# COURSE HANDOUT: S4 CE

**RAJAGIRI SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF CIVIL ENGINEERING**

## ❖ VISION

The department strives to excel in the areas of academia, research and industry by moulding professionals in the field of Civil Engineering to build a sustainable world.

## ❖ MISSION

To impart quality education and mould technically sound, ethically responsible professionals in the field of Civil Engineering with a broad skill set of creativity, critical thinking and effective communication skills to meet the desired needs of the society within realistic socio-economic environmental constraints.

## ➢ PROGRAMME OBJECTIVES

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of natural sciences, and engineering sciences.mathematics,
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

# MA202:

# Probability Distributions, Transforms and Numerical Methods

**MA202: Probability Distributions,Transforms and Numerical Methods**

**COURSE INFORMATION SHEET**

| | |
|---|---|
| PROGRAMME: CIVIL ENGINEERING | DEGREE: B. TECH. |
| COURSE: **Probability Distributions, Transforms and Numerical Methods** | SEMESTER: 4<br>CREDITS: 4 |
| COURSE CODE: **MA202**<br>REGULATION: 2016 | COURSE TYPE: THEORY |
| COURSE AREA/DOMAIN: Engineering Mathematics | CONTACT HOURS: 3 + 1T |
| | |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| I | Discrete Probability Distributions. (Relevant topics in section 4.1,4,2,4.4,4.6 Text1 ) Discrete Random Variables, Probability distribution function, Cumulative distribution function. Mean and Variance of Discrete Probability Distribution. Binomial Distribution-Mean and variance. Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance. | 8 |
| II | Continuous Probability Distributions. (Relevant topics in section 5.1,5.2,5.5,5.7 Text1) Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance. Normal Distribution, Mean and variance (without proof). Uniform Distribution. Mean and variance. Exponential Distribution, Mean and variance. | 10 |
| III | Fourier Integrals and transforms. (Relevant topics in section 11.7, 11.8, 11.9 Text2) Fourier Integrals. Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform. | 9 |
| IV | Laplace transforms. (Relevant topics in section 6.1,6.2,6.3,6.5,6.6 Text2) Laplace Transforms, linearity, first shifting Theorem. Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. Unit step function, second shifting theorem. Convolution Theorem (without proof). Differentiation and Integration of transforms | 13 |
| V | Solution Of equations by Iteration, Newton- Raphson Method. Interpolation of Unequal intervals, Lagrange's Interpolation formula interpolation of equal intervals<br>Newton's forward difference formula, Newton's Backward difference formula | 7 |
| VI | solution to linear system, Gauss elimination, Problems, Gauss Seidal Iteration Method, Numeric Integration- Trapezoidal Rule, Simpson's 1/3 Rule<br>Numerical solution of first order ODE- Euler method, Runge-Kutta | 9 |

| | | |
|---|---|---|
| | Method(fourth order) | |
| | TOTAL HOURS | 48 |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| T | Miller and Freund's, "Probability and statistics for Engineers"- Pearson-Eighth Edition |
| T | Erwin Kreyszig, "Advanced Engineering Mathmatics, 10th edition, Wiley, 2015 |
| R | V. Subdarapandian, "Probaility, statistics and Queing theory," PHI Learning, 2009 |
| R | C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathmatics- Sixth Edition |
| R | Jay L Devore, Probability and statistics for engineering and Science- eight edition |
| R | Steven C Chapra and Raymond P. Canale, Numerical Methods for Engineers- sixth Edition- Mc Graw Hill |

**COURSE OBJECTIVES:**

| Sl. No. | DESCRIPTION |
|---|---|
| 1 | To introduce the concept of random variable, probability distributions, specific discret and continous distributions with practical application in various engineering and social life situation |
| 2 | To know Laplace and Fourier transforms which has wide application in all engineering course |
| 3 | To enable the students to solve various engineering problems using numerical methods |

**COURSE OUTCOMES:**

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☑ CHALK & TALK | ☐ STUD. ASSIGNMENT | ☐ WEB RESOURCES | |
| ☐ LCD/SMART BOARDS | ☐ STUD. SEMINARS | ☐ ADD-ON COURSES | |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☑ ASSIGNMENTS | ☐ STUD. SEMINARS | ☑ TESTS/MODEL EXAMS | ☑ UNIV. EXAMINATION |

| | | | |
|---|---|---|---|
| ☐ STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) | ☑ STUDENT FEEDBACK ON FACULTY |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

**Prepared by** **Approved by**

**Fr. Ajeesh Puthussery CMI**
**(Course In-charge)**

**Course Plan**

| PROBABILITY DISTRIBUTIONS, TRANSFORMS AND NUMERICAL METHODS (MA202) | | | |
|---|---|---|---|
| Course Plan (S4 CE, 2017) | | | |
| **Hours** | **Topic** | **Planned** | **Actual** |
| | **Module 1** | | |
| 1 | Introduction | 2-Feb | |
| 2 | Discrete Random Variables | 3-Feb | |
| 3 | Probability distribution function | 6-Feb | |
| 4 | Cumulative distribution function | 7-Feb | |
| 5 | Problems | 9-Feb | |
| 6 | Mean and Variance of Discrete Probability Distribution | 10-Feb | |
| 7 | Binomial Distribution-Mean and variance | 13-Feb | |
| 8 | Poisson Approximation to the Binomial Distribution | 14-Feb | |
| 9 | Poisson distribution-Mean and variance | 16-Feb | |
| | **Module 2** | | |
| 10 | Continuous Random Variable | 17-Feb | |
| 11 | Probability density function, | 20-Feb | |
| 12 | Cumulative density function- Mean and variance | 21-Feb | |
| 13 | Normal Distribution-Mean and variance(without proof) | 23-Feb | |
| 14 | Problems | 27-Feb | |
| 15 | Uniform Distribution- Mean and variance. | 28-Feb | |
| 16 | Exponential Distribution, Mean and variance. | 2-Mar | |

| | | | |
|---|---|---|---|
| | **Module 3** | | |
| 17 | Fourier Integrals | 3-Mar | |
| 18 | Fourier integral theorem (without proof). | 6-Mar | |
| 19 | Problems | 7-Mar | |
| 20 | Fourier Transform and inverse transform | 9-Mar | |
| 21 | Fourier Sine & Cosine Transform | 10-Mar | |
| 22 | Problems | 13-Mar | |
| 23 | inverse transform | 14-Mar | |
| | Module 4 | | |
| 24 | Laplace Transforms, linearity | 16-Mar | |
| 25 | first shifting Theorem | 17-Mar | |
| 26 | Problems | 20-Mar | |
| 27 | Transform of derivative and Integral | 21-Mar | |
| 28 | Inverse Laplace transform | 23-Mar | |
| 29 | Solution of ordinary differential equation using Laplace transform | 24-Mar | |
| 30 | Unit step function, second shifting theorem | 27-Mar | |
| 31 | Convolution Theorem (without proof). | 28-Mar | |
| 32 | Problems | 30-Mar | |
| 33 | Differentiation and Integration of transforms | 31-Mar | |
| | Module 5 | | |
| 34 | Solution Of equations by Iteration, | 3-Apr | |
| 35 | Newton- Raphson Method. | 4-Apr | |
| 36 | Interpolation of Unequal intervals | 6-Apr | |
| 37 | Problems | 7-Apr | |
| 38 | Lagrange's Interpolation formula | 10-Apr | |
| 39 | interpolation of equal intervals | 11-Apr | |
| 40 | Newton's forward difference formula | 17-Apr | |

## MODULE 1

## DISCRETE PROBABILITY DISTRIBUTIONS

## ASSIGNMENT

1. Two balanced dice are rolled. Let X be the sum of the two dice.

a) Obtain the probability distribution of X.

b) Find the mean and standard deviation of X.

