## Maharashtra State Board of Technical Education, Mumbai

## Teaching and Examination Scheme for Post S.S.C. Diploma Courses

**Program Name : Civil Engineering Groups**

**Program Code : CE/CR/ CS** — **With Effect From Academic Year: 2017 - 18**

**Duration of Program : 6 Semesters** — **Duration : 16 Weeks**

**Semester : Second** — **Scheme - I**

| S. N. | Course Title | Course Abbreviation | Course Code | Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Theory | | | | | | Practical | | | | | | |
| | | | | | | | | Exam Duration in Hrs. | ESE | | PA | | Total | ESE | | PA | | Total | | |
| | | | | L. | T | P | | | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | |
| 1 | Applied Mathematics | AMS | 22201 | 3 | 1 | - | 4 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | -- | -- | -- | -- | -- | -- | 100 |
| 2 | Applied Science – Physics | ASM | 22202 | 2 | - | 4 | 8 | 90 Min | 70*& | 28 | 15* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 | 200 |
| | Applied Science – Chemistry | | | 2 | - | | | | | | 15* | 00 | | | 25@ | 10 | 25 | 10 | 50 | 20 | |
| 3 | Applied Mechanics | AME | 22203 | 3 | 1 | 2 | 6 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 | 150 |
| 4 | Construction Materials | CMA | 22204 | 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 | 150 |
| 5 | Basic Surveying | BSU | 22205 | 3 | - | 4 | 7 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 50# | 20 | 50 | 20 | 100 | 40 | 200 |
| 6 | Civil Engineering Workshop and Practice | CEW | 22008 | - | - | 4 | 4 | -- | -- | -- | -- | -- | -- | -- | 50# | 20 | 50^ | 20 | 100 | 40 | 100 |
| 7 | Business Communication Using Computers | BCC | 22009 | - | - | 2 | 2 | -- | -- | -- | -- | -- | -- | -- | 35@^ | 14 | 15^ | 06 | 50 | 20 | 50 |
| | | | Total | 16 | 2 | 18 | 36 | -- | 350 | -- | 150 | -- | 500 | -- | 235 | -- | 215 | -- | 450 | -- | 950 |

Student Contact Hours Per Week: **36 Hrs.** Medium of Instruction: **English**

**Theory and practical periods of 60 minutes each.** Total Marks: **950**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *& On Line Examination , ^ Computer Based Assessment

* Under the theory PA: Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

- For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **It is mandatory for the candidate to appear for practical (ESE) of both the part of Applied Science (Physics & Chemistry). Candidate remaining absent in exam of any one part, will be considered as absent for the head ESE (PR) of Applied Science.**
- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Applied Mathematics Scheme

Program Name : Civil Engineering Program Group

Program Code : CE/CR/CS

Semester : Second

Course Title : Applied Mathematics

Course Code : 22201

## 1. RATIONALE

This course is an extension of Basic Mathematics of first semester diploma. Applied Mathematics which is designed for its applications in engineering and technology using the techniques of calculus, differentiation, integration, differential equations and in particular numerical integration. Derivatives are used to find slope of the curve, maximum or minimum value of the function, values of derivative, integral at points helps in finding the area. Differential equations is used in finding the curve and its related applications for various engineering models. Numerical integration is used to find the area of the irregular shapes, especially where integration cannot be evaluated easily with analytical methods. This course further develops the skills and understanding of mathematical concepts which underpin the investigative skills used in engineering.

## 2. COMPETENCY

The aim of the course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve civil engineering related hands-based problems using the principles of applied mathematics.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

a. Calculate the equation of tangent, normal, radius of curvature by differentiation.
b. Solve the given problems of integration using suitable methods.
c. Apply the concept of integration to find area of curves.
d. Solve the differential equation of first order and first degree using suitable methods.
e. Apply the concept of numerical integration to evaluate definite integrals.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credits (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 4 | 0 | -- | 4 | 3 | 70 | 28 | 30 | 12 | 100 | 40 | -- | -- | -- | -- | -- | -- |

*(L - Lecture, T - Tutorial, P - Practical, C - Credits, ESE - End Semester Examination, PA - Progressive Assessment)*

*Legend: L - Lecture; T - Tutorial/Teacher Guided Theory Practice; P - Practical; C - Credits; ESE - End Semester Examination; PA - Progressive Assessment*

## 5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of competency (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry employer identified competency depicted at the centre of this map.

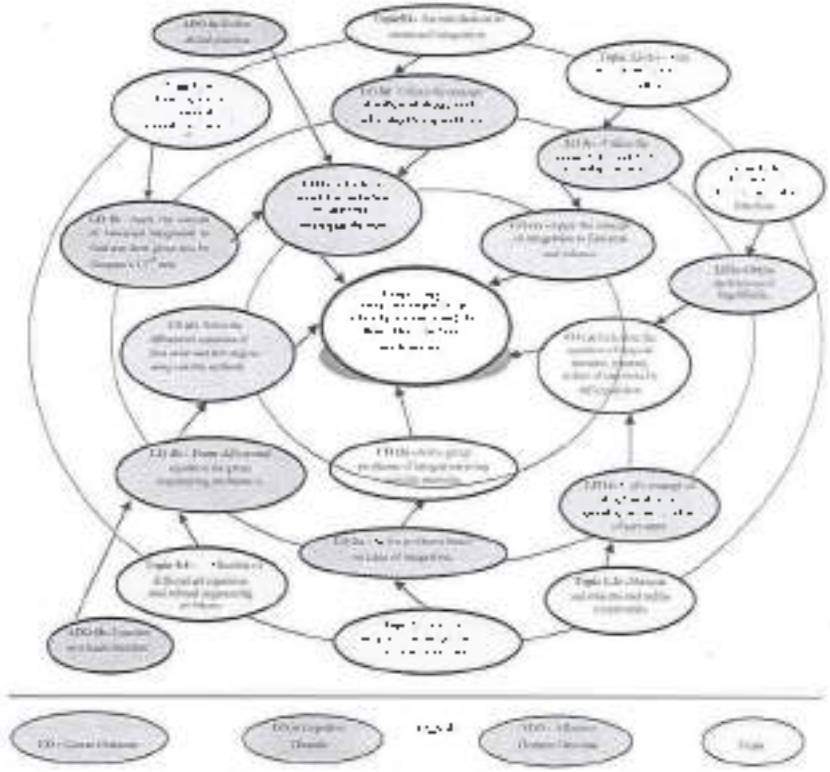

Figure 1 - Course Map

## 6. SUGGESTED PRACTICALS/EXERCISES

The tutorials in this section are LOs (or sub-components of the COs) to be developed and assessed in the student to lead to the attainment of the competency.

| S. No. | Tutorials | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 1 | Solve problems based on finding value of the functions at different points | I | 1 |
| 2 | Solve problems to find derivatives of implicit function and parametric functions | I | 1 |
| 3 | Solve problems to find derivatives of logarithmic and exponential functions | I | 1 |
| 4 | Solve problems based on finding equation of tangent and normal | I | 1 |
| 5 | Solve problems based on finding maxima and minima of function and radius of curvature at a given point | I | 1 |
| 6 | Solve the problems based on standard formulae of integration | II | 1 |
| 7 | Solve problems based on methods of integration: substitution, partial fractions | II | 1 |
| 8 | Solve problems based on integration by parts | II | 1 |
| 9 | Solve practice problems based on properties of definite integration | III | 1 |
| 10 | Solve practice problems based on finding area under curves, area between two curves and volume of revolutions | III | 1 |
| 11 | Solve the problems based on formation, order and degree of differential equations | IV | 1 |
| 12 | Develop a model using variable separable method related to engineering problem | IV | 1 |
| 13 | Develop a model using the concept of linear differential equation related engineering problem | IV | 1 |
| 14 | Solve problems based on Trapezoidal rule | V | 1 |
| 15 | Solve problems based on Simpson's $\frac{1}{3}^{rd}$ rule | V | 1 |
| 16 | Make use of concept of numerical integration to solve related civil engineering problems | V | 1 |
| | **Total** | | 16 |

*Note: The above tutorial sessions are for guideline only. The remaining tutorial hours are for remedial classes.*

6. MAJOR EQUIPMENT, INSTRUMENTS REQUIRED:
- Not applicable -

7. UNDERPINNING THEORY COMPONENTS

The following topics/sub-topics should be taught and assessed in order to develop the Cognitive domain learning outcomes for achieving the Course Outcomes for identified course pattern:

| Unit | Major Cognitive Domain Learning Outcomes | Topics and Sub-topics |
|---|---|---|
| **Unit – I Differential Calculus** | 1a. Solve the given simple problems based on limits of functions<br>1b. Solve the given simple problems based on rules of derivatives | 1.1 Functions and Limits :<br>a) Concept of function and simple examples<br>b) Concept of limits without |



| Unit | Major Cognitive Domain Learning Outcomes | Topics and Sub-topics |
|---|---|---|
| | 1c. Apply the concept of differentiation to find given equation of tangent and normal<br>1d. Apply the concept of differentiation to find maxima and minima and radius of curvature for given function | examples<br>1.2 Derivatives :<br>a Rules of derivatives on Algebraic, product, quotient of functions<br>b Derivatives of composite functions - chain Rule, implicit and parametric functions<br>c Derivatives of inverse, logarithmic and exponential functions<br>1.3 Applications of derivatives<br>a) Second order derivatives of above examples<br>b Equation of tangent and normal<br>c Maxima and minima<br>d Radius of curvature |
| **Unit – II Integral Calculus** | 2a. Solve the given simple problems based on rules of integration<br>2b. Obtain the given simple integrals using substitution method<br>2c. Integrate given simple functions using the integral by parts<br>2d. Evaluate the given simple integral by partial fractions | 2.1 Simple Integration : Concept of integration and integration of standard functions<br>2.2 Methods of integration<br>a) Integration by substitution<br>b) Integration by parts<br>c) Integration by partial fractions |
| **Unit – III Applications of Definite Integration** | 3a. Solve given simple problems based on properties of definite integration<br>3b. Apply the concept of definite integration to find the area under the given curve(s)<br>3c. Utilize the concept of definite integration to find the area between given two curves<br>3d. Evoke the concept of definite integration to find the volume of revolution of given surface | 3.1 Definite Integration<br>a) Simple examples<br>b) Properties of definite integral (without proof) and simple examples<br>3.2 Applications of integration<br>a) Area under the curves<br>b) Area between two curves<br>c) Volume of revolution |
| **Unit-IV First Order First Degree Differential Equations** | 4a. Find the order and degree of given differential equation<br>4b. Form simple differential equations for given simple engineering problems<br>4c. Solve given differential equations as variable separable type<br>4d. Solve the given simple problems | 4.1 Concept of Differential equation<br>4.2 Order, degree and formation of Differential equations<br>4.3 Solution of differential equation<br>a Variable separable type<br>b Linear differential equations<br>4.4 Application of differential equations and related engineering problems |

| Unit | Major Cognitive Domain Learning Outcomes | Topics and Sub Topics |
|---|---|---|
| | based on first order differential equations | |
| Unit – V Numerical Integration | 5a. Apply the concept of numerical integration to find area from given data by Trapezoidal rule<br>5b. Apply the concept of numerical integration to find area from given data by Simpson's $1/3^{rd}$ rule<br>5c. Apply the concept of numerical integration to find area from given data by Simpson's $3/8^{th}$ rule.<br>5d. Utilize the concept of numerical integration to solve related engineering problem | 5.1 An introduction to numerical integration<br>a. Trapezoidal rule<br>b. Simpson's $1/3^{rd}$ rule<br>c. Simpson's $3/8^{th}$ rule |

*Note: To attain the COs and competency above listed Learning Outcomes (LOs) need to be undertaken to achieve the appropriate level of Bloom's Cognitive Domain Taxonomy.*

## 8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Differential calculus | 14 | 04 | 06 | 12 | 24 |
| II | Integral calculus | 12 | 02 | 06 | 08 | 16 |
| III | Applications of Definite Integration | 06 | 02 | 02 | 04 | 08 |
| IV | First Order and First Degree Differential Equations | 06 | 02 | 02 | 04 | 08 |
| V | Numerical integration | 06 | 02 | 06 | 04 | 12 |
| Total | | 48 | 12 | 23 | 35 | 70 |

*Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

*Note: This specification table provides general guidelines to assist student for their learning and to teachers to use it while assessing students with respect to attainment of LOs. The actual specification table with regard to assessment levels of R, U and A in the question paper may vary from one to another.*

## 9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of first order differentials as given on the above unit.
b. Use graphical calculators/ EXCEL/ DPLOT/ and GRAPH for related topics.
c. Use Mathcad as Mathematics Tool's and solve the problems of Calculus.
d. Identify problem's based on applications of differential equations and solve these problems.



e. Prepare models to explain different concepts of applied mathematics.
f. Prepare a seminar on any relevant topic based on applications of integration.
g. Prepare a seminar on any relevant topic based on applications of numerical integration to related engineering problems.

## 10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
b. *'Course Item'* No. 4 does not mean only the traditional lecture method but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the LOs/COs through class-room presentations (see implementation guidelines for details).
d. With respect to item No. 10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
e. Guide students in understanding micro-projects.

## 11. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he might be required to finish it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory based or field-based. Each student will have to maintain a dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro project should not be less than *16 hrs.(org) student engagement hours* during the course.

In the first two semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he can contribute to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare models using the concept of tangent and normal to finding out rate of sliding of a vehicle.
b. Prepare models using the concept of radius of curvature to bend a railway track.
c. Prepare charts displaying the area of irregular shapes using the concept of integration.
d. Prepare charts displaying volume of irregular shapes using concept of integration.
e. Prepare models using the concept of differential equations for moving problems.
f. Prepare models using the concept of differential equations for radio carbon decay.
g. Prepare models using the concept of differential equations for population growth.
h. Prepare models using the concept of differential equations for thermal cooling.
i. Prepare charts displaying the area of irregular shapes using the concept of Simpson's $1/3^{rd}$ rule.
j. Prepare charts displaying the area of irregular shapes using the concept of Simpson's $3/8^{th}$ rule.

