testing instruments needs to be made.
4. Use of data visualization packages needs to promoted for making various plots.

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

Course Outcome	Course Outcome Description
CO 1	The understand the behaviour of engineering materials under various forms and stages of loading.
CO 2	Characterize the elastic properties of various materials.
CO3	Evaluate the strength and stiffness properties of engineering materials under various loading conditions.

Mapping of course outcomes with program outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	1	3	-	-	2	2	-	2
CO 2	3	2	2	2	1	3	-	-	2	2	-	2
CO 3	3	2	2	2	1	3	-	-	2	2	-	2

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance   :   15 marks
Continuous Assessment   :   30 marks
Internal Test (Immediately before the second series test)   :   30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks
(a) Preliminary work   : 15 Marks
(b) Implementing the work/Conducting the experiment   : 10 Marks
(c) Performance, result and inference (usage of equipment and trouble shooting)   : 25 Marks
(d) Viva voce   : 20 marks
(e) Record   : 5 Marks

General instructions:
Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. S.P. Timoshenko, *History of Strength of Materials*, Dover publications, 1953

2. Egor P. Popov, Engineering Mechanics of Solids, Pearson, 1998.

3. IS 1608 (2005): Metallic Materials – Tensile testing at Ambient temperature, 3rd Revision, July 2008

4. IS 1598 (1977): Method for Izod Impact test of Metals, 2nd reprint, September 1986.

5. IS 1499 (1977) : Method for Charpy Impact test (U-Notch) for metals, 3rd reprint, March 1992.

6. IS 5242 (1979) Method of Test for determining Shear Strength of Metals, 1st revision, 2006.

7. IS 1500 (2005): Method for Brinell Hardness Test for Metallic Materials, 3rd revision, 2005.

8. IS 1501 (2002) : Method for Vickers hardness Test for Metallic Materials.

9. IS 1717 (2012): Metallic Materials – Wire – Simple Torsion Test, 3rd revision, 2012.

10. IS 883 (1994): Design of Structural Timber in Building- Code of Practice, Reaffirmed 2005)

11. www.vlab.co.in

SYLLABUS

Exercise 1.   Study on stress-strain characteristics of mild steel and by conducting uniaxial tension test on rod specimens

Exercise 2.   Study on stress-strain characteristics of tor steel by conducting uniaxial tension test on rod specimens

Exercise 3.   Study on estimation of shear capacity of mild steel specimen by conducting a double shear test on rod specimen.

Exercise 4.   Study on flexural behaviour of steel by conduction of test on RSJ (I cross section)

Exercise 5.   Study on torsional behaviour and estimation of modulus of rigidity of steel by conducting torsion test on rod specimens

Exercise 6.   Study on estimation of modulus of rigidity of steel and brass / copper materials utilizing the principles of torsional vibrations.

Exercise 7. Study on estimation of toughness properties of steel specimens by conducting (a) Izod &(b) Charpy impact tests.

Exercise 8.   Study on estimation of hardness properties of engineering materials such as brass, aluminium, copper, steel etc.by performing Brinell hardness test

Exercise 9. Study on estimation of Hardness properties of engineering materials such as brass, aluminium, copper, steel etc.by performing

9.1 Rockwell hardness test

9.2 Vicker's hardness test

Exercise 10. Study on estimation of modulus of rigidity of steel by performing tension tests on spring specimens.

Exercise 11. Study on estimation of modulus of rigidity of steel by performing compression tests on spring specimens

Exercise 12. Study on flexural behaviour of timber material by performing tests on beam specimens.

Exercise 13. Study on estimation of compression strength of timber specimen.

Exercise 14. Experiment on verification of Maxwell's reciprocal theorem

Exercise 15. Bend &rebend test on mild steel specimen

Optional Exercises:

Study/ demonstration of :

- o Fatigue test on steel rod specimen
- o Strain gauges and Load cells
- o Elastic buckling modes of column under different boundary conditions