2. Three coins are tossed. Let X be the number of heads obtained. Construct a probability distribution.

3. A game of chance is played by spinning a wheel and paying the amount that comes up. There are four possible outcomes:

| x | p(x) |
|---|---|
| Rs.1 | .50 |
| Rs.2 | .30 |
| Rs.5 | .15 |
| Rs.10 | ?? |

a) What is the probability that Rs.10 comes up?

4. Use the table of binomial distributions to find

a)B(7,19,.45)

b)B(8,10,0.95)

c) b(7,19,.45)

d) )b(8,10,0.95)

5. It is known that 5% of the books bound at a certain press have defective bindings.

Find the probability that 2 of 100 books bound by this press will have defective

bindings using (1) the formula for binomial distribution

(2) the Poisson approximation to the binomial distribution.

6. Which conditions for the binomial distribution, if any, fail to holding the following situations?

a) The number of persons having a cold at a family reunion attended by 30 persons.

b) Among 8 projectors in the department office,2 do not work properly but are not marked defective. Two are selected and the number that do not work properly will be recorded.

7. Check whether the following can define probability distributions, and explain your answers.

a) f (x) = 1/5 for x = 5,6,7,8,9

b) f (1) = 0.16, f(2) = 0.28, f(3) = 0.28 and f(4) = 0.28

8. Use the Poisson distribution to approximate the binomial probability b(3;100,0.03).

9. A consulting engineer receives, on average 0.7 requests per week. If the number of requests follows Poisson process, find the probability that

a) in a given week, there will be at least 1 request;

b) in a given 4 week period there will be at least 3 requests.

10. Show that P(x) = x/11 - .25 for x = 4, 5, 6, 7 is a probability distribution.

b) Find the mean of this distribution.
c) Find the variance of this distribution.
d) Prove that P(x) = x/11 - 0 .25 for x = 3, 4, 5, 6, is NOT a probability distribution.

## TUTORIAL

1.Write the probability distribution of the number of heads when a fair coin is tossed 3 times.

2. . The probability that a man aged 60 will live to be 70 is 0.65. What is the probability that out of 10 men, now 60 ,at least 7 will live to be 70 ?

3 . Find the probability that in a family of 4 children there will be

a) At least 1 boy b) At least 1 boy and at least 1 girl

Assume that the probability of a male birth is 0.5

4. Using Poisson distribution, find the probability that the ace of spades will be drawn from a pack of well-shuffled cards at least once in 104 consecutive trials.

5. A random variable X has the following probability function:

| X | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| P(x) | 0 | k | 2k | 2k | 3k | $K^2$ | $2k^2$ | $7K^2+k$ |

a) Find k
b) Evaluate P(x< 6), P(x≥6)

6. During war, 1 ship out of 9 was sunk on an average in making a certain voyage. What was the probability that exactly 3 out of a convoy of 6 ships would arrive safely.

7. Six coins are tossed 6400 times. Using the Poisson distribution, determine the approximate probability of getting 6 heads x times.

8. If X is a Poisson variate such that P(X=2)= 9 P(X= 4)+ 90 P(X= 6), find the standard deviation.

9. Prove that B(x;n,p) = 1- B(n-x-1;n,1-p)

10.If the probability that an individual suffers a bad reaction due to a certain injection is 0.001, determine the probability that out of 2000 individuals

a) Exactly 3

b)More than 2 individuals will suffer a bad reaction.

**Module 2-Continuous Probability Distributions**

**ASSIGNMENT**

1. If the systolic blood pressure for a certain group of obese people has a mean of 132 mmHg and a standard deviation of 8mmHg, find the probability that a randomly selected obese person will have the following blood pressure. Assume that the variable is normally distributed.

a. Above 130
b. Below 140
c. Between 131 and 136

2. The scores on a test have a mean of 70 (out of 100) and a standard deviation of 15. If a personnel manager wishes to select from the top 75% of applicants who take the test, find the cutoff score. Assume the variable is normally distributed

3. In a normal distribution 31% of the items are under 45 and 8% are over 64.Find the mean and standard deviation of the distribution.

4. If X is normally distributed with mean 5 and standard deviation 2, find p(X>8).

5. Buses arrive to a bus stop according to an exponential distribution with rate $\lambda = 4$ busses/hour.
(a) If you arrived at 8:00 am to the bus stop, what is the expected time of the next bus?

(b) Assume you asked one of the people waiting for the bus about the arrival time of the last bus and he told you that the last bus left at 7:40 am. What is the expected time of the next bus?

6. The average life of a certain type of motor is 10 years, with a standard deviation of 2 years. If the manufacturer is willing to replace only 3% of the motors that fail, how long a guarantee should he offer? Assume that the lives of the motors follow a normal distribution.

7. Consider a computer system with Poisson job-arrival stream at an average of 2 per minute. Determine the probability that in any one-minute interval there will be (i) 0 jobs; (ii) exactly 2 jobs; (iii) at most 3 arrivals. (iv) What is the maximum jobs that should arrive one minute with 90 % certainty

8. A shop sells five pieces of shirt every day, then what is the probability of selling three shirts today?

9. The mean height of 500 students is 151 cm. and the S.D is 15 c.m. Assuming that the heights are normally distributed, find how many students heights lie between 120 c.m and 155 c.m.

10. If the systolic blood pressure for a certain group of obese people has a mean of 132 mmHg and a standard deviation of 8mmHg, find the probability that a randomly selected obese person will have the following blood pressure. Assume that the variable is normally distributed.

**TUTORIAL**

1. In a normal distribution 31% of the items are under 45 and 8% are over 64.Find the mean and standard deviation of the distribution

2. A company pays its employees an average wage of $3.25 an hour with a standard deviation of 60 cents. If the wages are approximately normally distributed, determine

a. the proportion of the workers getting wages between $2.75 and $3.69 an hour;
b. the minimum wage of the highest 5%.