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

## 12. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Higher Engineering Mathematics | Grewal, B.S | Khanna publications, New Delhi, 2015 ISBN: 9174091955 |
| 2 | A Text Book of Engineering Mathematics | Dutta, D. | New Age International Publications New Delhi, 2006. ISBN: 978-81-224-1689-3 |
| 3 | Advanced Engineering Mathematics | Kreyig, Erwin | Wiley Publications, New Delhi, 2016 ISBN 978-81-265-5423-2, |
| 4 | Advanced Engineering Mathematics | Das, H.K. | S. Chand Publications, New Delhi 2006. ISBN: 9788121903455 |
| 5 | Engineering Mathematics, Volume I (4th edition) | Sastry, S.S. | PHI learning, New Delhi, 2014 ISBN:978-81-203-3416-2. |
| 6 | Comprehensive Basic Mathematics Volume 2 | Venkat, G.R. | New Age International Publications, New Delhi, 2005. ISBN:978-81-224-1684-8 |
| 7 | Getting Started with MATLAB-7 | Pratap, Rudra | Oxford University Press, New Delhi, 2005 ISBN: 0195171241 |
| 8 | Engineering Mathematics (2nd edition) | Croft, Anthony | Pearson Education, New Delhi,2010 ISBN 978-81-317-2605-1 |

## 13. SOFTWARE/LEARNING WEBSITES

a www.scilab.org - SCILab
b www.mathworks.com/products/matlab - MATLAB
c Spreadsheet applications
d www.dpld.com/ - DPoI
e www.allmathcad.com/ - MathCAD
f www.wolfram.com/mathematica/ - Mathematica
g http://fossee.in
h https://www.khanacademy.org/math?gclid=CNeHuabCys4CFdOUaAodHoPgg
i www.easycalculation.com
j www.math-magic.com

| | |
|---|---|
| Program Name | : Mechanical and Civil Engineering Program Group |
| Program Code | : AE/CE/FG/ME/PT/PG |
| Semester | : Second |
| Course Title | : Applied Science (Physics & Chemistry) |
| Course Code | : 22202 |

## 1. RATIONALE

In Many engineering have to deal with various materials and machines. The study of concepts and principles of science like elasticity, viscosity, surface tension, motion, Newton Laws, polarization, LASERS, X-Rays, metals, alloys, magnetic, heat, refractory materials, water treatment and analysis, fuel and combustion will help the student to select and use relevant materials and methods which will be environmental friendly.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Solve broad-based engineering problems using principles of advanced physics and chemistry.

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

a. Select relevant materials on industry by analyzing physical properties.
b. Apply laws of Quantum Mechanics in various applications.
c. Use LASERS, X-Rays and photoelectric sensors.
d. Select the relevant metallurgical process related to mechanical applications.
e. Use relevant water treatment process to solve industrial problems.
f. Operate relevant (applicable) equipments.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credits (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| | | | | | ESE | | PA | | Total | ESE | | PA | | Total | |
| L | T | P | | Paper Hrs. | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 2 | - | - | 4 | 3 Hrs | 70 | 28 | 30 | 12 | 100 | 40 | 25 | 10 | 25 | 10 | 50 | 20 |
| | | | | | | | | | | | | | | | | |

*(Two hours for theory, Out of 30 marks, 10 marks are for internal test assessment & mark each for Physics and Chemistry as teachers assignment of COs and the remaining 10 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain COs required for the attainment of the COs*

*Legends: L-Lecture, T – Tutorial/Teacher Guided Theory Practice, P – Practical, C – Credit, ESE – End Semester Examination, PA – Progressive Assessment*

*Note: Question of Objective and Diploma will be considered at elsewhere marks for each unit.*



## 5. COURSE MAP (with sample COs, PrOs, UOs, ASCs and topics)

This course map / flowchart shows an overview of the flow and linkages of the topics at various levels of Bloom's taxonomy in subsequent semesters to be attained by the student by the end of the course, in all domains of learning as per the industry employer identified competencies depicted at the centre of the map.

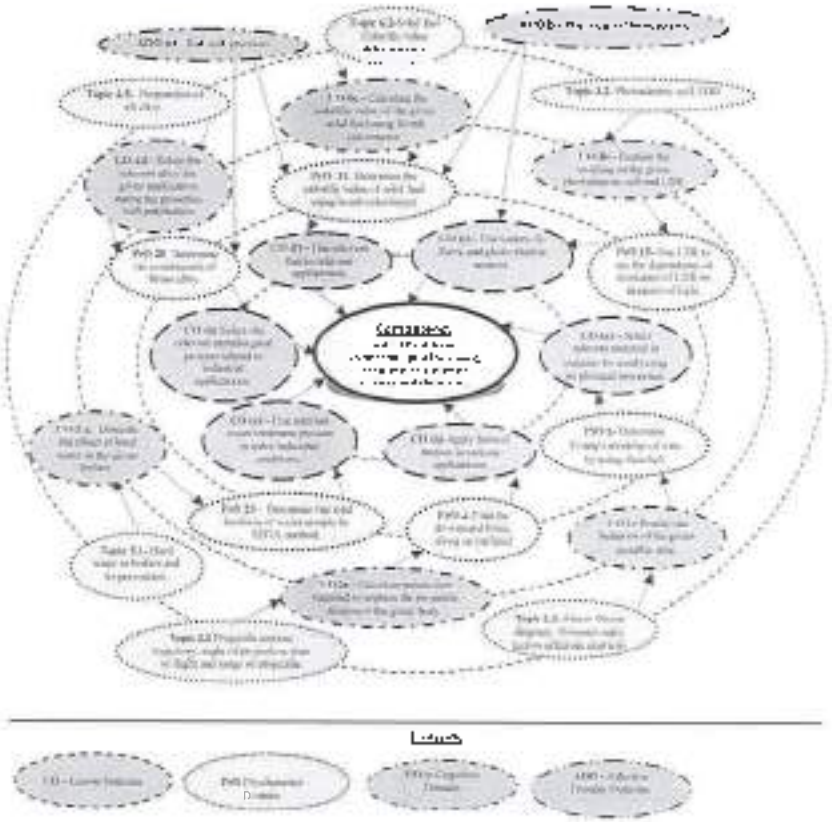


Figure 1 - Course Map

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs i.e. sub-components of the COs to be developed and assessed in the student for the attainment of the competency.

| Sr. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| | Physics | | |
| 1 | Use Searle's method to determine the Young's modulus of given | 1 | 4 |

| S No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| | Note | | |
| 2 | Apply Archimedes' principle to determine the buoyancy force on a solid immersed in liquid. | I | 02 |
| 3 | Determine the coefficient of viscosity of given liquid by Stoke's method. | I | 02 |
| 4 | Find the downward force along an inclined plane acting on a roller due to gravity and its relationship with the angle of inclination. | I | 02 |
| 5 | Predict the range of the projectile from the initial launch speed and angle. | II | 02* |
| 6 | i) Find the dependence of the stopping potential on the frequency of light source in photoelectric effect experiment.<br>ii) Find the dependence of the stopping potential on the intensity of light source in photoelectric effect experiment. | III. | 02 |
| 7 | Determine the I-V characteristics of photoelectric cell and LDR. | III. | 02* |
| 8 | Determine the divergence of laser beam. | III | 02 |
| | **Chemistry** | | |
| 9 | Standardization of $KMnO_4$ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by $KMnO_4$ solution. | IV | 02* |
| 10 | Determine the percentage of copper in given copper ore. | IV | 02 |
| 11 | Determine total hardness, temporary hardness and permanent hardness of water sample by EDTA method. | V | 02* |
| 12 | Determine the alkalinity of given water sample. | V | 02 |
| 13 | Determine the turbidity of given water sample by Nephelometric method. | V | 02 |
| 14 | Determine the moisture and ash content in given coal sample using proximate analysis. | V | 02* |
| 15 | Determine the calorific value of given solid fuel using Bomb calorimeter. | VI | 02* |
| 16 | Determine the percentage of Sulphur in given coal sample by ultimate analysis (Demonstration). | VI | 02 |
| | Total | | 32 |

Note

- *A minimum set of 10-12 PrOs is given in the above table. More such PrOs can be added to attain the required competency. A judicious mix of minimum 12 or more practicals need to be performed out of the above PrOs. Practicals marked as * are compulsory so that the student can derive the Program Level Outcomes (PLOs) for getting employment in the industry.*
- *The 'Hours' and 'Weightage' column in the table above are only a guide for the teachers and students. The actual hours and weightage may vary from industry to industry.*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| 1 | Preparation of experimental set up | 20 |
| 2 | Setting and operation | 20 |
| 3 | Safety measures | 10 |
| 4 | Observations and Recording | 10 |
| 5 | Interpretation of result and Conclusion | 20 |
| 6 | Answer to viva-voce questions | 10 |
| 7 | Submission of report in time | 10 |
| | Total | 100 |



The above PrOs may comprise of the following Social Skill Attitudes, Scientific Attitude, Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when she undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- Valuing Level in 1st year
- Organising Level in 2nd year
- Characterising Level in 3rd year.

## 9. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

| Sr. No. | Equipment Name with Broad Specifications | Exp No. |
|---|---|---|
| 1 | Stroke's apparatus with stoned mass (0.5 kg each) | 1 |
| 2 | Liquid container | 2 |
| 3 | Ball bearings (different size and materials) | 2,3 |
| 4 | Stroke's apparatus (glass tube, viscous liquid, spherical balls of varying sizes) | 3 |
| 5 | Stop watch | 4,5 |
| 6 | Photo transducer | 4 |
| 7 | Timer | 4 |
| 8 | Projectile motion detector | 5 |
| 9 | Photoelectric effect apparatus | 6 |
| 10 | Experimental setup for characteristics of photoelectric cell | 7 |
| 11 | Experimental setup for characteristics of LDR | 7 |
| 12 | Laser Source : He-Ne, diode laser | 8 |
| 13 | Electronic balance with the scale range of 0.001g to 500g, min size 100 mg, response time 3s sec, Power requirement 50-250 V, 10 watt | All |
| 14 | Electric oven thermostat 18" x 18" x 18", temperature range 100 to 250 °C with the capacity of 40 lit | 2 to |
| 15 | Hot plate magnetic | 5 |

| S. No. | Equipment Name with Broad Specifications | Exp. No. |
|---|---|---|
| 20 | Muffle furnace, Temperature up to 900 °C, digital temperature control facility with an accuracy of +/- 5°C | 14,16 |
| 21 | Nephelometer : Auto-ranging from 0.0-200 NTU, +/- 2% of reading plus 0.1 NTU, power 220 Volts +/- 10% AC 50 Hz | 13 |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics/sub-topics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | **Physics** | |
| Unit– I Properties of matter and Non-Destructive Testing | 1a. Explain concept of elasticity and plasticity for the given material.<br>1b. Explain Stress-strain behavior given in terms of modulus of elasticity.<br>1c. Predict the behavior of the given metallic wire. | 1.1 Deforming force and Restoring force, Elasticity, Plasticity, Rigidity<br>1.2 Stress and Strain and their types, Hooke's Law, Young's modulus and Bulk modulus of elasticity<br>1.3 Stress-Strain diagram, Poisson's ratio, factors affecting elasticity |
| | 1d. Explain pressure-depth relation for the given gas.<br>1e. Explain Newton's law of viscosity for the given liquid.<br>1f. Explain Stokes' law for the free fall of the body through the given viscous medium. | 1.4 Fluid friction, pressure, pressure-depth relation, Pascal's law, Archimedes' principle<br>1.5 Viscosity, velocity gradient, Newton's law of viscosity<br>1.6 Free fall of spherical body through viscous medium and Stokes' law, derivation of coefficient of viscosity by Stokes' method, effect of temperature and adulteration on viscosity of liquids. |
| | 1g. Describe the salient features of the given NDT method. | 1.7 Non-destructive testing (NDT), Various NDT methods used, Criteria for the selection of NDT method, merits and demerits of NDT |
| Unit– II Types of Motion | 2a. Explain the equations of motion for the given body moving in the given type of path<br>2b. Calculate the angular velocity of the given body.<br>2c. Explain the relevant Newton's laws of motion for the given moving object<br>2d. Calculate the work/power/energy for the given situation<br>2e. Calculate the given | 2.1 Displacement, velocity, acceleration and retardation, equations of motion, equations of motion under gravity<br>2.2 Angular displacement, angular velocity, angular acceleration, three equations of angular motion<br>2.3 Momentum, impulse, impulsive force, Newton's laws of motion and their Applications<br>2.4 Work, power and energy, potential energy, kinetic energy, work-energy principle |





| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | parameters for the given projectile motion | 2.5 Projectile motion, trajectory, angle of projection, time of flight and range of projectile with formula. |
| Unit– III Photoelectricity, X-Rays and LASERs | 3a. Explain the concept of the given parameters of the given material.<br>3b. Explain the working of the given photoelectric device. | 3.1 Planck's hypothesis, properties of photons, Photo electric effect, Threshold frequency, Threshold wavelength, stopping potential, Work Function, characteristics of photoelectric effect, Einstein's photoelectric equation<br>3.2 Photoelectric Cell and LDR, principle, working and applications |
| | 3c. Explain the production of X-Rays of the given material with properties and applications. | 3.3 Production of X-rays by modern Coolidge tube, properties and applications. |
| | 3d. Differentiate between LASER and given colour of light.<br>3e. Explain the given terms with examples. | 3.4 Laser properties, absorption, spontaneous and stimulated emission, applications of Laser<br>3.5 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser. |
| | **Chemistry** | |
| Unit-IV Metals, alloys, Cement, and Refractory materials | 4a. Describe construction and working of the given type of furnace.<br>4b. Describe the extraction process of the given ore with chemical reaction.<br>4c. Explain purposes and preparation methods of making the given alloy.<br>4d. Select the relevant alloy for the given application stating the properties with justification.<br>4e. Describe the constituents, hardening and setting process of the given type of cement.<br>4f. Select the relevant refractory for given application stating the properties with justification. | 4.1 Metallurgy, Mineral and gangue, flux, slag.<br>4.2 Types of furnace: Muffle furnace, Blast furnace.<br>4.3 Extraction processes of Haematite, copper pyrite ores: Crushing, concentration, reduction, refining.<br>4.4 Properties of iron and copper, Hardness, tensile strength, brittleness, malleability, ductility, refraction test, fatigue resistance, specific gravity, specific heat, brazing, castability, surfaces.<br>4.5 Preparation of alloys (Fusion and compression methods)<br>4.6 Ferrous alloys: Low carbon, medium carbon, high carbon steels.<br>4.7 Non-ferrous alloys: Brass, Bronze, Duralumin, Tungsten, Solder, Woods metal.<br>4.8 Cement, Types, Proportion and Portland cement constituents, setting and hardening, applications.<br>4.9 Lime: classification, constituents, setting and hardening, applications. |