3. If the systolic blood pressure for a certain group of obese people has a mean of 132 mmHg and a standard deviation of 8mmHg, find the probability that a randomly selected obese person will have the following blood pressure. Assume that the variable is normally distributed.

4. The scores on a test have a mean of 70 (out of 100) and a standard deviation of 15. If a personnel manager wishes to select from the top 75% of applicants who take the test, find the cutoff score. Assume the variable is normally distributed

5. The lifetime T (years) of an electronic component is a continuous random variable with a probability density function given by f(t)=e−t t ≥ 0 (i.e. λ = 1 or μ = 1) Find the lifetime L which a typical component is 60% certain to exceed. If five components are sold to a manufacturer, find the probability that at least one of them will have a lifetime less than L years.

6. The time required to repair a machine is an exponential random variable with rate λ = 0.5 downs/hour. 1. What is the probability that a repair time exceeds 2 hours? 2. What is the probability that the repair time will take at least 4 hours given that the repair man has been working on the machine for 3 hours?

7. If three persons, on an average, come to ABC company for job interview, then find the probability that less than three people have come for interview on a given day.

8 Suppose you are conducting a quiz and post a question to the audience of 20 competitors. The time allowed to answer the question is 30 seconds. How many persons are likely to respond within 5 seconds? (Normally, the competitors are required to click a button of the correct choice and the winner is chosen on the basis of first click)

9 Suppose in a quiz there are 30 participants. A question is given to all 30 participants and the time allowed to answer it is 25 seconds. Find the probability of participants responds within 6 seconds?

10. Suppose a flight is about to land and the announcement says that the expected time to land is 30 minutes. Find the probability of getting flight land between 25to 30 minutes?

## Module 3-Fourier Integrals and Transforms

## TUTORIAL

1. Find the Fourier cosine transform of $f(x) = 3$ for $0 \le x < 2$

$= 1$ for $x > 2$

2. Solve the integral equation $\int_0^\infty f(x)\cos ax\,dx = \begin{cases} 1-\alpha, & 0 \le \alpha \le 1 \\ 0 & ,\alpha > 1 \end{cases}$

3. Find the Fourier sine transform of $\frac{1}{x(x^2+a^2)}$

4. Using Fourier integral prove that $\int_0^\infty \frac{\sin \pi\lambda \sin x\lambda}{1-\lambda^2} d\lambda = \begin{cases} \frac{\pi}{2}\sin x, & 0 \le x \le \pi \\ 0, & x \ge \pi \end{cases}$

5. Find f(x), from $\int_0^\infty f(x)\cos xt\, dx = \begin{cases} 2, & 0 \le t < 1 \\ 3, & 1 \le t < 2 \\ 0, & t \ge 2 \end{cases}$

6. Find the fourier transform of $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a > 0 \end{cases}$ .Deduce that that $\int_0^\infty \frac{\sin t}{t} dt = \frac{\pi}{2}$

7. Find the fourier cosine transform of $2e^{-2x} + 3e^{-4x}$

8. Solve the integral equation $\int_0^\infty f(x)\sin sx\, dx = e^{-s}$

## ASSIGNMENT

1. Find the Fourier integral representation of the function $f(x) = \begin{cases} 0, & x < 0 \\ \frac{1}{2}, & x = 0 \\ e^x, & x > 0 \end{cases}$

2. . Find the Fourier sine transform of $f(x) = 1$ for $0 \le x < a$

= 0 for $x > a$

3. . Find the Fourier sine and cosine transform of $f(x) = \begin{cases} 1, & 0 \le x < a \\ 0, & x > a \end{cases}$

4. Solve the integral equation $\int_0^\infty f(x)\cos ax\, dx = e^{-a}$

5. Find the Fourier cosine transform of $\frac{1}{x^2+a^2}$

6. Find f(x),if its sine transform is $\frac{e^{-as}}{s}$.Hence deduce that the inverse sine transform of $\frac{1}{s}$

7. Using parseval's identity calculate (a) $\int_0^\infty \frac{dx}{(a^2+x^2)^2}$ (b) $\int_0^\infty \frac{x^2 dx}{(a^2+x^2)^2}$ if a> 0

8. Find f(x), from $\int_0^\infty f(x)sinxt\,dx = \begin{cases} 1, 0 \le t < 1 \\ 2, 1 \le t < 2 \\ 0 \quad , t \ge 2 \end{cases}$

9. Using Fourier integral prove that $\int_0^\infty \frac{\cos \lambda x}{1+\lambda^2} d\lambda = \frac{\pi}{2} e^{-x}$

10. Solve the integral integral equation $\int_0^\infty f(x)\cos px\,dx = \begin{cases} 1-p, 0 \le p \le 1 \\ 0 \quad , p > 1 \end{cases}$ .

Hence deduce that $\int_0^\infty \frac{\sin^2 t}{t^2} dt = \frac{\pi}{2}$

## MODULE 4

## LAPLACE TRANSFORM

## ASSIGNMENT QUESTIONS

1. Find the transform of
   (a) $\cos^2 3t$ ( b ) $e^{-2t} \sin 4t$ (c) $\cosh at - \cos at$
2. Find the inverse laplace transform of
   (a) $\frac{s+2}{s^2-4s+13}$ (b) $\frac{s^2+2s-3}{s(s-3)(s+2)}$ (c) $\frac{1+2s}{(s+2)^2(s-1)^2}$
3. Find the Laplace transform of
   (a) $t\cos 4t$ ( b ) $t^2 \sin 2t$
4. Express the following in terms of Unit Step Function & hence find their Laplace Transform,
   $f(t) = \begin{cases} t^2, 0 < t < 2 \\ 0, t > 2 \end{cases}$
5. Apply Convolution Theorem to evaluate $L^{-1}\left[\frac{s^2}{(s^2+4)^2}\right]$.
6. Solve the IVP by the Laplace transform.
   (a) $y'' + 3y' + 2.25y = 9t^3 + 64 : y(0) = 1 \;\&\; y'(0) = 31.5$
   (b) ) $y'' + 4y' + 3y = e^{-t} : y(0) = \; y'(0) = 1$
7. Solve $L^{-1}\left[\frac{1}{(s^2+2s+5)^2}\right]$.
8. Solve the IVP by the Laplace transform
   $y'' - 3y' + 2y = 1 - e^{-2t} : y(0) = 1 \;\&\; y'(0) = 0.$
9. Solve $L[t^2 \sin 2t]$.