| Unit | Unit Outcomes (UOs) (Cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | | 4.10 Refractory material: Types, properties |
| Unit–V Water Treatment | 5a. Describe the given terminologies related to hard water and their effects<br>5b. Describe the given process for softening of the given water sample<br>5c. Describe with sketches the purification of the given type of water.<br>5d. Describe the given type of waste water treatment. | 5.1 Hardness: Classification<br>5.2 Hard water: Ill effects and prevention. Boiler scale, caustic embrittlement, priming and foaming, sludge and sludges<br>5.3 Water softening: lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process (cation exchange and anion exchange).<br>5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization<br>5.5 Waste water treatment: Sewage treatment, BOD and COD of sewage water, Reverse Osmosis, recycling of waste water |
| Unit-VI Fuels and Combustion | 6a. Describe salient properties of the given type of fuel.<br>6b. Explain the given type of analysis of the given type of coal.<br>6c. Calculate the calorific value of the given solid fuel using Bomb calorimeter.<br>6d. Describe composition, properties of given gaseous fuel with their applications.<br>6e. Calculate the mass and volume of air required for complete combustion of the given fuel | 6.1 Fuel: Calorific value and ignition temperature, classification.<br>6.2 Solid fuels: Coal, Classification and composition , proximate analysis, Ultimate analysis, Bomb calorimeter, Carbonization of coke by Otto Hoffmann's oven.<br>6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, properties, Knocking, cracking, octane number and cetane number.<br>6.4 Gaseous fuels: Biogas, LPG, and CNG. Combustion equation of gaseous fuels, mass and volume of air required for complete combustion. |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the Abstraction Level and Mode of Bloom's Cognitive Domain Taxonomy*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| | **Physics** | | | | | |
| I | Properties of matter and its uses | 14 | 02 | 05 | 06 | 13 |
| II | Types of bonding | 09 | 02 | 02 | 05 | 09 |
| III | Photoelectric effect, X-Rays and LASERs | 09 | 03 | 04 | 04 | 11 |
| | **Chemistry** | | | | | |





| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| V | Metals, alloys, cement, refractory materials | 13 | 02 | 04 | 06 | 12 |
| VI | Water treatment | 10 | 02 | 03 | 06 | 11 |
| VII | Fuels and combustion | 12 | 03 | 04 | 05 | 12 |
| Total | | 64 | 15 | 22 | 33 | 70 |

*Legends: R = Remember, U = Understand, A = Apply and above (Bloom's Revised Taxonomy)*

*Note: Any one unit (or unit pair) can be asked in the question paper with approximately 25% more than the weightage assigned to it in the blueprint table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Seminar on any relevant topic.
b. Industry survey regarding engineering material used in different industries.
c. Prepare power point presentation or animation for showing applications of laser.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses *(MOOCs)* may be used to teach various topic/ sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. *About 15-20% of the topics/sub topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.15, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
e. Guide students in undertaking micro-projects.

## 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, integrated. The micro-projects could be industry application based, internet-based, workshop-based, laboratory-based or field based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course.

In the first two semesters the micro-project could be group-based. However in higher semesters, it should be individually undertaken to build up the skill and confidence in every

student to become perfect in order so that s/he could cope to the projects of the industry. A suggestive list is given here. Similar more projects could be added by the concerned faculty

a. **Elasticity:** Prepare working model to demonstrate the stress – strain behavior of different wires of different thickness and material.
b. **Viscosity:** Collect 5 to 6 liquids and prepare a working model to differentiate liquids on the basis of viscosity and demonstrate their applications.
c. **Motion:** Prepare model of ball rolling down on inclined plane to demonstrate the conservation of energy and motion of an object on inclined plane.
d. **Photo Sensors:** Prepare simple photo sensor using LDR.
e. **Properties of Laser:** Use Key chain laser to differentiate laser with ordinary light.
f. **Water analysis:** Collect water samples from different water sources and find the characteristics like acid Vs. other impurities, dissolved solids, suspended particles.
g. **Water treatment:** Collect 5 to 6 water samples to find the dosage of bleaching powder required for its sterilization.
h. **Water analysis:** Prepare model to find the scale forming capacity of bore water in addition of soda ash.
i. **Fuels:** Prepare chart showing different types of liquid fuels showing their calorific value and uses.
j. **Cements:** Collect different samples of cement and find their initial and final setting time.
k. **Refractory materials:** Prepare chart showing properties of refractory materials.
l. **Metal properties:** Prepare chart showing different industrial application of metal and relate it with required properties or properties using internet.
m. **Alloy steel:** Find the effect of alloying elements like Mn, Cr, Ni, W, V, Co on properties of steel. Prepare chart showing percentage composition, properties and industrial applications of different types of steel based on above alloying elements using internet.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Physics Textbook Part I and Part – Class X. | Nat[illegible], J. V., Joshi, A. W., Marsur, Anuradha, et al. | National Council of Education Research and Training, New Delhi, 2020. ISBN: 8174506383 |
| 2 | Physics Textbook Part I and Part II – Class XII | Nat[illegible] J. V., Joshi, A. W., Ghatak A. K., et | National Council of Education Research and Training, New Delhi 2020. ISBN: 8174506314 |
| 3 | Engineering Physics | Bhattacharya, D. K., Tandon, Poonam | Oxford Publishing, New Delhi. ISBN 0199452814 |
| 4 | Principles of Engineering Physics 1 | Md. Nazoor Khan and Somanchala Panigrahi | Cambridge university press, New Delhi, 2019. ISBN: 9781316637623 |
| 5 | Engineering Physics | Palaniswamy, P. K. | SCITECH Publications, Chennai ISBN: 9788183711712 |
| 6 | Principles of Physics | Walker, J., Halliday, D., Resnick, R. | Wiley Publications, New Delhi, 10th ed. ISBN: 9788126554324 |
| 7 | Textbook of Engineering Physics | Avadhanulu, M. N., Kshirsagar, P. G. | S. Chand and Co., New Delhi, 2019. ISBN: 9788121903677 |
| 8 | Engineering Chemistry | Agarwal, Shikha | Cambridge university press, New Delhi, 2019. ISBN: 9781107674615 |





| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 9 | Engineering Chemistry | Dara, S. S., Umare, S. S. | S. Chand and Co. Publication, New Delhi, 2011. ISBN: 8121929468 |
| 10 | Engineering Chemistry | Jain & Jain | Dhanpat Rai and sons, New Delhi, 2015. ISBN: 9352160402 |
| 11 | Engineering Chemistry | Vairam, S. | Wiley India Pvt. Ltd., New Delhi, 2015. ISBN: 9788126533602 |
| 12 | Chemistry for engineers | Agnihotri, Rakesh | Wiley India Pvt. Ltd., New Delhi, 2016. ISBN: 9788126539284 |

## 14. SOFTWARE/LEARNING WEBSITES

a. http://vlab.amrita.edu/index.php?sub=1&brch=282&sim=1&cnt=1
b. http://nptel.ac.in/courses.php?disciplineId=104
c. http://depts.washington.edu/physdemo/liquid.html
d. www.physicsclassroom.com
e. www.learnerstv.com
f. www.sciencejoywagon.com/physicszone
g. www.explorelearning.com
h. http://phet.colorado.edu/en/
i. www.chemistryteaching.com
j. www.rsc-edu-resources.org
k. www.chemtutor.com
l. www.chemistry.about.com
m. www.rsc.org
n. www.chemcollective.org
o. www.ncert.nic.in
p. www.mhrd.gov.in

| | |
|---|---|
| Program Name | : Mechanical, Civil Chemical and Fabrication Technology and Erection Engineering Program Group |
| Program Code | : AEH, ECH/CHE/CME/FTE/PG |
| Semester | : Second |
| Course Title | : Applied Mechanics |
| Course Code | : 22203 |

## 1. RATIONALE

In day-to-day working we come across different types of structures created for different purposes and locations. While designing the structures analysis of forces and stresses is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, their effects and their effects on structural elements which will help in analysing different structural systems.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use principles of applied mechanics to solve broad-based engineering related problems.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented in such a way that the student demonstrates ability to develop *Industry oriented* COs associated with the above mentioned competency:

a. Identify the force systems for given conditions by applying the basics of mechanics.
b. Select the relevant simple lifting machines for given purposes.
c. Determine unknowns in various different engineering systems.
d. Check the stability of various force systems.
e. Apply the principles of friction in various conditions for useful purposes.
f. Find the centroid and centre of gravity of various components in engineering systems.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching scheme | | | Credit (L+T+P) | Examination scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| | | | | Paper Hrs. | SSE | | PA | | Total | | CSE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | 1 | 2 | 6 | 3 | 70 | 28 | 30 | 12 | 100 | 40 | 50 | 20 | 50 | 20 | 100 | 40 |

*(*) Under the heading 'Out of 50 marks' 10 marks are for micro project undertaken to facilitate attainment of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain of COs required for the attainment of these COs.*



*Legends: L=Lecture, T= Tutorial/Teacher Guided Theory Practice, P= Practical, C= Credit, ESE - End Semester Examination, PA - Progressive Assessment*

## 5. COURSE MAP (a graphical representation of linkages among COs, POs, CCOs, ACOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry expected competency depicted at the centre of this map.

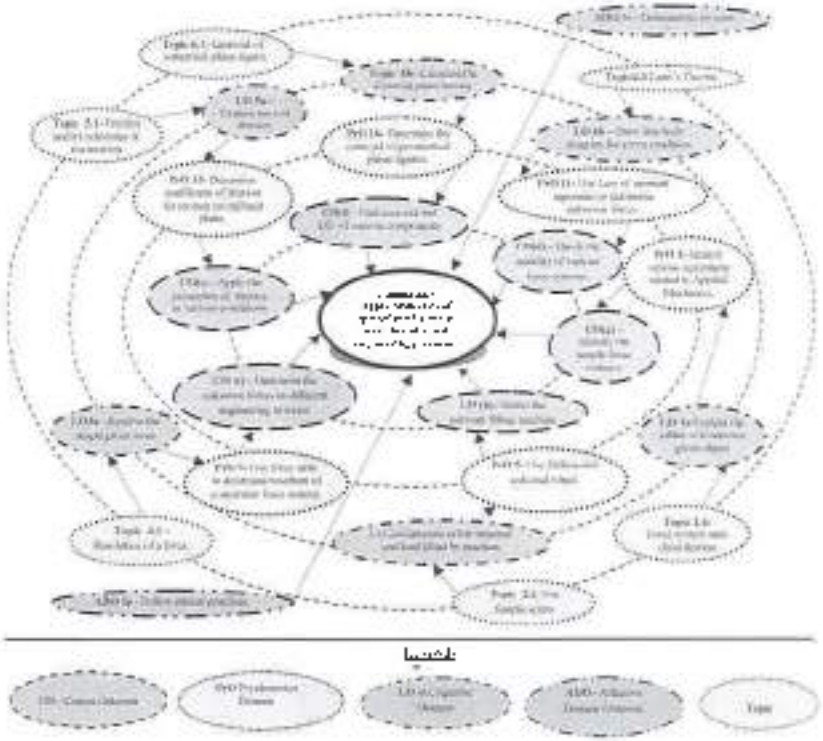


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-units) to the attainment of the COs to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 1 | Identify various equipment related to Applied Mechanics. | I to VI | 02 |
| 2 | Use Differential axle and wheel | I | 02 |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 3 | Use Simple screw jack. | II | 02 |
| 4 | Use worm and worm wheel. | II | 02 |
| 5 | Use any one of Double purchase crab. | II | 02 |
| 6 | Use Weston's differential or worm gear geared pulley block. | II | 02 |
| 7 | Use law of polygon of forces to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-I) | III | 02* |
| 8 | Use law of polygon of forces to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-II) | III | 02* |
| 9 | Graphically determine resultant of concurrent force system. | III | 02 |
| 10 | Graphically determine resultant of parallel force system. | III | 02 |
| 11 | Use Law of moment apparatus to determine unknown forces. | IV | 02* |
| 12 | Apply Lami's theorem to determine unknown force. | IV | 02 |
| 13 | Determine support reactions for simply supported beam. | IV | 02 |
| 14 | Determine co-efficient of friction for motion on horizontal plane. | V | 02* |
| 15 | Determine co-efficient of friction for motion on inclined plane. | V | 02 |
| 16 | Determine centroid of geometrical plane figures. | VI | 02 |
| | Total | | 32 |

*Note*

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practicals need to be performed, out of which the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain' as generally required by the industry.*

ii. *The 'Process and Product related skills' associated with each PrO is to be assessed instead of the traditional way of assessing only the 'Final Product'. The sample given below.*

| S.No | Performance Indicators | Weightage in % |
|---|---|---|
| 1 | Preparation of experimental set up | 20 |
| 2 | Setting and operation | 20 |
| 3 | Safety measures | 10 |
| 4 | Observations and Recording | 10 |
| 5 | Interpretation of result and Conclusion | 20 |
| 6 | Answer to Sample questions | 10 |
| 7 | Submission of report in time | 10 |
| | Total | 100 |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs in such a way that the acquisition of the ADOs takes place gradually in the student when he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs like 'working in a team' or 'follow ethical practices' should gradually increase as planned below:

- Valuing Level in 1st year
- Organizing Level in 2nd year
- Characterizing Level in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will enable the student to perform all the experiments as listed in Section-6. However, equipment of comparable specifications may be used.

| S. No. | Equipment Name with Broad Specifications | Exp. No. |
|---|---|---|
| 1 | Differential axle and wheel (cast, mounted on a shaft with the wheel of 40 cm diameter and axles are in steps of 20 cm and 10 cm reducing diameter. | 2 |
| 2 | Simple screw jack (Table mounted metallic body, screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter. | 3 |
| 3 | Worm and worm wheel (wall mounted type with threaded spindle, load drum, effort wheel, with necessary slotted weights, hanger and thread) | 4 |
| 4 | Single Purchase Crab winch (Table mounted heavy cast iron body. The effort wheel is of 30 cm material of 25 cm diameter mounted on a shaft of about 40 mm dia. On the same shaft a geared wheel of 15 cm dia. | 5 |
| 5 | Double Purchase Crab winch (Heavy assembly same as above but with double set of gearing arrangement.) | 5 |
| 6 | Weston's Differential pulley blocks (consisting of two pulleys, one bigger and other smaller. | 6 |
| 7 | Weston's Differential worm geared pulley block (Consists of a metallic (preferably steel) rugged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weight) | 6 |
| 8 | Universal Force Table (Consists of a circular 40 cm dia. Aluminium disc, graduated into 360 degrees.) with all accessories. | 7, 9 |
| 9 | Law of moments apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1 m long, pivoted at centre. | 8 |
| 10 | Beam Reaction apparatus (The apparatus is with two circular dia type 20 kg. | 11 |
| 11 | Pivot on apparatus for motion along horizontal and inclined plane (base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees pan. Two weight boxes (each of 5 gm, 10 gm, 2×20 gm, 2×50 gm, 2×100 gm weights). | 12 |
| 12 | Models of geometrical figures | 13 |

## 8 UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop COs in cognitive domain for achieving the COs to attain the identified competency.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| Unit – I Mechanics and force system | 1a. Explain concepts of the given terms<br>1b. State the relevant units of various quantities in the given situations<br>1c. Explain effects of a force on the given object<br>1d. Identify the force system for the given situation | 1.1 Significance and relevance: Mechanics and its mechanics, statics, dynamics.<br>1.2 Space, time, mass, particle, body, rigid body.<br>1.3 Scalar and vector quantity, concept of measurement (Numerical) Fundamental units and derived units.<br>1.4 Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force. Principle of transmissibility of force. Force system and its classification. |
| Unit – II Simple lifting machine | 2a. Describe the components of the given lifting machine.<br>2b. Differentiate the working principle of the given two types of simple lifting machines.<br>2c. Determine velocity ratio, efficiency and law of the given simple lifting machine<br>2d. Calculate effort required and load lifted by the given simple lifting machine.<br>2e. Interpret the graphs after drawing them with the given data<br>2f. Select the relevant simple lifting machine required for the given purpose with justification | 2.1 Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine.<br>2.2 Ideal machine, friction in machine, maximum Mechanical Advantage and efficiency, reversible and non-reversible machines, condition for reversibility.<br>2.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block.<br>2.4 Graphs of Load verses Effort (Load verses Ideal Effort, Load verses Effort lost in friction, Load verses M.A., Load verses Efficiency |
| Unit- III Resolution and composition | 3a. Resolve the given single force.<br>3b. Calculate the resultant of the given force system analytically.<br>3c. Determine graphically the resultant of the given force system.<br>3d. Find the condition of the given force system in equilibrium. | 3.1 Resolution of a force – Orthogonal and Non Orthogonal components of a force, moment of a force, Varignon's Theorem.<br>3.2 Composition of forces – Resultant, analytical method of determination of resultant for concurrent, non-concurrent and parallel coplanar force systems – Law of triangle, parallelogram and polygon of forces.<br>3.3 Graphical method, graphical representation of forces, Space diagram, force diagram, polar diagram and funicular polygon. Graphical method of determination of resultant for concurrent and parallel coplanar force systems. |
| Unit– IV Equilibrium | 4a. Draw the free body diagram for the given condition<br>4b. Determine unknown force in the given situation using Lami's theorem.<br>4c. Identify the types of beams required for the given situation<br>4d. Determine reactions in the given type of beam analytically and graphically | 4.1 Equilibrium and Equilibrant, free body and free body diagram. Analytical and graphical conditions of equilibrium.<br>4.2 Equilibrium of force systems analytically.<br>4.3 Lami's Theorem.<br>4.4 Types of beam: supports: simple, hinged, roller and fixed; and loads: point or beam (vertical and inclined point load, UD load, couple); span of beam.<br>4.5 Beam: reaction for simple, supported beam with or without overhang – subjected to combination of Point load and UD load or Vertical Point load and couple.<br>4.6 Beam: reaction graphically for simply supported beam subjected to vertical loads only. |
| Unit– V Friction | 5a. Determine force of friction and coefficient of friction for the given condition<br>5b. Describe the conditions for motion for the given situation<br>5c. Determine friction force in the given situation<br>5d. Identify the various forces acting on a ladder for the given conditions using free body diagram. | 5.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, coefficient of friction, angle of friction, angle of repose, relation between coefficient of friction and angle of friction.<br>5.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane.<br>5.3 Equilibrium of body on inclined plane subjected to force parallel to the plane only.<br>5.4 FBD of ladder in friction. |
| Unit– VI Centroid and centre of gravity | 6a. Determine the centroid of geometrical plane figures and centre of gravity of the given simple solid.<br>6b. Calculate centroid of the given composite plane lamina<br>6c. Determine centre of gravity of the given solids<br>6d. Determine centre of gravity of the given composite solid. | 6.1 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle)<br>6.2 Centroid of composite figures composed of not more than three geometrical figures.<br>6.3 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere)<br>6.4 Centroid or Centre of Gravity of composite solids composed of not more than two simple solids |

*Note: To attain the COs and competencies above, Total CIEs need to be undertaken to achieve the Application Level and above of Bloom's Cognitive Domain Taxonomy.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Mechanics and Force System | 08 | 02 | 02 | 02 | 06 |
| II | Simple Lifting Machines | 08 | 02 | 04 | 06 | 12 |
| III | Resultants and Composition | 10 | 02 | 04 | 05 | 11 |
| IV | Friction | 10 | 02 | 02 | 10 | 14 |
| V | Centroid | 08 | 02 | 04 | 06 | 12 |
| VI | Centroid and Centre of Gravity | 08 | 02 | 02 | 08 | 12 |
| Total | | 48 | 12 | 18 | 40 | 70 |

*Legends: R=Remember; U=Understand; A=Apply and above (Revised Bloom's Taxonomy)*

Note: *The question paper blue print provides general guidelines to the course teacher for their learning and teachers to ensure that desired emphasis is given to the attainment of COs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, the following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Collect five different photographs indicating concurrent, parallel, general force system in equilibrium.
b. Prepare a table of type of machine and relevant industrial application.
c. Collect five different situations where law of moment plays an important role.
d. Prepare models representing various types of supports (hinged, roller and fixed).
e. Observe situations wherein friction is essential and not essential.
f. Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
b. '*L*' in item No. 4 does not mean only the traditional lecture method, but a different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guidelines for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
e. Guide student(s) in undertaking micro-projects.

## 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of the individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course.

In the first four semesters, the micro-project are to be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he can contribute to the projects of the industry. A suggestive list is given here. Similar micro projects could be added by the concerned faculty:

a. **Types of Forces**: Prepare chart showing real life examples indicating various types of forces.
b. **Lifting Machine**: Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools viz. MECHANO and VEC TANIX.
c. **Types of support**: Prepare chart showing actual and corresponding schematic diagram of various type of support.
d. **Beams**: Prepare models of beam subjected to point loads or firmly distributed loads, simply supported overhang and cantilever type beam.
e. **Friction**: Prepare chart regarding type of friction in various field conditions and collect data regarding coefficient of friction by referring books. Determine coefficient of friction for three different types of surfaces.
f. **Centre of Gravity**: Prepare a chart of situations wherein concept of Centre of Gravity is vital.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Applied Mechanics | Khurmi, R.S. | S Chand & Co. New Delhi 2014 ISBN: 9788121965431 |
| 2 | Engineering Mechanics | Ramamurtham, S. | S Chand & Co. New Delhi 2008 ISBN: 9788187433514 |
| 3 | Foundations and Applications of Applied Mechanics | Ram, H. D. Chauhan, A. K. | Cambridge University Press Thomson Press India Ltd., New Delhi 2015, ISBN 9781107436626 |
| 4 | Engineering Mechanics-Statics Vol.1 | Meriam, J. ... Kraige, L.G. | Wiley Publication, New Delhi. ISBN: 978 81 265 4196 |

## 14. SOFTWARE/LEARNING WEBSITES

a. http://www.gmg.com.au
b. www.youtube.com for videos regarding machines and applications, fraction
c. www.splet.com
d. www.howstuffworks.com

| | |
|---|---|
| **Program Name** | : Civil Engineering Program Group |
| **Program Code** | : CE/CR/CS |
| **Semester** | : Second |
| **Course Title** | : Civil Engineering Workshop and Practice |
| **Course Code** | : 22008 |

## 1. RATIONALE

Student Civil Engineering Practitioners is a basic engineering course. The knowledge of basic civil engineering operations like masonry, plastering, concreting, finishing works is essential for technicians to achieve his/her duties and responsibilities. Therefore an opportunity is created through this course to develop basic skills with the safety aspects required for the same. Students should be able to supervise construction activities and use quality control techniques and measurements and comprehend the safety to self, co-workers and the environmental components of the building. Working in field develops the attitude of team working and safety awareness. This course provides the hands-on experience of field work.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Perform basic civil engineering jobs using relevant tools

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and to acquire soft skills associated with the competency are to be developed and demonstrated, in that the student should exhibit the following industry oriented COs associated with the above mentioned competency:

a) Identify the various construction materials.
b) Perform masonry jobs.
c) Perform plastering jobs.
d) Identify the tools required for building constructions.
e) Identify the various components of typical civil structures like roads, bridges.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Max | Min | Max | Min | Max | Min |
| – | – | 4 | 4 | – | – | – | – | – | – | 60# | 24 | 40 | 16 | 100 | – |

*(P) are the practical only courses. Use 04 hrs. two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 60 marks) one micro project assessment (seen in section 12) has a weightage of 40% (i.e. 40 marks). This is designed to facilitate attainment of COs holistically. # Denotes as Theory ESE.*

*Legends: L (Lecture); T (Tutorial/Teacher Guided Theory Practice); P (Practical); C (Credits); ESE (End Semester Examination); PA (Progressive Assessment).*





## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates the flow line linkages of the topics at various levels of outcomes (details of subjects required to be attained by the students by the end of the course, i.e. CO, domains of learning in terms of the industry employer identified competency at the end of the course).

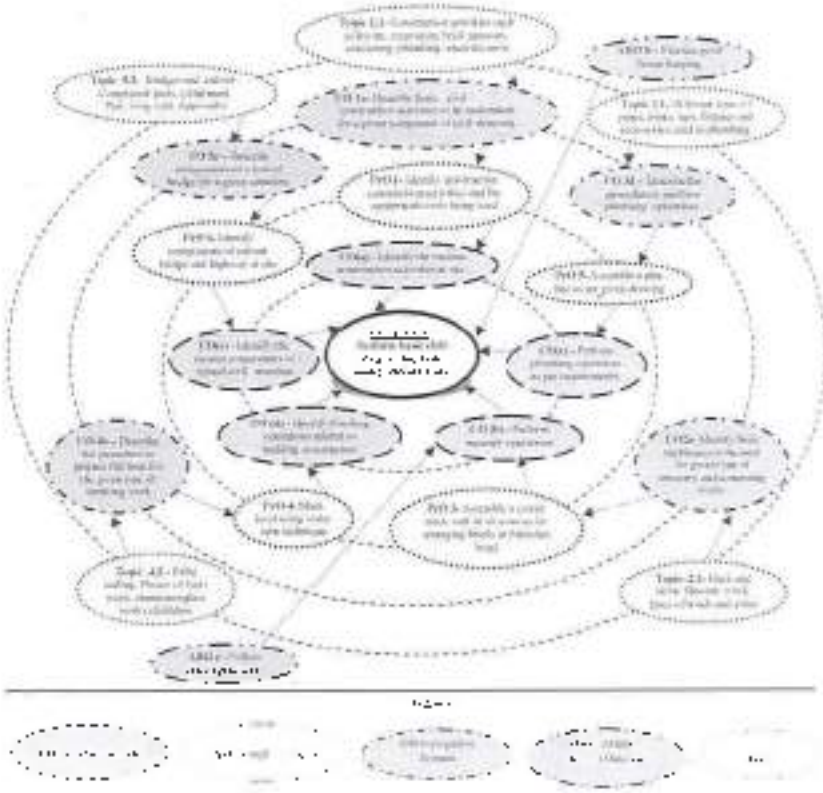

Figure 1 - Course Map

## 6. SUGGESTED PRACTICAL LEARNING OUTCOMES/TUTORIALS

The practical/tutorial/exercises PrOs (i.e. sub-components/sub-units of the COs) to be developed and assessed in the student for the attainment of the competency:

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs required |
|---|---|---|---|
| 1 | Identify the soil/construction constituents and the equipments/tools required at site for the work. Part I | I, II | 02* |
| 2 | Identify the construction activities at site during visit. Part II | I, II | 02 |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 5 | Identify the substructure construction activities and the equipments/tools being used at site during the visit Part II | I, II | 02 |
| 6 | Identify the substructure construction activities and the equipments/tools being used during the visit Part IV | I, II | 02 |
| 7 | Assemble a cement brick wall in two courses by arranging bricks in Stretcher bond, ensure that wall is in line, plumb and at right angle to existing wall (Group of 10 students) | II | 02* |
| 8 | Assemble a cement brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to existing wall (Group of 10 students) Part II | II | 03 |
| 9 | Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to existing wall (Group of 10 students) Part II | II | 02 |
| 10 | Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to existing wall (Group of 10 students) Part III | II | 02 |
| 11 | Assemble a corner brick wall in six courses by arranging bricks in Stretcher bond. Ensure that wall is in line, plumb and at right angle to existing wall (Group of 10 students) Part IV | II | 02 |
| 12 | Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part I | III, IV | 02* |
| 13 | Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part II | III, IV | 02 |
| 14 | Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part III | III, IV | 02 |
| 15 | Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part IV | III, IV | 02 |
| 16 | Mark level of given height from ground level at different locations in the specified layout using water pipe level/ spirit level Part I (Group of 10 students) | I, V | 02* |
| 17 | Mark level of given height from ground level at different locations in the specified layout using water pipe level/ spirit level Part II (Group of 10 students) | II, IV | 02 |
| 18 | Mark level of given height from ground level at different locations in the specified layout using water pipe level/ spirit level Part III (Group of 10 students) | II, IV | 02 |
| 19 | Mark level of given height from ground level at different locations in the specified layout using water pipe level/ spirit level Part IV (Group of 10 students) | II, IV | 02 |
| 20 | Assemble a pipe line as per given drawing using pipes of one inch diameter pipes of half inch diameter nipple reducer union valves T elbows and then disassemble the pipe line Part I | III | 02* |
| 21 | Assemble a pipe line as per given drawing using pipes of one inch diameter pipes of half inch diameter nipple reducer union valves T elbows and then disassemble the pipe line Part II | III | 02 |





| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| | line Part III | | |
| 22 | Assemble a pipe line as per given drawing using pipes of one inch diameter pipes of half inch diameter nipple, reducer union valves T elbows and then disassemble the pipe line Part III | II | 02 |
| 23 | Assemble a pipe line as per given drawing using pipes of one inch diameter pipes of half inch diameter nipple reducer union valves T elbows and then disassemble the pipe line Part IV | II | 02 |
| 24 | Test the quality of cement on site/Laboratory Part I | IV | 02* |
| 25 | Test the quality of cement on site/Laboratory Part II | IV | 02 |
| 26 | Test the quality of cement on site/Laboratory Part III | IV | 02 |
| 27 | Identify types of bent up bar and stirrups/ ties during the field visit for the reinforcement for beams, column and slab Part I | V | 02* |
| 28 | Identify types of bent up bar and stirrups/ ties during the field visit for the reinforcement for beams, column and slab Part II | V | 02 |
| 29 | Identify types of bent up bar and stirrups/ ties during the field visit for the reinforcement for beams, column and slab Part III | V | 02 |
| 30 | Identify the various components of the culvert at site | V | 04* |
| 31 | Identify the various components of the bridge at site | V | 04 |
| 32 | Identify the various components of the highways at site | V | 04 |
| | Total | | 64 |

*Note*

- *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the Course competency. A judicial mix of minimum 24 or more practical PrOs/tasks need to be performed out of which the practicals marked (*) are compulsory, so that the student reaches the 'Precision Level' of Dave's Psychomotor Domain for performing the practical and industry oriented skills.*
- *Hence, the Process and Product related skills associated with each PrO of the laboratory manual/ workbook are to be identified and mentioned by the teacher for assessment. Sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| 1 | Preparation of experimental set up | 20 |
| 2 | Setting and operation | 20 |
| 3 | Safety measures | 10 |
| 4 | Observations and Recording | 10 |
| 5 | Interpretation of result and Conclusion | 20 |
| 6 | Viva voce on the experiment | 10 |
| 7 | Submission of report in time | 10 |
| | Total | 100 |

The above PrOs also contribute to the following 'Generic Skills' which are 'Course Outcomes' (COs) that are 'Not' developed through the laboratory/ field based experiences:

g. Follow safety practices
h. Practice good housekeeping
i. Demonstrate working as a leader and a team member
j. Maintain tools and equipment
k. Follow ethical practices

The ANOs are not specific to any one PrOs but are embedded in many PrOs. Hence, the acquisition of the ANOs takes place gradually in the content when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ANOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year

## 7. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will help in the Polytechnic to conduct of experiments as well as aid to prepare competent technicians considered.

| S. No. | Equipment Name with Broad Specifications | Exp. No. |
|---|---|---|
| 1 | Raw material such as bricks of standard size 230 mm x 115 mm x 75 mm | 3,8 |
| 2 | Trowel, Line & Pin, Plumb Bob, Straight edge, Steel tape (about 12 inches (300-450 mm) long and from 10 (or 15 mm to 20 (or 25 mm wide) or 1 to 3 inches wide) | 2 |
| 3 | Portable Hand tools – Spade, Pan, Rammer, Trowel, Hoe | 2 |
| 4 | Square, Spirit level and straight edge, Bridge, Rule, Mason's Hammer, Club hammer and the pointed trowel, Straight edge from 150-450 mm to 250 mm wide | 3 |
| 5 | Levels and Staff, Line, Pins | 3 |
| 6 | Surveying Level, Water tube, Plumb bob, Right Angle | – |
| 7 | Demonstration of level to establish 'plinth' and 'Level' Lines | 4 |
| 8 | Plumbing materials such as pipes and accessories for different types of pipe joints, pipe wrench | 7 |
| 9 | Pipe Bending Machine | 7 |
| 10 | Pipe Vice – 100 mm | 7 |
| 11 | Pipe Cutter – 50 mm | 7 |
| 12 | Oxy-acetylene Welding Equipment | 3,6 |
| 13 | Demonstration of Soldering Iron, Soldering wire and Bending tool | |
| 14 | Bricks of standard size 230 mm x 115 mm x 75 mm | 3,8 |





## 8. UNDERPINNING THEORY COMPONENTS

The following important topics should be taught and assessed in order to develop the cognitive domain skills required to achieve the COs to attain the identified competency.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| Unit – I Overview of Construction activities | 1a. Describe basic construction activities to be undertaken for the given component of civil structure.<br>1b. Identify the construction activities at the given site.<br>1c. Identify the tools used for the given type of foundation layout.<br>1d. Describe different safety precautions to be taken at the given construction site. | 1.1 Construction activities such as layout, excavation, brick masonry, concreting, plumbing, electrification, interdependency of various activities<br>1.2 Workshop and Safety precautions |
| Unit – II Masonry and Concreting | 2a. Identify the basic techniques to be used for the given type of masonry and concreting works with justification.<br>2b. Identify the roles of quality control measures to be adopted in operations related to the given type of masonry and concreting with justification.<br>2c. Describe the methods of plastering and pointing to be undertaken in the given situation.<br>2d. Describe the methods of the formwork for the given type of building.<br>2e. Identify the type of bond in the given type of brickwork. | 2. Brick and stone Masonry work: Types of bonds and joints (vertical and horizontal).<br>2.1 Foundation: Materials, bedding and water level to be.<br>2.2 Plastering, Pointing.<br>2.4 Proper mixing of concrete, concrete layers.<br>2.5 Use of Concrete Mixtures and Vibrators, Different types of Vibrators.<br>2.6 Formwork, Scaffolding.<br>2.7 Curing and Softening. |
| Unit – III Plumbing services | 3a. Identify the plumbing tools and fixtures in the given situation with justification.<br>3b. Select the pipe fittings, tools and machinery for the given type of work with justification.<br>3c. Select the type of plumbing joints and machinery for the given situation with justification.<br>3d. Describe the procedure to perform plumbing operations for the given condition.<br>3e. Describe the safety precautions to be undertaken for the given site. | 3.1 Different types of pipes, joints, sizes, fixtures and accessories used in plumbing.<br>3.2 Components of given water bonds, used in water supply, sanitary, sewerage lines. |
| Unit – IV Finishing Works | 4a. Describe the operations to be undertaken related to the given situation of false ceiling, aluminum partitions, plastering work.<br>4b. Describe the procedure to prepare the | 4.1 Flooring, skirting, dado.<br>4.2 False ceiling, Cleaning of the POP work, aluminum partitions, glass works, cladding.<br>4.3 Whitewash and painting. |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Subtopics |
|---|---|---|
| | base for the given type of finishing (3 hours each)<br>4. Choose the relevant attachment/ cutter for the given type of work in pipelines (3 hours each)<br>U4. Describe the steps and precautions for the given type of work in steel Surface Water Structures | Tools required: brush, roller and spray painting preparation of surface for timber and steel (one type for painting) |
| Unit-V Construction of Road, culverts/ bridges | 5a. Identify the various materials for the given type of road (soil/ stone/ water bound/ bituminous) with justification<br>5b. Describe the types and components of road for the given situation<br>5c. Describe the components of typical bridge for the given situation.<br>5d. Describe the components of typical Culvert for the given situation<br>5e. Select the relevant materials for construction of given type of bridge/ culvert | 5.1 Types of road, components of road (camber, gradient, super elevation, widening, shoulder, kerb, footpath, drainage)<br>5.2 Bridges and Culverts components parts (abutment, pier, wing wall, Approaches) |

Note: To attain the UOs and competency, above listed UOs need to be undertaken in the sequence listed and above all *Process of Engineering Decision Making*.

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable -

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-*curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Undertake a market survey in local area for procurement of civil engineering materials, plumbing materials and finishing items

b. Organize a visit to Construction sites of different types such as simple residential buildings in city, air-conditioned buildings. Observe the construction practices on the field

c. Undertaking field-oriented assignments

d. Course related internet based micro-projects

e. Develop Power point presentation or animation for activities seen during field visit

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics

b. 'Flipped classroom' technique where students will be encouraged to watch video lectures on specific topics at their home premises as per provided links in order to have more time in the classroom for group discussion, clarification of doubts, and other activities to enhance learning

c. Arrange *15-20% of the topics/subtopics* which are relatively simpler or descriptive in nature to be given to the students for *self-directed learning* and assess the development of the UOs through class room presentations (role play, poster, problem solving, etc.) and/or micro-projects

d. Use direct instruction method sparingly, i.e. only when it is most appropriate

e. Encourage use of Web-based resources: e-learning contents, Virtual Laboratories, Process animations, Video demonstrations, etc.

f. Arrange visit to nearby Construction sites for understanding various construction stages and practices followed on site

g. Show video/animation films to explain various processes like excavation, foundation, concrete placing, curing, water supply and sewer pipeline

h. Provide opportunities for undertaking micro-projects and other assignments in each unit

## 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and COs. Hence, micro-project could be industry application based, market-based, workshop-based, laboratory-based or field-based. Each student will have to maintain a dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Bill Preparation** (Group of 4-5 students) – Prepare bill of materials for given pipeline layout

b. *Masonry and concreting* - Each student will collect the information regarding cost of materials for the construction of brick masonry, bricks reinforcement and cement concrete

c. *Finishing Work* – Collect the information from local market regarding the type, thickness, manufacturer, cost of various brands and grades of aluminium sections. Study of these specifications (2 hours each) (Individual activity)

d. *Plumbing* – Download the specifications for plumbing tools such as bench vice, hammers, pipe wrench, pipe accessories

e. *Masonry and concreting* – Undertake a market survey of different types of cement, aggregates, sand, admixtures, their specifications, prices, etc. (Group of five students)

f. *Plumbing* – Collect the technical information for various plumbing accessories such as GI, PVC pipes, bend, union, couplings of various dimensions and write a brief report and submit it.

g. *Masonry and concreting* (Individual activity) –

   i. Collect five samples of bricks from different suppliers and test them to assess the quality and write a report on it, with reference to the standard specified and process followed during testing.

   ii. Prepare a mild concentration of various proportions 1:3 and apply it on the plastered wall of 2 layers (CM) and observe the time required for the plaster to dry.

   iii. Prepare a concrete cube of proportion 1:2:4, 1:3:6 and 1:4:8 and prepare a table to show their determinate strength (individual activity)

iv. Measure and estimate by -Collect the list of available stone or flooring tiles with their IS specification and make a report of it.

f. *Masonry and concreting* (Group of five students) - Undertake the local survey for various shuttering material being used in its specifications.

g. *Masonry and concreting* (Group of ten students) - Assemble and dissemble the shuttering material for a beam of given dimension using appropriate material as directed by subject teacher.

h. Finishing Work (Any one activity) - Undertake the survey for different brands of paint painting tools and prepare a report with reference to the following points

i. Constituents of paint material

ii. Coverage area of finishing surface

iii. Cost.

iv. Durability and aesthetic features

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | PWD- Standard Data Book for Building Work | PWD | PWD, Government of Maharashtra, Mumbai |
| 2 | CPWD Specifications (Vol-I and II) | CPWD | CPWD, Govt. of India, New Delhi |
| 3 | The Practical design of Structural Elements in Timber | Bell, J.W. | Chiver Press, London 1989 ISBN: 9780566090288 |
| 4 | Basic Plumbing With Illustrations | Massey, Howard C. | Craftsman Book Co. California, ISBN: 9780934644097 |
| 5 | Modern Plumbing | Baker, E. Keith Blanker | Goodheart-Willcox Co ISBN: 978-1590703502 |
| 6 | District Schedule of rates. (DSR) | PWD | PWD, Government of Maharashtra, Mumbai |
| 7 | A to Z Of Practical Building Construction & its Management | Mohit Sandeep | Satya Prakashan, New Delhi : 2015; ISBN : 9788175842051 |

## 14. SOFTWARE/LEARNING WEBSITES

a. http://www.asc-l.com.au

b. http://www.construction-engineer.com/cb-doing-design-and.html

c. www.nidhan.com

d. cpwd.gov.in

e. https://wrd.maharashtra.gov.in

Program Name : All Branches of Diploma in Engineering and Technology.

Program Code: CE/CR/CS/CH/PS/CM/CO/IF/CW/DE/EL/EN/FQ/ET/EX/MI/MU/TE/

FP/FU/OS/OA/PG/TE/PU/PD/DY/IC

Semester : Second

Course Title : Business Communication Using Computers

Course Code : 22009

## 1. RATIONALE

Communication is the key factor for smooth and efficient functioning of any industry or business activity. Effective business communication is the lifeblood of any organization and is required to maintain quality and progress. The efficacy of business communication skills are essential for engineering professionals for instructing, guiding and motivating subordinates to achieve desired goals at work place. It is very crucial for any entrepreneur to run organization successfully by communicating effectively and skillfully with employees, customers and investors. Thus this course has been designed to enhance the skills to *'Communicate effectively and skillfully at workplace.'*

## 2. COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through various teaching learning experiences:

- **Communicate effectively and skillfully at workplace.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

1. Communicate effectively by avoiding barriers in various forms and dimensions.
2. Communicate SKILLFULLY using different methods of communication.
3. Give presentations by using audio visual aids.
4. Write letters using correct punctuations.
5. Compose memo and letter for business matters.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Max | Min | Max | Min | Max | Min |
| -- | -- | 2 | 2 | -- | -- | -- | -- | -- | -- | 50 * | -- | 50 # | 25 | 50 | 25 |

(*) Term work practical marks: The PA (TW) marks will be based on the quality of the practicals performed. The assessment of practicals has a weightage of 60% i.e. 30 marks and micro-project assessment has a weightage of 40% i.e. 20 marks. The term work is to be graded as per the principle of CO's be used, as there is no theory ESE.



*Legends: Code no. T = Tutorial, Teacher Guided Theory, Practical, C = Credit, ESE = End Semester Examination, PA = Progressive Assessment.*

## 5. COURSE MAP (with sample COs, PrOs, Units, ADIOs and topics)

This course map illustrates at a glance the flow and linkages of various types of outcomes (COs, PrOs, ADIOs in sub-sequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

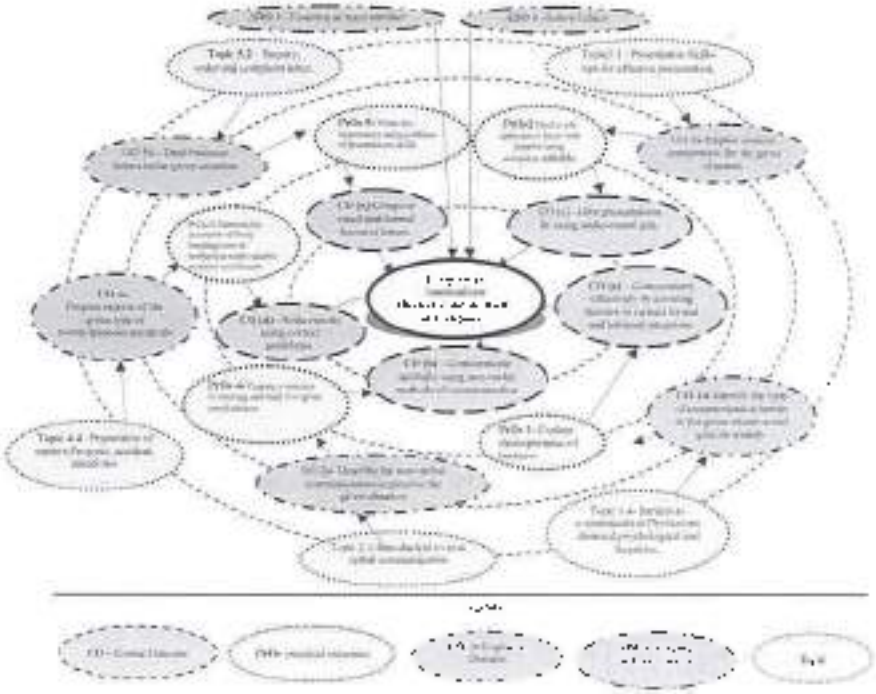

Figure 1 - Course Map

## 6. SUGGESTED PRACTICALS/ ACTIVITIES / EXERCISES (Integrate the theory in the laboratory while conducting practicals)

The practicals in this section are PrOs i.e. the sub-components of the COs to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs required |
|---|---|---|---|
| | | | |
| 1 | Explain the importance of business communication in an organization using case study | 1 | 2* |

| S No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 2 | Draft a job application letter with resume using computer | V | 2* |
| 3 | Mention five examples of body language use at workplace with suitable pictures and images | I | 2* |
| 4 | Prepare a minutes of meeting and mail it to given e mail address | VI | 2 |
| 5 | Write the importance and guidelines of presentation skills | III | 2* |
| 6 | Draft a detailed Progress Report | IV | 2* |
| 7 | Organize a debate on types of communication | I & III | 2 |
| 8 | Summarize an industry report using techniques of summarizing. | IV | 2 |
| 9 | Draft a complaint letter on given topic | V | 2 |
| 10 | Design PowerPoint presentation on any technical topic | III | 2* |
| 11 | Explain the eight principles of effective communication | I | 2* |
| 12 | Explain various non-verbal codes with examples. | II | 2 |
| 13 | Explain the importance of personal appearance stating types of grooming for a professional | II | 2* |
| 14 | Draft a memo on given topic | V | 2 |
| 15 | Present any Two barriers to communication using case study | I | 2* |
| 16 | Present a technical paper using IEEE format | III | 2* |
| | | | 32 |

Note

i. *A suggestive list of practical LOs is given in the above table. More such practical LOs can be added to cover the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's Psychomotor Domain hierarchy as generally required by the industry. The use of labs for the practical should not exceed more than 24 students strictly for the maintenance of desired learning environment.*

ii. *Format the 'Process' and 'Product' related skills associated with each LO of the laboratory experiments/practicals may be as per need.*

## 7. MAJOR EQUIPMENTS /INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will help in procurement in case of new institutions. It will also help in procurement of equipment by institutes concerned.

| S No. | Equipment Name with Broad Specifications | Exp. S.No. |
|---|---|---|
| 1 | LCD Projector | All |
| 2 | Smart Board with networking | All |
| 3 | Language lab with internet | All |
| 4 | Printer | Wherever Applicable |



## 8. UNDERPINNING THEORY COMPONENTS

The following topics/sub-topics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

| Unit | Unit Outcomes (UOs) in cognitive domain | | Topics and Sub-topics |
|---|---|---|---|
| | Writing Skills | Speaking Skills | |
| Unit – I Introduction to Business Communication | 1a. Describe the importance of the business communication in the given situation<br>1b. Identify the missing element in the given communication process<br>1c. Identify the type of communication in the given situation<br>1d. Identify the type of communication barrier in the given situation and its remedy. | 1e. Use different types of verbal and non-verbal communication for the given situation | 1.1 Introduction to Communication-Elements, importance, Functions<br>1.2 Types (meaning and importance)–Verbal (Oral-Written), Formal, Informal, Vertical, Horizontal and Diagonal communication<br>1.3 Principles of effective communication<br>1.4 Barriers to communication-Physical, mechanical (ph) Industrial and linguistic<br>1.5 Business communication-Meaning, characteristics and importance |
| Unit – II Non-Verbal Communication | 2a. Describe the non-verbal communication required in the given situation<br>2b. Describe personal appearance required in the given communication situation<br>2c. Describe the given body expressions | 2d. Use relevant facial expressions in the given situation<br>2e. Answer questions after listening to presentation | 2.1 Introduction to Non-Verbal communication (Meaning and importance)<br>2.2 Body Language-Aspects of body Language, gestures and eye contact, positive facial expressions personal appearance-Dressing and grooming, occasions<br>2.3 Body Language-positive and negative body language |
| Unit – III Presentation Skills | 3a. Prepare seminar presentation for the given situation<br>3b. Prepare debate points 'for and against' the given topic<br>3c. Prepare the points for computer presentation on | 3d. Make seminar presentation<br>3e. Participate in debate speaking 'for or against' the given topic<br>3f. Make effective | 3.1 Presentation skills-tips for effective presentation.<br>3.2 Guidelines for developing power point presentation<br>3.3 Presenting Technical papers |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | | Topics and Sub-topics |
|---|---|---|---|
| | Writing skills | Speaking Skills | |
| | b) For given topic | computer presentations | |
| Unit– IV Office Drafting | 4a. Draft the given notice using the relevant format.<br>4b. Draft the given memorandum using the relevant format<br>4c. Prepare agenda for the given type of meetings<br>4d. Prepare minutes of the given type of meetings<br>4e. Prepare reports of the given type of events episodes accidents | 4f. Read the agenda of the given meeting<br>4g. Read the report of the given event<br>4h. Initiate telephone calls for given situation<br>4i. Answer official phone calls for given situation | 4.1. Office drafting, Formats and Guidelines<br>4.2. Formulating notices and memoranda<br>4.3. Preparation of agenda and writing minutes of meetings.<br>4.4. Preparation of reports- progress reports. Accident reports case study<br>4.5. Summarizing techniques |
| Unit-V Business Correspondence | 5a. Respond to given job advertisements by writing your CV/ Resume.<br>5b. Draft business letters in the given situations<br>5c. Draft complaint letters for the given situations<br>5d. Compose e- mails with reference to the given situation | | 5.1. Business correspondence<br>5.2. Enquiry, order and complaint letters<br>5.3. E-mails- netiquette<br>5.4. Difference between Curriculum Vitae/ Bio-data and Resume<br>5.5. Job application and resume writing |

*Note: To write the UOs, appropriate action verbs from the Revised Bloom's Taxonomy of Cognitive Domain are to be used. For example, Level of Bloom's Taxonomy (Remember) Action verbs that could be used for writing specific outcomes*

## 9 SUGGESTED SPECIFICATION TABLE FOR INTERNAL END SEMESTER EXAMINATION

| Unit No. | Unit Title | Distribution of practical Marks | | | |
|---|---|---|---|---|---|
| | | R Level | U Level | A Level | Total Marks |
| I | Introduction to Business Communication | 07 | 07 | 11 | 25 |
| II | Non-verbal Communication | 02 | 01 | 02 | 05 |
| III | Presentation Skills | 02 | 01 | 02 | 05 |
| IV | Office Drafting | 02 | 04 | 10 | 16 |
| V | Business Correspondence | 02 | 04 | 10 | 16 |
| | Total | 14 | 17 | 34 | 35 |





*Legends: R=Remember; U=Understand; A=Apply and above (Bloom's Revised Taxonomy)*
*Note: This specification table provides general guidelines to assist teachers for their teaching and to teachers to frame question papers. Actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED GUIDELINES FOR ASSESSMENT TOOL TO CONDUCT INTERNAL END SEMETER EXAM (ESE)

| Weightage (20 Marks) A | Weightage (15 Marks) B | Total |
|---|---|---|
| Assessment based on PrOPs, practicals conducted during semester<br>Based on computer and written skill.<br>(Minimum four questions each five marks)<br>Sample questions:<br>Eg. I Draft an email to The manager regarding the shortage of raw material at production department.<br>Note- submit the printout of mail. (Computer based)<br><br>Eg. II Write job application with resume. (written) | Oral examination based on UOs<br>Topics mentioned in syllabus.<br>(Minimum five questions each two marks to be asked)<br>Eg. I Explain the importance of communication in professional life.<br>II State any four guidelines of presentation skills. | (35 Marks)<br>A+B<br><br>Duration: 2 hours |

## STAGES OF STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in the course:

a. Collect good articles from newspapers and magazines and read them with correct intonation.
b. Listen to Business news on TV and radio.
c. Watch videos of effective presentations on television and open learning sources for presentation skills and body language
d. Undertake micro-projects

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics

- 'L' in *Item No. 4* does not mean only the traditional lecture method but different types of teaching methods and media that are to be employed to develop the outcomes.
- About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- Mode of transaction: Refer to Item No. 10, teachers need to create the most opportunities and provide time for *co-curricular activities*.
- Arrange various communication activities using Electronic Equipment.
- Show video/animation films to develop listening skills and enhance vocabulary.
- Use real life situations for explanation.
- Prepare audio-visual presentations.
- Guide micro-projects in groups as well as individually.

## 12. SUGGESTED TITLES OF MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of CrAs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement* hours during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to execute projects on his/her own so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Study the personal appearance and grooming of employees visiting sales area, shopping mall in the vicinity.
b. Comparative study of Bio-data, Resume and Curriculum vitae.
c. A detailed study of guidelines required for presentation skills.
d. Summarize technical content using English newspaper, magazines or online resources.
e. Prepare a booklet on aspects of body language in pictorial form.
f. A detailed study of the importance of technical paper and technical paper presentation.
g. Case study on the importance of Business communication in an organization.
h. Report on various formal business activities.
i. Study of oral presentations of famous business leaders.
j. Detailed study of business etiquettes observed in organizations.
k. Summarize the business article of the Editor of English newspapers/magazines and other sources.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Effective Communication Skills | M.Ashraf Rizvi | Tata McGraw-Hill |
| 2 | Communication Skills | Sanjay Kumar and Pushp Lata | Oxford University Press |
| 3 | Personality Development and Soft Skills | Barun K. Mitra | Oxford University Press |

## 14. SOFTWARE/LEARNING WEBSITES

a. http://www.bbcactivate.com/english/ace-your-presentation
b. http://learnenglish.britishcouncil.org/en/content/
c. http://www.talkenglish.com/
d. http://englishtips4u.com/
e. www.myspeechcoach.com
f. www.toastmasters.com
g. http://www.mindtools.com/
h. www.studyladder.com/guides
i. http://talkenglish.com/
j. www.speaking-tips.com





| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 4 | Communication Skills | Sanjay Kumar and Pushp Lata | Oxford University Press |
| 5 | Personality Development and Soft Skills | Barun K. Mitra | Oxford University Press |

## 14. SOFTWARE/LEARNING WEBSITES

a. http://www.bbcactivate.com/english/ace-your-presentation
b. http://learnenglish.britishcouncil.org/en/content/
c. http://www.talkenglish.com/
d. http://englishtips4u.com/
e. www.myspeechcoach.com
f. www.toastmasters.com
g. http://www.mindtools.com/
h. www.studyladder.com/guides
i. http://talkenglish.com/
j. www.speaking-tips.com