10. Find $L[f''(t)]$ if $(t) = e^{-2t} \sin 4t$.

**TUTORIAL QUESTIONS**

1. Find the transform of
   (a) $\sin h^3 2t$ ( b )$\cosh at.\cos at$ (c) $cos^3 2t$
2. Find the inverse laplace transform of
   (a) $\frac{2s^2-6s+5}{s^3-6s^2+11s-6}$ (b) $\frac{s}{(s+1)^2(s^2+1)}$ (c) $\frac{1}{s^3-a^3}$.
3. Find the Laplace transform of
   (a) $tsinh\ at$ ( b ) $\sin 2t - 2t\cos 2t$
4. Express the following in terms of Unit Step Function & hence find their Laplace Transform,

$$f(t) = \begin{cases} 2t, 0 < t < \pi \\ 1, t > \pi \end{cases}$$

5. Apply Convolution Theorem to evaluate $L^{-1}\left[\frac{1}{s(s^2+4)}\right]$.
6. Solve the IVP by the Laplace transform.
   (a) $y' + 2y = 0 : y(0) = 1.5$
   (b) ) $y'' + 7y' + 12y = 21e^{3t} : y(0) = 3.5, y'(0) = -10$
7. Evaluate $L[f(t)]$ if $f(t)$ equals
   (a) $tcos\ 4t$ (b) $sin^4 t$
8. Solve $L[f(t)]$ if $f(t)$ equals
   (a)$\frac{18s}{(s^2+36)^2}$ (b) $\frac{240}{(s^2+1)(s^2+25)}$
9. Find the inverse Laplace Transform of
   (a) $\log\left(1+\frac{1}{s^2}\right)$ (b) $cot^{-1}(s/a)$
10. Solve the IVP by the Laplace transform $y'' + 2y' + y = t : y(0) = -3, y(1) = -1$

# CE 202:

# STRUCTURAL ANALYSIS I

## CE 202:STRUCTURAL ANALYSIS I

## COURSE INFORMATION SHEET

| | |
|---|---|
| **PROGRAMME:** CIVIL ENGINEERING | **DEGREE:** BTECH |
| **COURSE:** STRUCTURAL ANALYSIS I | **SEMESTER:** 4 **CREDITS:** 4 |
| **COURSE CODE:** CE202<br>**REGULATION:** | **COURSE TYPE:** CORE |
| **COURSE AREA/DOMAIN:** CIVIL ENGINEERING | **CONTACT HOURS:** 3+1 (Tutorial) Hours/Week. |
| **CORRESPONDING LAB COURSE CODE (IF ANY):** NIL | **LAB COURSE NAME:** NA |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| I | TRUSS ANALYSIS: Analysis of determinate truss-Methods of joints and sections<br>*Displacement response of statically determinate structural systems using energy methods:*Elastic theorems and energy principles - strain energy due to axial load, bending moment, shear and torsion - strain energy method, Castigliano's method for deflection | 8 |
| II | Principle of virtual work – Unit load method-Betti‟s theorem - Maxwell‟s law of reciprocal deflections - principle of least work - application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames – pin jointed trusses – temperature ffects, lack of fit. Statically indeterminate structures: Degree of static and kinematic indeterminacies - force and displacement method | 9 |
| III | Strain Energy methods: Analysis of beams, frames and trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. Method of Consistent deformations: Analysis of beams frames and trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. | 9 |
| IV | Moving loads and influence lines. Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams - influence lines for forces in beams and trusses analysis for and trusses analysis for different types of moving loads - single concentrated load - several concentrated loads uniformly distributed load shorter and longer than the span. | 10 |
| V | *Statically determinate suspension bridges and arches* Analysis of forces in cables - temperature effects -suspension bridges with three hinged stiffening girders | 10 |

| | | |
|---|---|---|
| **VI** | *Statically indeterminate suspension bridges and arches.*- theory of arches – Eddy's theorem – analysis of three hinged arches-suspension bridges with two hinged stiffening girders - analysis of two hinged arches - settlement and temperature effects. | 10 |
| **TOTAL HOURS** | | **56** |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| R1 | Gere and Timoshenko, Mechanics of materials, CBS. Publishers |
| R2 | Kenneth Leet,Chia M Uang& Anne M Gilbert., Fundamentals of Structural Analysis, McGraw Hill |
| R3 | M.L. Gambhir, Fundamentals of structural Mechanics and analysis, Printice Hall India |
| R4 | DevdasMenon, Structural Analysis, Narosa Publications |
| R5 | Reddy C.S., Indeterminate Structural Analysis, Tata McGraw Hill |
| R6 | Kinney S., Indeterminate Structural Analysis, Oxford & IBH |
| R7 | Hibbeler., Structural Analysis, Pearson Education |
| R8 | Timoshenko S.P.& Young D.H., Theory of Structures, McGraw Hill |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| CE201 | MECHANICS OF SOLIDS | Bending moment and shear force, Bending Formula, Properties of materials | 3 |

**COURSE OBJECTIVES:**

To equip the students with the comprehensive methods of structural analysis with emphasis on analysis of elementary structures.

**COURSE OUTCOMES:**

| | |
|---|---|
| 1 | To study about analysis of trusses and to study displacement response of statically determinate structural systems using energy methods: |
| 2 | To study application of unit load method and strain energy method for determination of |

| | |
|---|---|
| | deflection of statically determinate beams, frames & pin jointed trusses |
| 3 | Analysis of Statically indeterminate structures using strain energy method and method of consistent deformation |
| 4 | To Study about moving loads and influence lines |
| 5 | To study about Statically determinate and indeterminate suspension bridges and arches |

**GAPES IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:**

| SNO | DESCRIPTION | PROPOSED ACTIONS |
|---|---|---|
| 1 | conjugate beam method | NPTEL + Reading books |

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

**TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| | |
|---|---|
| 1 | conjugate beam method |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| 1 | https://www.youtube.com/watch?v-strain energy |
| 2 | www.nptel.ac.in/syllabus/ |
| 3 | www.civil.iitb.ac.in/ |
| 4 | textofvideo.nptel.iitm.ac.in/ |
| 5 | nptel.ac.in/courses/105106050/20 |
| 6 | nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/.../m2l7.pdf |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ CHALK & TALK ☐ | ☐ STUD. ASSIGNMENT☐ | ☐ WEB RESOURCES ☐ | ☐LCD/SMART BOARDS ☐ |
| ☐ STUD. SEMINARS☐ | ☐ ADD-ON COURSES | | |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☐ ASSIGNMENTS ☐ | ☐ STUD. SEMINARS ☐ | ☐ TESTS/MODEL EXAMS ☐ | ☐ UNIV. EXAMINATION ☐ |

| | | | |
|---|---|---|---|
| ☐ STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) □ | ☐ STUDENT FEEDBACK ON FACULTY (TWICE) □ |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

**Prepared by**
**Ms. Tressa Kurian**
**(Faculty)**

**Approved by**
**Dr. Ruby Abraham**
**(HOD)**

**Course Plan**

| Day Planned | Module | Topics Planned |
|---|---|---|
| Day 1 | 1 | TRUSS ANALYSIS: Analysis of determinate truss- |
| Day 2 | 1 | TRUSS ANALYSIS Methods of joints |
| Day 3 | 1 | TRUSS ANALYSIS Methods of joints |
| Day 4 | 1 | TRUSS ANALYSIS Methods of sections |
| Day 5 | 1 | TRUSS ANALYSIS Methods of sections |
| Day 6 | 1 | Elastic theorems and energy principles - |
| Day 7 | 1 | strain energy due to axial load, bending moment |
| Day 8 | 1 | strain energy due to shear and torsion - strain energy method |
| Day 9 | 1 | Castigliano’s method for deflection |
| Day 10 | 2 | Principle of virtual work – Unit load method-Betti‟s theorem |
| Day 11 | 2 | Maxwell‟s law of reciprocal deflections -principle of least work - application of unit load method |

| | | |
|---|---|---|
| Day 12 | 2 | Beams- strain energy method for determination of deflection |
| Day 13 | 2 | Beams- strain energy method for determination of deflection |
| Day 14 | 2 | strain energy method for determination of deflection of statically determinate frames |
| Day 15 | 2 | strain energy method for determination of deflection of statically determinate frames |
| Day 16 | 2 | strain energy method for determination of deflection of statically determinate – pin jointed trusses - temperature effects, lack of fit. |
| Day 17 | 2 | strain energy method for determination of deflection of statically determinate – pin jointed trusses - temperature effects, lack of fit. |
| Day 18 | 2 | Statically indeterminate structures: Degree of static and kinematic indeterminacies. |
| Day 19 | 2 | Force and displacement method |
| Day 20 | 3 | Strain Energy methods:<br>Analysis of beams - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 21 | 3 | Strain Energy methods:<br>Analysis of beams, effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 22 | 3 | Strain Energy methods:<br>Analysis of frames with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 23 | 3 | Strain Energy methods:<br>Analysis of frames with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 24 | 3 | Strain Energy methods:<br>Analysis of trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 25 | 3 | Strain Energy methods:<br>Analysis of trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 26 | 3 | Method of Consistent deformations:<br>Analysis of beams - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 27 | 3 | Method of Consistent deformations:<br>Analysis of beams - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 28 | 3 | Method of Consistent deformations:<br>Analysis of frames with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |

| | | |
|---|---|---|
| Day 29 | 3 | Method of Consistent deformations:<br>Analysis of frames with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 30 | 3 | Method of Consistent deformations:<br>Analysis of trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 31 | 3 | Method of Consistent deformations:<br>Analysis of trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. |
| Day 32 | 4 | Moving loads and influence lines. Introduction to moving loads - concept of influence lines |
| Day 33 | 4 | influence lines for reaction in simply supported beams and over hanging beams |
| Day 34 | 4 | influence lines for shear force in simply supported beams and over hanging beams |
| Day 35 | 4 | influence lines bending moment in simply supported beams and over hanging beams |
| Day 36 | 4 | Influence lines for forces in beams different types of moving loads - single concentrated load - several concentrated loads |
| Day 37 | 4 | Influence lines for forces in beams different types of moving loads - single concentrated load - several concentrated loads |
| Day 38 | 4 | Influence lines for forces in beams different types of moving loads - single concentrated load - uniformly distributed load shorter than the span. |
| Day 39 | 4 | Influence lines for forces in beams different types of moving loads - uniformly distributed load shorter than the span. |
| Day 40 | 4 | Influence lines for forces in beams different types of moving loads - - uniformly distributed load longer than the span. |
| Day 41 | 4 | influence lines for forces in trusses for different types of moving loads - |
| Day 42 | 5 | *Statically determinate suspension bridges and arches* Analysis of forces in cables with concentrated and continuous loadings |
| Day 43 | 5 | *Statically determinate suspension bridges and arches* Analysis of forces in cables with concentrated and continuous loadings |
| Day 44 | 5 | *Statically determinate suspension bridges and arches* Analysis of forces in cables - temperature effects |
| Day 45 | 5 | *Statically determinate suspension bridges and arches* Analysis of forces in cables - temperature effects |
| Day 46 | 5 | *Statically determinate suspension bridges and arches* Analysis of forces in cables - temperature effects |
| Day 47 | 5 | *Statically determinate suspension bridges and arches* suspension bridges with three hinged stiffening girders |
| Day 48 | 5 | *Statically determinate suspension bridges and arches* suspension bridges with three hinged stiffening girders |

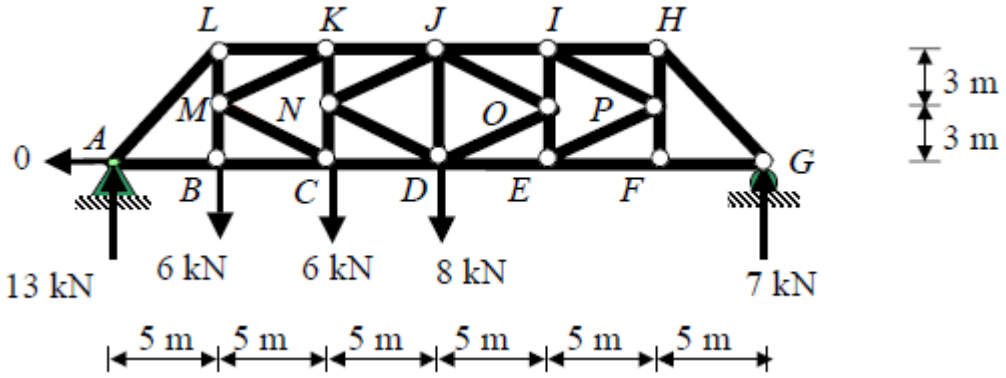
| | | |
|---|---|---|
| Day 49 | 5 | *Statically determinate suspension bridges and arches* suspension bridges with three hinged stiffening girders |
| Day 50 | 5 | *Statically determinate suspension bridges and arches* suspension bridges with three hinged stiffening girders |
| Day 51 | 5 | *Statically determinate suspension bridges and arches* suspension bridges with three hinged stiffening girders |
| Day 52 | 6 | *Statically indeterminate suspension bridges and arches.*- theory of arches – Eddy's theorem - |
| Day 53 | 6 | *Statically indeterminate suspension bridges and arches.*–- analysis of three hinged arches- |
| Day 54 | 6 | *Statically indeterminate suspension bridges and arches.*–- analysis of three hinged arches |
| Day 55 | 6 | *Statically indeterminate suspension bridges and arches.*–- analysis of three hinged arches |
| Day 56 | 6 | *Statically indeterminate suspension bridges and arches.*–- analysis of three hinged arches |
| Day 57 | 6 | *Statically indeterminate suspension bridges and arches.*- -suspension bridges with two hinged stiffening girders |
| Day 58 | 6 | *Statically indeterminate suspension bridges and arches.*- -suspension bridges with two hinged stiffening girders |
| Day 59 | 6 | *Statically indeterminate suspension bridges and arches.*- -suspension bridges with two hinged stiffening girders |
| Day 60 | 6 | Analysis of two hinged arches - settlement |
| Day 61 | 6 | Analysis of two hinged arches - temperature effects |

**Tutorial Questions**

1. A single rolling load of 100 kN moves on a girder of span 20m.

   (a) Construct the influence lines for (i) shear force and (ii) bending moment for a section 5m from the left support. (b) Construct the influence lines for points at which the maximum shears and maximum bending moment develop. Determine these values.

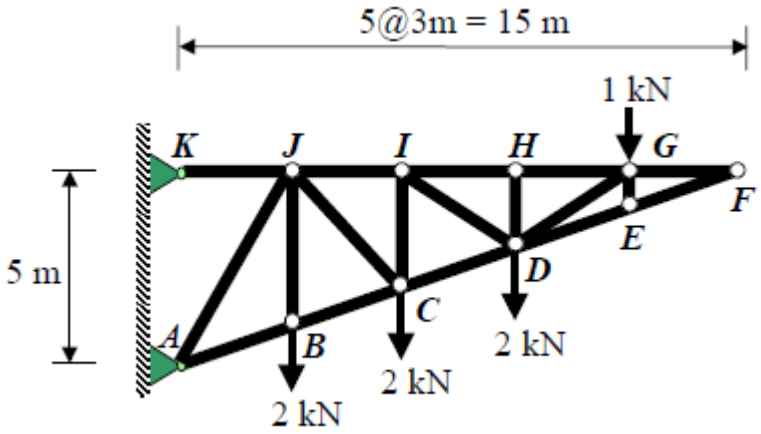
2. Determine the force in members BC and MC of the K-truss shown in the figure below. State whether the members are in tension or compression. The reactions at the supports have been calculated.




**Assignment Questions**

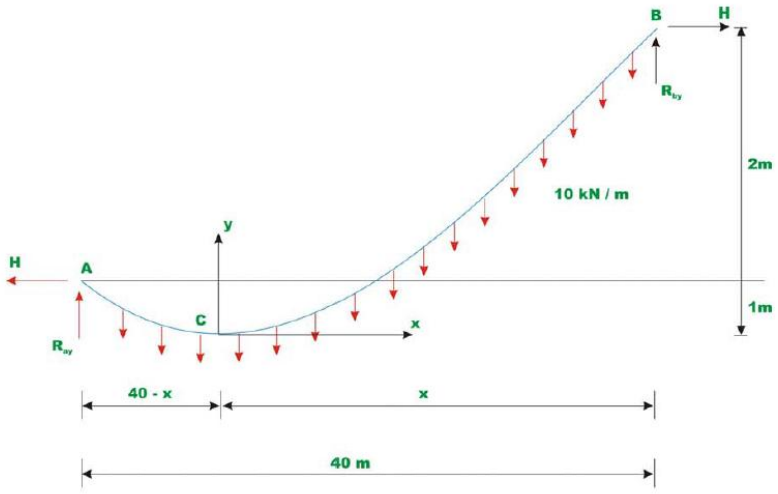
**Assignment No.1**

1. Determine all the member forces.Identify zero-force members.




**Assignment No. 2**

1. A cable of uniform cross section is used to span a distance of 40m as shown in Fig. The cable is subjected to uniformly distributed load of 10 kN/m. Run.The left support is below the right support by 2 m and the lowest point on the cable is located below left support by 1 m. Evaluate the reactions and the maximum and minimum values of tension in the cable.




2. A cable of uniform cross section is used to support the loading shown in Fig. Determine the reactions at two supports and the unknown sag.

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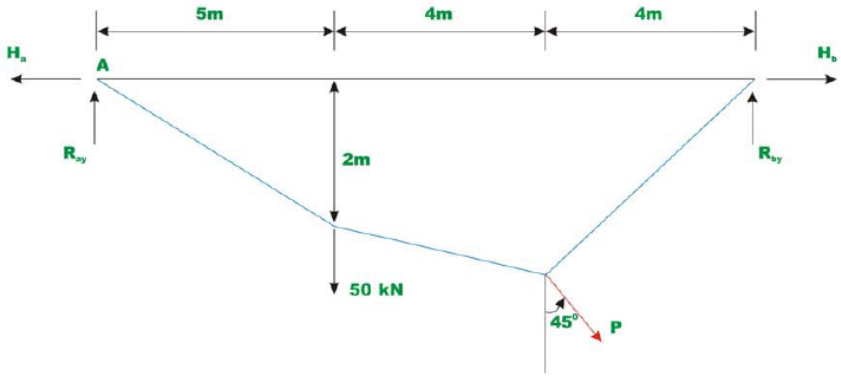

# CE 204:

# CONSTRUCTION TECHNOLOGY

## CE 204:CONSTRUCTION TECHNOLOGY

## COURSE INFORMATION SHEET

| | |
|---|---|
| PROGRAMME: CE | DEGREE: BTECH |
| COURSE: CONSTRUCTION TECHNOLOGY | SEMESTER: S4 CREDITS: 4 |
| COURSE CODE: CE 204<br>REGULATION: 2010 | COURSE TYPE: CORE |
| COURSE AREA/DOMAIN: | CONTACT HOURS: 4 hours/Week. |
| CORRESPONDING LAB COURSE CODE (IF ANY): NIL | LAB COURSE NAME: NIL |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| I | Construction Materials – Building stones –Classification of rocks – Quarrying of stones.Dressing – Properties and uses of common stones –Tests conducted on stones.Timber – Classification – seasoning -defects in Timber — decay– preservation – Manufacture,properties and uses of plywood, fibre board, particle board.Mortar – Types – Sand – properties – uses. Iron and Steel –Reinforcing steel – types – specifications. Structural steel – specifications Miscellaneous materials (only properties, classifications and their use in construction industry): Glass, Plastics, A.C. Sheets, Bitumen,Adhesives, Aluminium | 8 |
| II | . Concrete – Aggregates – Mechanical & Physical properties and tests – Grading requirements – Water quality for concrete – Admixtures – types and uses – plasticizers – accelerators – retarders –water reducing agents Making of concrete - batching – mixing – types of mixers – transportation – placing – compacting– curing Properties of concrete – fresh concrete – workability – segregation and bleeding – factors affecting workability & strength – tests on workability – tests for strength of concrete in compression, tension & flexure. Concrete quality control – statistical analysis of results – standard deviation –acceptance criteria – mix proportioning (B.I.S method) – nominal mixes. | 10 |
| III | Building construction - Preliminary considerations –Foundations - shallow and deep foundations –description of spread, grillage, raft and pile foundation. Masonry – Types of stone masonry – Bonds in brickwork – advantages and limitations of masonry construction - corbels, cornice and copings composite walls - cavity walls and partition walls – construction details and features – scaffoldings. | 9 |
| IV | Lintels and arches – types and construction details.Floors and flooring – different types of floors andfloor coveringsRoofs and roof coverings – different types of roofs– suitability – types and uses of roofing materialsDoors, windows and ventilators – Types andconstruction detailsFinishing works – Plastering, pointing, whitewashing, colour washing, distempering, painting Methods of providing DPC. Termite proofing | 10 |
| V | Tall Buildings – Framed building – steel and concrete frame – structural systems –erection of steel work–concrete framed construction–formwork – construction | 9 |

| | | |
|---|---|---|
| | and expansion. jointsIntroduction to prefabricated construction – slip form constructionVertical transportation –Stairs – types - layout and planning.-<br>Elevators – types – terminology – passenger,service and goods elevators – handling capacity -arrangement and positioning of lifts –Escalators – features – use of ramps | |
| VI | Introduction to Cost-effective construction -principles of filler slab and rat-trap bond masonryBuilding failures – General reasons – classification– Causes of failures in RCC and Steel structuresFoundation failure – failures by alteration, improper maintenance, overloading – Fire, Windand Earthquake. | 9 |
| TOTAL HOURS | | 55 |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| T1 | Rangwala S C., Engineering Materials, Charotar Publishers |
| T2 | Punmia B. C, Building construction. Laxmi Publications |
| T3 | Gambhir M L, Concrete Technology, Tata McGrawHill. |
| T4 | Krishna Raju N, Design of Concrete Mixes, CBS publishers. |
| T5 | Neville A.M. and Brooks.J.J, Concrete Technology, Pearson Education. |
| T6 | G c Sahu & Joygopal Jena., Building Materials and construction, McGraw Hill Education |
| T7 | National Building Code. |
| T8 | Smith P & Julian W. Building services, Applied Science Pub. |
| T9 | Mcking T.M, Building Failures, Applied Science Pub. |
| T10 | Shetty M.S., Concrete Technology, S. Chand & company. |
| T11 | Arora and Bindra, Building construction, Dhanpath Rai and Sons. |
| T12 | Adler R, Vertical Transportation for Building, American Elsevier Pub. |
| T13 | Tall building systems & concepts, Monograph on planning and design of Tall building, |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| | Introduction To Civil Engineering | | S1 |

**COURSE OBJECTIVES:**

| | |
|---|---|
| | |

**COURSE OUTCOMES:**

| SNO | DESCRIPTION | PO MAPPING |
|---|---|---|
| 1 | Understand the properties ofdifferent building materials available | |
| 2 | Understand the manufacturing of Convrete and its properties | |
| 3 | Understand the different types of foundations | |
| 4 | Attain knowledge in construction details and finishing works | |

| | | |
|---|---|---|
| 5 | Understand the different types of stone masonry and brick masonry | |
| 6 | Attain knowledge in different types of building failures | |
| 7 | Understand the different aspects of tall buildings | |

**GAPES IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:**

| SNO | DESCRIPTION | PROPOSED ACTIONS |
|---|---|---|
| 1 | Sanitary fittings and plumbing systems | Notes |

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

**TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| | |
|---|---|
| 1 | Types of machineries used in mass construction |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| 1 | NPTEL |
| | |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ **CHALK & TALK** √ | ☐ **STUD. ASSIGNMENT** √ | ☐ WEB RESOURCES √ | ☐ PPTs √ |
| ☐ LCD/SMART BOARDS | ☐ STUD. SEMINARS √ | ☐ ADD-ON COURSES | |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☐ **ASSIGNMENTS** √ | ☐ STUD. SEMINARS √ | ☐ **TESTS/MODEL EXAMS** √ | ☐ **UNIV. EXAMINATION** √ |
| ☐ STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)** √ | ☐ **STUDENT FEEDBACK ON FACULTY (TWICE)** √ |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

| *DAY* | *MODULE* | *TOPICS TO BE COVERED* |
|---|---|---|
| *1* | *1* | *Building stones, Classification of rocks,dressing,* |
| *2* | | *quarrying,uses, properties and tests of stones* |
| *3* | | *Timber-classification,defects* |
| *4* | | *Seasoning and preservation, properties and uses of plywood, fibreboard and particle board* |
| *5* | | *Mortar and their types* |

| | | |
|---|---|---|
| *6* | | *Properties and uses of glass, plastics, A.C. sheets* |
| *7* | | *reinforcing steel* |
| *8* | | *Structural steel* |
| *9* | | *Aggregates- mechanical and physical properties, water quality of concrete* |
| *10* | | *Admixtures-types and uses* |
| *11* | | *Manufacturing of concrete* |
| *12* | *2* | *properties of oncrete* |
| *13* | | *Workability-factors affecting,tests* |
| *14* | | *Quality control of concrete* |
| *15* | | *Nominal mix and design mix* |
| *DAY* | ***MODULE*** | ***TOPICS TO BE COVERED*** |
| *16* | | *Foundation-introduction* |
| *17* | | *Foundation-different types-shallow* |
| *18* | | *Foundation-different types-deep* |
| *19* | | *Masonry-Rules of bond in brick work* |
| ***20*** | *3* | *English bond and Flemish bond* |
| *21* | | *Walls-composite, cavity and partition* |
| *22* | | *Corbels, cornices and copings* |
| | ***MODULE*** | ***TOPICS TO BE COVERED*** |
| *23* | | *Lintels and arches-types and construction* |
| *24* | | *Floors and floor coverings-different types* |
| *25* | *4* | *Roofs-different types* |
| *26* | | *Roof coverings-types and uses* |
| *27* | | *Doors,windows-construction details* |

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| *28* | | *Finishing works-plastering,pointing* |
| *29* | | *Finishing works-white washing, colour washing* |
| *30* | | *Finishing works-distempering, painting* |
| *31* | | *Finishing works-termite proofing,DPC* |
| *32* | | *DPC- methods of providing DPC* |
| | ***MODULE*** | ***TOPICS TO BE COVERED*** |
| *33* | | *Tall buildings-Steel and concrete framed* |
| *34* | | *Formwork-construction* |
| *35* | *5* | *Slip form construction* |
| ***36*** | | *Joints-types* |
| *37* | | *Pre fabricated* |

## TUTORIAL QUESTIONS

**Module 1:**

1) Write the three classification for rocks
2) Write a short note on the tools used for dressing of stones
3) Write the five methods of artificial seasoning of timber
4) Write a short note on the classification and uses of miscellaneous materials in the industry?

**Module 2:**

1) Write the significance of water cement ratio in concrete?
2) Write the role of admixtures and their types used in concrete?
3) Define workability. What are the factors affecting workability?
4) Write the different tests for fresh concrete?

**Module 3:**

1) Differentiate between stone masonry and brick masonry?
2) Give a classification for foundations?
3) List out the rules of bond in brick masonry?
4) Differentiate between English bond and Flemish bond?
5) Draw the elevation and plan of English bond and Flemish bond for different thick walls?

**Module 4:**

1) Write the construction details of Lintels and arches?
2) Write a short note on the different types of floors and flooring materials?
3) What are the different types of roofs and roofing materials used?
4) Write a short on note on each type of finishing work ?

**Module 5:**

1) What are joints and the different types of joints?
2) Write a short note on slipform construction?
3) What are the different types of stairs?

**Module 6:**

1) What are the general reasons for building failures?
2) What are the different types of foundation failures?
3) What are the causes of failures in RCC buildings and steel Structures?

ASSIGNMENT QUESTIONS

**ASSIGNMENT 1**

1) Write the different stages of manufacturing of concrete?
2) What are the defects in timber?
3) What are the different methods of providing DPC?

**ASSIGNMENT II**

1) Draw the layout and plan of dog legged stairs and open well stairs
2) Write the features of escalators?
3) Wrie the different types of elevators, their handling capacity, arrangement and positioning of lifts?

# CE 206:

# FLUID MECHANICS II

## CE 206:FLUID MECHANICS II

## COURSE PLAN

| MODULE | DAY | PORTIONS PLANNED |
|---|---|---|
| 1 | DAY 1 | Hydraulic machines - impulse-momentum principle - problems. Impact of jet, force of jet on stationary and moving plates - problems |
| 1 | DAY 2 | Turbines - classification.Velocity triangle for Pelton, Francis, Kaplan turbines - problems |
| 1 | DAY 3 | Specific speed - problems.Selection of turbines, Types of draft tubes |
| 2 | DAY 4 | Types of centrifugal pumps, velocity triangle for pumps - problems |
| 2 | DAY 5 | velocity triangle for pumps - problems |
| 2 | DAY 6 | Work done - head of pump, losses and efficiency - problems |
| 2 | DAY 7 | Minimum starting speed, specific speed - problems |
| 2 | DAY 8 | Multistage pumps, pumps in parallel - problems |
| 3 | DAY 9 | Introduction - Flow in open channel, Types of flow, Velocity distribution in open channel flow |
| 3 | DAY 10 | Uniform flow in open channels - Chezy's equation - Problems |
| 3 | DAY 11 | Chezy's Equation - problems. Manning's Equation, Kutter's formula - problem |
| 3 | DAY 12 | Manning's Equation, Kutter's formula - problems |
| 3 | DAY 13 | Most Economical cross-sections - problems |
| 3 | DAY 14 | Most Economical cross-sections - problems |
| 3 | DAY 15 | Computation of uniform flow, conveyance, normal depth - problems |
| 3 | DAY 16 | Computation of uniform flow, conveyance, normal depth - problems. Energy in open channel flow - specific energy - problems |
| 3 | DAY 17 | Energy in open channel flow - specific energy - problems. Momentum in open channel flow - specific force |
| 3 | DAY 18 | Momentum in open channel flow - specific force - problems. Critical flow and its computation |

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| 3 | DAY 19 | Critical flow in rectangular channels - problems |
| 3 | DAY 20 | Application of specific energy and discharge diagrams to channel transitions - problems |
| 3 | DAY 21 | Application of specific energy and discharge diagrams to channel transitions - problems |
| 4 | DAY 22 | Measurement of flow in open channels - mean velocity - pitot tube, current meter, floats. |
| 4 | DAY 23 | Discharge in flumes and rivers. Gradually varied flow - dynamic equation for gradually varied flow in wide rectangular channels. Different forms of dynamic equation, channel bottom slopes |
| 4 | DAY 24 | Study of surface profiles and its charecteristics in prismatic channels |
| 4 | DAY 25 | Backwater computation by direct step method |
| 4 | DAY 26 | Backwater computation by direct step method |
| 5 | DAY 27 | Rapidly varied flow, hydraulic jump - initial and sequent depths - problems |
| 5 | DAY 28 | Rapidly varied flow, hydraulic jump - initial and sequent depths - problems |
| 5 | DAY 29 | Non-dimensional equation of hydraulic jump - problems |
| 5 | DAY 30 | Practical application of hydraulic jump, types of jump on horizontal floor |
| 5 | DAY 31 | Basic characteristics of hydraulic jump - energy loss, efficiency, height of jump - problems |
| 5 | DAY 32 | Jump as energy dissipator, stilling basins. Location of hydraulic jump - problems |
| 6 | DAY 33 | Units and dimensions of physical quantities, Dimensional Homogeneity of formulae and its application to common fluid flow problems |
| 6 | DAY 34 | Dimensional analysis - Rayleigh's method, Buckingham's method |
| 6 | DAY 35 | Derivations of Froude's , Reynold's, Webber and Mach numbers |
| 6 | DAY 36 | Hydraulic Models- need, Geometric, Kinematic, Dynamic similarity |
| 6 | DAY 37 | Scale Ratios of various physical quantities for Froude's and Reynold's model laws, problems. |

| | | |
|---|---|---|
| 6 | DAY 38 | Types of models - undistorted and distorted models, scale effects in models |
| 6 | DAY 39 | Spillway models and ship models |

## ASSIGNMENT

ASSIGNMENT 1

1. Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel never exceeds **50%.**
2. Distinguish between turbines and pumps.
3. A pelton wheel is having a mean bucket diameter of **1 m** and is running at **1000 r.p.m.** The net head on the pelton wheel is **700 m**. If the side clearance angle is $\mathbf{15^0}$ and discharge through nozzle is **0.1 $\mathbf{m^3/s}$**, find (i) Power available at the nozzle, and (ii) Hydraulic efficiency of the turbine
4. A centrifugal pump delivers water against a net head of **14.5 m** and a design speed of **1000 r.p.m**. The vanes are curved back to an angle of $\mathbf{30^0}$ with the periphery. The impeller diameter is **300 mm** and outlet width is **50 mm**. Determine the discharge of the pump if manometric efficiency is **95%.**
5. A jet of water moving at **10 m/s** impinges on a concave shaped symmetrical vane to deflect the jet through $\mathbf{120^0}$ when stationary. If the vane is moving at **6 m/s**, find the angle of the jet so that there is no shock at the inlet. Also compute the magnitude and direction of absolute velocity of jet at the exit and the work done per unit time. Assume smooth vanes

ASSIGNMENT 2

1. A wide rectangular channel carries a discharge of 2.8 $m^3/s$ per meter width, with a depth of flow of 1.5 m. Calculate the minimum rise in floor at a section required to produce critical flow condition. What is the corresponding fall in water level?
2. Find the rate of change of depth of water in a rectangular channel 10 m wide and 1.5 m deep, when the water is flowing with a velocity of 1 m/s. The channel bed slope is 1 in 4000 and energy line slope is 0.00004.
3. With usual notations, show that in the case of a rectangular channel, the relationship between the initial and sequent depths of a hydraulic jump is given by

$$y_2 = \frac{y_1}{2}\left[-1 + \sqrt{1 + 8F_1^2}\right]$$

4. Show that the condition for the discharge to be maximum for a given specific energy in an open channel flow is the same as that for the specific energy to be minimum for the given discharge