**Maharashtra State Board of Technical Education, Mumbai**

**Teaching and Examination Scheme for Post S.S.C. Diploma Courses**

**Program Name : Civil Engineering Groups**

**Program Code : CE/CR/ CS** — **With Effect From Academic Year: 2017 - 18**

**Duration of Program : 6 Semesters** — **Duration : 16 Weeks**

**Semester : Third** — **Scheme - I**

| S. N. | Course Title | Course Abbreviation | Course Code | Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Theory | | | | | | | Practical | | | | | |
| | | | | | | | | Exam Duration in Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | L | T | P | | | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | Max Marks | Min Marks | |
| 1 | Advanced Surveying | ASU | 22301 | 3 | - | 4 | 7 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 50# | 20 | 50 | 20 | 100 | 40 | 200 |
| 2 | Highway Engineering | HEN | 22302 | 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 | 150 |
| 3 | Mechanics of Structures | MOS | 22303 | 3 | 2 | 2 | 7 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 | 150 |
| 4 | Building Construction | BCO | 22304 | 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 | 150 |
| 5 | Concrete Technology | CTE | 22305 | 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25# | 10 | 25 | 10 | 50 | 20 | 150 |
| 6 | Computer Aided Drawing | CAD | 22022 | - | - | 4 | 4 | -- | -- | -- | -- | -- | -- | -- | 50@ | 20 | 50~ | 20 | 100 | 40 | 100 |
| | | | **Total** | **15** | **2** | **16** | **33** | -- | **350** | -- | **150** | -- | **500** | -- | **200** | -- | **200** | -- | **400** | -- | **900** |

Student Contact Hours Per Week: **33 Hrs.** Medium of Instruction: **English**

**Theory and practical periods of 60 minutes each.** Total Marks : **900**

Abbreviations: ESE- End Semester Exam, PA - Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination , ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

**Program Name** : **Civil Engineering Program Group**

**Program Code** : **CE/CR/CS**

**Semester** : **Third**

**Course Title** : **Advanced Surveying**

**Course Code** : **22301**

## 1. RATIONALE

In the era of globalization today, the technology has brought the significant advancements in surveying instruments and technology. Available precise digital surveying instruments are used currently due to their accuracy, speed and easy operation of the same. These equipments and the applications are extensively used in the fields of civil engineering, mining engineering, environmental engineering, transportation engineering and marine engineering. Since, Remote sensing and Geographic Information System (GIS) is a vital discipline and being widely used for plotting and storing spatial information, it is expected the students should know the basics of the same to apply it in field. Through this course students will develop the desired skills and competencies which are expected from them for survey related works.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Prepare plans, contour maps using Advanced Surveying equipment and techniques.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Prepare plans using Plane Table Surveys.
b. Prepare plans using Theodolite surveys.
c. Find distances and elevations using Tacheometer.
d. Set out simple circular curves.
e. Prepare plans using Total Station instrument.
f. Locate coordinates of stations using GPS.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | | Practical | | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | | |
| L | T | P | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | 4 | 7 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 50# | 20 | 50 | 20 | 100 | 40 | |

*(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken*

*during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.*

***Legends:*** *L-Lecture, T – Tutorial/Teacher Guided Theory Practice; P - Practical, C – Credit, ESE - End Semester Examination; PA - Progressive Assessment*

## 1. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

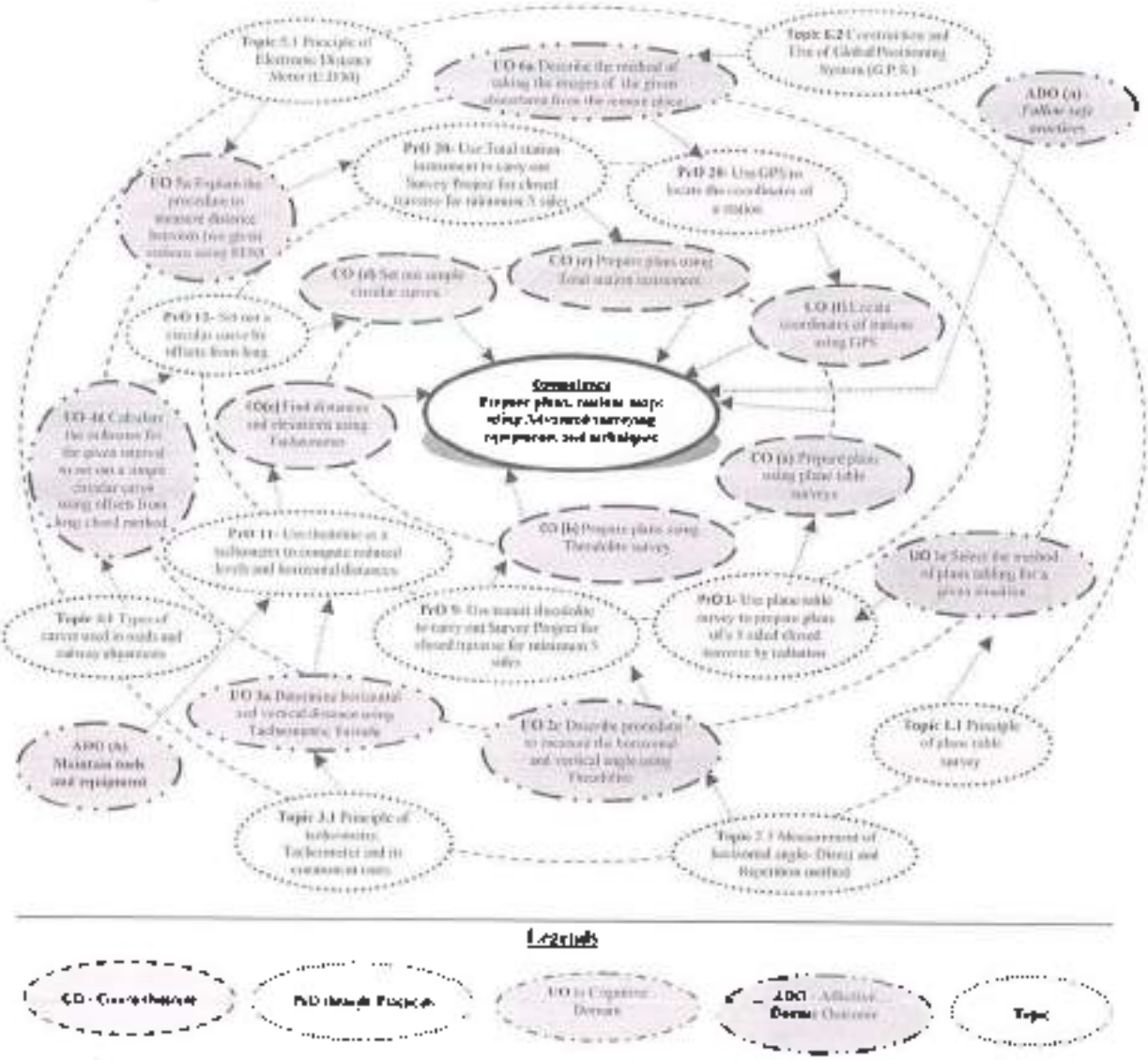


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 1 | Use Plane Table Survey to prepare plans of a 5 sided closed traverse by Radiation Method. | I | 02* |
| 2 | Use plane table survey to prepare plans of a plot of 7 sided closed traverse by Radiation Method. | I | 02 |
| 3 | Use plane table survey to prepare plans locate details by Intersection Method | I | 02* |
| 4 | Use plane table survey to prepare plans locate details by Traversing Method | I | 02* |
| 5 | Use plane table survey to carry out Survey Project for closed traverse for minimum 5 sides around a building.(Compulsory) | I | Full day* |
| 6 | Set up the transit Theodolite | II | 02 |
| 7 | Use transit theodolite to measure Horizontal angle correctly by Direct Method. | II | 02* |
| 8 | Use transit theodolite to measure Vertical angle correctly by Direct Method. | II | 02* |
| 9 | Use transit theodolite to measure Horizontal angle correctly by method of Repetition. | II | 02* |
| 10 | Use transit theodolite to measure Vertical angle correctly by method of Repetition | II | 02 |
| 11 | Use transit theodolite to carry out Survey Project for closed traverse for minimum 5 sides(Compulsory). | II | Full day* |
| 12 | Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Theodolite Survey Project. | II | 02* |
| 13 | Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Theodolite Survey Project. | II | 02* |
| 14 | Use thedolite as a Tacheometer to compute reduced levels and horizontal distances. | III | 02* |
| 15 | Set out a circular curve by offsets from Long Chord Method. | IV | 02* |
| 16 | Set out a circular curve by Rankine's Method of Deflection Angles. | IV | 02 |
| 17 | Use One Second Micro Optic Theodolite to Measure Horizontal angle by Direct Method | V | 02 |
| 18 | Use One Second Micro Digital Theodolite to Measure Horizontal angle by Direct Method | V | 02 |
| 19 | Use EDM to measure horizontal distance.(Part I) | V | 02* |
| 20 | Use EDM to measure horizontal distance(Part II) | V | 02 |
| 21 | Set up the Total Station instrument. (Part I) | V | 02* |
| 22 | Set up the Total Station instrument. (Part II) | V | 02 |
| 23 | Use Total station instrument to measure horizontal distances. | V | 02* |
| 24 | Use Total station instrument to measure horizontal distances. | V | 02 |
| 25 | Use Total station instrument to measure horizontal distances. | V | 02 |
| 26 | Use Total station instrument to measure horizontal distances. | V | 02 |
| 27 | Use Total station instrument to measure horizontal angle. | V | 02* |
| 28 | Use Total station instrument to measure horizontal angle. | V | 02 |
| 29 | Use Total station instrument to measure horizontal angle. | V | 02 |
| 30 | Use Total station instrument to measure vertical angle. | V | 02* |

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| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 31 | Use Total station instrument to measure vertical angle. | V | 02 |
| 32 | Use Total station instrument to carry out Survey Project for closed traverse for minimum 5 sides.**(Compulsory)** | V | Full day* |
| 33 | Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Total Station Survey Project. | V | 02* |
| 34 | Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Total Station Survey Project. | | 02* |
| 35 | Use GPS to locate the coordinates of a station. | VI | 02* |
| | **Total** | | **64** |

***Note***

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| 1 | Preparation of experimental set up | 10 |
| 2 | Setting and operation | 20 |
| 3 | Safety measures | 10 |
| 4 | Observations and Recording | 20 |
| 5 | Interpretation of result and plotting. | 20 |
| 6 | Answer to sample questions | 10 |
| 7 | Submission of report in time | 10 |
| | **Total** | **100** |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences.

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below.

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | PrO. S. No. |
|---|---|---|
| 1 | Plane table with accessories- Plane and telescopic Alidade,Trough compass, U-fork ,Spirit level. | 1-5 |
| 2 | Twenty Second Transit theodolite with accessories. | 6-11 |
| 3 | One second Micro optic Theodolite with accessories. | 14,16,17 |
| 4 | Electronic Digital Theodolite with accessories. | 18 |
| 5 | Electronic Distance meter (+or- 2mm accuracy) with accessories. | 19,20 |
| 6 | Total Station (+ or - 2mm accuracy) instrument with accessories | 21-32 |
| 7 | GPS instrument | 35 |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit – I Plane Table Surveying** | 1a. Explain the functions and use of the given accessories of plane table.<br>1b. Describe the method of orienting the plane table in a given situation.<br>1c. Select the method of plane tabling for a given situation.<br>1d Compare the given two methods of doing plane table survey. | 1.1 Principle of plane table survey.<br>1.2 Accessories of plane table and their use, Telescopic alidade.<br>1.3 Setting of plane table; Orientation of plane table - Back sighting and Magnetic meridian method, True Meridian Method<br>1.4 Methods of plane table surveys- Radiation, Intersection and Traversing.<br>1.5 Merits and demerits of plane table survey. |
| **Unit– II Theodolite Surveying** | 2a. Explain the given components of a transit Theodolite<br>2b Describe the salient features and the relationship between the given fundamental axes.<br>2c. Describe the procedure to measure the horizontal and vertical angles using Theodolite for the given situation.<br>2d Apply checks for determining the type of traverse using the given data.<br>2e. Compute Latitude, Departure, Consecutive co ordinates. Independent coordinates from the | 2.1 Types and uses of Theodolite; Component parts of transit Theodolite and their functions, Reading the Vernier of transit Theodolite,<br>2.2 Technical terms- Swinging, Transiting, Face left, Face right,<br>2.3 Fundamental axes of transit Theodolite and their relationship<br>2.4 Temporary adjustment of transit Theodolite,<br>2.5 Measurement of horizontal angle- Direct and Repetition method, Errors eliminated by method of repetition, |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | data given.<br>2f. Select relevant method of Theodolite traversing for given condition.<br>2g. Apply Bowditch's rule and Transit rule to balance the traverse for a given data.<br>2h. Tabulate Gale's Traverse table for the given data. | 2.6 Measurement of magnetic bearing of a line, Prolonging and ranging a line, deflection angle.<br>2.7 Measurement of vertical Angle.<br>2.8 Theodolite traversing by included angle method and deflection angle method.<br>2.9 Checks for open and closed traverse, Calculations of bearing from angles.<br>2.10 Traverse computation-Latitude, Departure, Consecutive co ordinates, Independent coordinates, Balancing the traverse by Bowditch's rule and Transit rule, Gale's Traverse table computation. |
| **Unit- III Tacheometric surveying** | 3a. Explain the functions of the given component(s) of a Tacheometer.<br>3b. Determine horizontal and vertical distances using Tacheometric formula in the given situation.<br>3c. Calculate constants of tacheometer from the given data.<br>3d. Determine RLs of stations and the distance between the stations using tachometric survey for the given data. | 3.1 Principle of tacheometry, Tacheometer and its component parts, Anallatic lens.<br>3.2 Tacheometric formula for horizontal distance with telescope horizontal and staff vertical<br>3.3 Field method for determining constants of tacheometer,<br>3.4 Determining horizontal and vertical distances with tacheometer by fixed hair method and staff held vertical,<br>3.5 Limitations of tacheometry. |
| **Unit– IV Curve setting** | 4a. Propose the curves used in alignment of roads for given condition with justification.<br>4b. Propose the types of curves used in alignment of railways for given condition with justification.<br>4c. Label the figure of given simple circular curve.<br>4d. Calculate the ordinates for the given interval to set out a simple circular curve using offsets from long chord method.<br>4e. Tabulate the given data required for setting out a circular curve using Rankine's method of deflection angle. | **4.1** Types of curves used in roads and railway alignments.<br>4.2 Notations of simple circular curve Designation of the curve.<br>4.3 Setting simple circular curve by offsets from long chord and Rankine's method of deflection angles. |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit –V Advanced surveying equipments** | 5a. Explain the procedure to measure the distance between two given stations using EDM.<br>5b. Describe procedure to measure the horizontal angle using givenTheodolite.<br>5c. Describe the procedure to measure the vertical angle using the given Theodolite.<br>5d. Explain the procedure to measure Horizontal and vertical angles between the given lines using Total Station instrument.<br>5e. Describe the procedure to measure distances and coordinates of the given points to prepare plans using Total Station instrument. | 5.1 Principle of Electronic Distance Meter (EDM), its component parts and their Functions, use of EDM.<br>5.2 Construction and use of One Second Micro Optic Theodolite, Electronic Digital Theodolite. Features of Electronic Theodolite.<br>5.3 Construction and Use of Total Station, Temporary adjustments.<br>5.4 Use of function keys.<br>5.5 Measurements of Horizontal angles, vertical angles, distances and coordinates using Total Station. Traversing, Profile Survey and Contouring with Total Station. |
| **Unit-VI Remote sensing, GPS and GIS** | 6a. Describe the method of taking the images of the given object/area from the remote place.<br>6b Propose the relevant system of remote sensing to be used for given situation.<br>6c. Describe the procedure to find the coordinates of the given station using GPS.<br>6d Explain the utility of GIS applications in given civil engineering problem. | 6.1 Remote Sensing – Over view, Electro-Magnetic Energy, Remote sensing system-, Active and Passive system, Applications of remote sensing in Mining, land use / Land cover, mapping, disaster management and Environment.<br>6.2 Construction and use of Global Positioning System (G.P.S.)<br>6.3 Geographic Information System(GIS): Over view, Components, Applications, Soft wares for GIS, Sources of errors in GIS. |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Plane Table Surveying | 04 | 02 | 02 | 04 | 08 |
| II | Theodolite Surveying | 16 | 04 | 06 | 14 | 24 |
| III | Tacheometric surveying | 06 | 02 | 02 | 04 | 08 |
| IV | Curve setting | 06 | 02 | 02 | 04 | 08 |
| V | Advanced surveying equipments | 10 | 02 | 06 | 06 | 14 |
| VI | Remote sensing and GIS | 06 | 02 | 02 | 04 | 08 |
| **Total** | | | 14 | 20 | 36 | 70 |

*Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Measure area of small open ground by plane tabling.
b. Prepare a flex chart to explain one method of plane tabling.
c. Measure the height of the flag post using Theodolite.
d. Set the alignment of proposed road using Theodolite.
e. Measure the height of the flag post using Theodolite as tacheometer.
f. Plot the contours using Total station by direct method.
g. Mark building layout using Total station.
h. Measure distance between two distant(>500m) points using EDM
i Locate the coordinates of the campus using GPS
j. Search and download the demo versions of various software and prepare a report stating the applications.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes
c. About ***15-20% of the topics/sub-topics***, which is relatively simpler or descriptive in nature, is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects .
f. Arrange visit to nearby newly started site for understanding various surveying techniques.
g. Show video/animation films to explain various instruments like EDM, Total Station, GPS
h. Prepare maintenance charts for various instruments in survey laboratory.

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in each student to become problem solver so

that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Collect the relevant technical and commercial information of advanced survey instruments available in the market with specifications.
b. Carry out comparative study of following survey instruments of different make and brands: Total station/ EDM/GPS/Micro optic theodolite.
c Set the profiles of curves at the changes in alignment of road in the premises of the institute.
d Determine the RLs of the existing structures like lintels, chajja, slab, and beam using Tacheometer and Total station in a multi-storeyed building and compare the results.
e. Download specifications for Total station/ EDM/GPS/Micro optic theodolite and make a chart.
f. Coordinate System –UTM (Universal Transverse Mercator Coordinate system
g. Mobile devices used for distance measurement
h. 360 degree lazer
i. Information about Drone survey

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Surveying and Levelling Part I and II | Kanetkar, T. P. and Kulkarni, S. V. | Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007 |
| 2 | Surveying and Levelling | Basak, N. N. | McGraw Hill Education (India) Pvt. Ltd ,Noida ISBN: 93-3290-153-8 |
| 3 | Survey I and Survey II | Duggal, S. K. | Tata McGraw Hill Education Pvt. Ltd., Noida, ISBN:13: 978-1259029837 |
| 4 | Surveying | Saikia, M D; Das B.M and Das, M.M. | PHI Learning Pvt. Ltd., New Delhi ISBN: 978-81-203-3985-9 |
| 5 | Surveying and Levelling | Subramanian, R. | Oxford University Press New Delhi ISBN 13:978-0-19-808542-3 |
| 6 | Surveying Vol. I and Surveying Vol. II | Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar | Laxmi Publications Pvt. Ltd., New Delhi. ISBN. 13: 9788170088837 |
| 7 | Textbook of Surveying | Rao, P. Venugopala and Akella, Vijayalakshmi | PHI Learning Pvt. Ltd., New Delhi ISBN: 978-81-203-4091-9 |
| 8 | Textbook of Surveying | Venkatramaiah, C | Universities Press, Hyderabad ISBN: 978-81-737-1021-6 |
| 9 | Surveying theory and | Anderson, James M | Mc Graw Hill Education, Noida |

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| | practice | and Mikhail, Edward M. | ISBN:13-978-1-25-902564-8 |
| 10 | Plane Surveying | De, Alak | S.Chand Publications, New Delhi ISBN:9788121917803 |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/courses/105107121/
b. https://www.youtube.com/watch?v=QtEkZPEeeZk
c. https://www.youtube.com/watch?v=KQgq5xqSTUw
d. https://www.youtube.com/watch?v=zcRs3KTQzN0
e. https://www.youtube.com/watch?v=6d4mERJFPpI
f. https://www.youtube.com/watch?v=Dj06aUJ9Wjc
g. https://www.youtube.com/watch?v=O68LLRfo0tA
h. https://www.youtube.com/watch?v=n_EMrTbDZak
i. https://www.youtube.com/watch?v=H2AQq2jslqg
j. https://www.youtube.com/watch?v=C8UKJtZIAWE
k. https://www.youtube.com/watch?v=J6j_sJyyudI
l. http://www.asnu.com.au
m. www.oupinheonline.com

**Program Name** : **Civil Engineering Program Group**

**Program Code** : **CE/CR/CS**

**Semester** : **Third**

**Course Title** : **Highway Engineering**

**Course Code** : **22302**

## 1. RATIONALE

Road Transportation is the most effective and economical means of transportation in our country. The need for travel to various places at faster speed has also increased. In order to professionally contribute to the field of highway engineering, the associated engineers and supervisors must have adequate knowledge and skills relating to technical aspects of continuously increasing volume of traffic flow, design of highway intersections/interchanges, geometric alignment and design, materials, structural design of pavement, new developments in road construction and use of modern and waste materials, techniques, design and maintenance of pavements. Agencies like NHAI and State Government and private organisation are intensely involved in improving and building road networks in India. Diploma Engineering students have good scope in jobs related to road construction as well as such infrastructural associated different projects works. This course provides scope of learning about various aspects of roads, carrying out survey, investigation, planning, design, construction and maintenance works related to road constructions.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Undertake construction and maintenance of pavements (Roads).**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Identify the types of roads as per IRC recommendations.
b. Implement the geometrical design features of different highways.
c. Perform different tests on road materials.
d. Evaluate traffic flow characteristics.
e. Implement hill road construction using relevant materials, techniques and methods.
f. Undertake maintenance of roads and drainage.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| L | T | P | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 |

*(*): Under the theory PA. Out of 50 marks 10 marks are for micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.*

***Legends:*** *L-Lecture, T – Tutorial/Teacher Guided Theory Practice; P - Practical, C – Credit, ESE - End Semester Examination, PA - Progressive Assessment*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

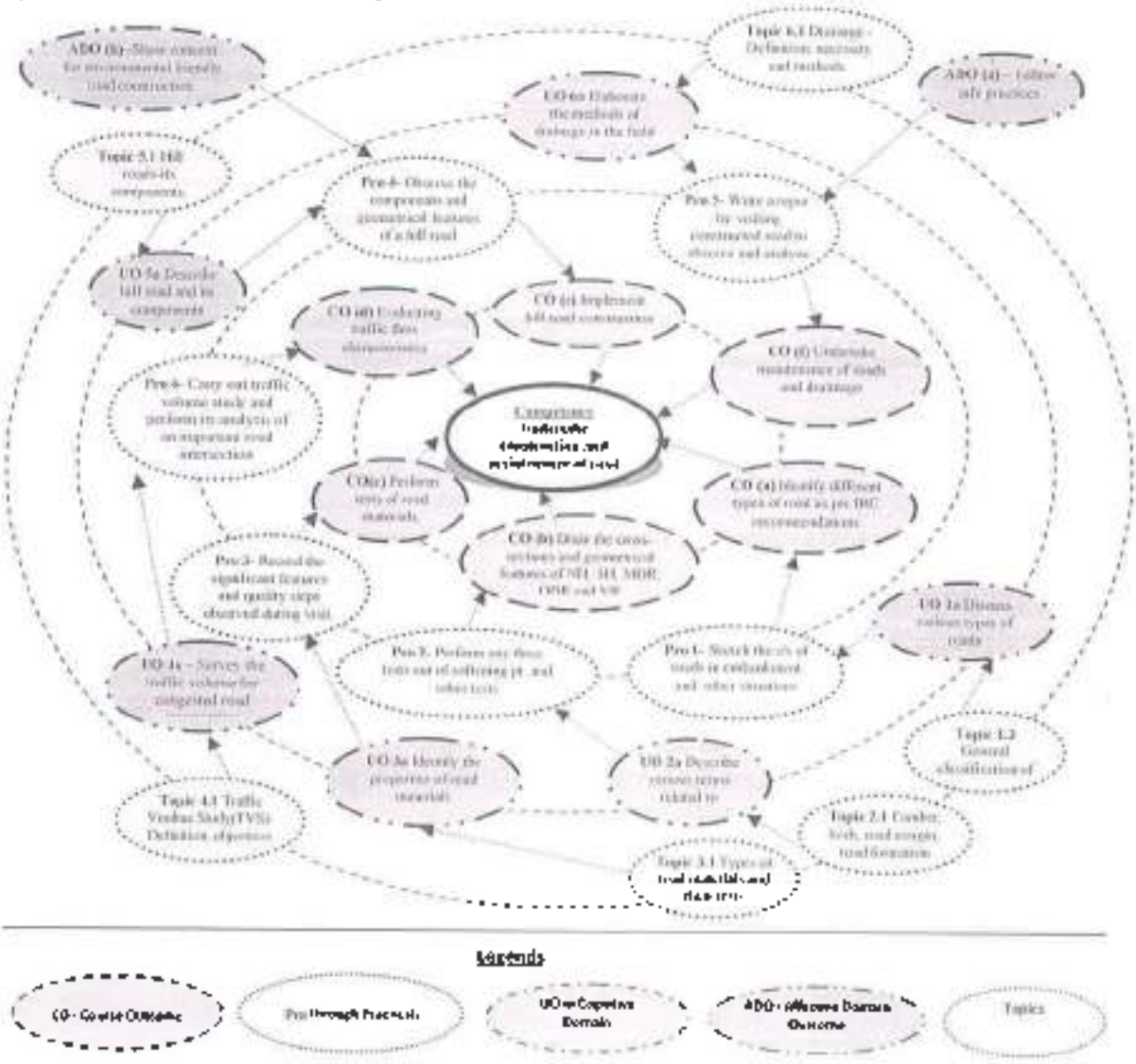


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS / EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 1 | Draw the sketches showing standard cross sections of NH/SH, MDR/ODR in embankment and cutting on A3 size sheets. | II | 02* |
| 2 | Conduct Flakiness Index Test on the aggregates. | II | 02* |
| 3 | Conduct Elongation Index Test on the aggregates. | II | 02* |
| 4 | Conduct Angularity Number Test on the aggregates. | II | 02 |
| 5 | Conduct Softening point test on bitumen. | III | 02* |
| 6 | Conduct Penetration test on bitumen. | III | 02* |
| 7 | Conduct Flash and Fire Point test on bitumen. | III | 02 |
| 8 | Conduct Ductility test on Bitumen. | III | 02 |
| 9 | Visit the constructed road to suggest the possible remedial measures against the observed defects | III | 02* |
| 10 | Prepare the photographic report containing details for experiment no. 9 | III | 02* |
| 11 | Carry out Traffic Volume Study (minimum two hours of peak period) for an important road intersection or roadway in your city/ town/ village. | IV | 02* |
| 12 | Perform analysis of traffic volume data of experiment no. 11. | IV | 02* |
| 13 | Draw the sketch of collision diagram for any one case. | IV | 02* |
| 14 | Visit the hill road constructed site to understand its components and prepare the photographic report containing details. | V | 02 |
| 15 | Prepare the photographic report containing details for experiment no. 14. | V | 02 |
| 16 | Visit the road of any one type (flexible or rigid) to know the drainage condition. | VI | 02 |
| 17 | Prepare the photographic report suggesting possible repairs and maintenance for experiment no. 16. | VI | 02 |
| | **Total** | | **34** |

*Note*

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical UOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

*ii. Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below.*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| 1 | Preparation of experimental set up | 20 |
| 2 | Setting and operation | 20 |
| 3 | Safety measures | 10 |
| 4 | Observations and Recording | 10 |
| 5 | Interpretation of result and Conclusion | 20 |
| 6 | Answer to sample questions | 10 |
| 7 | Submission of report in time | 10 |
| | **Total** | **100** |

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

The above PrOs also comprise of the followong social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | Pro. No. |
|---|---|---|
| 1 | Thickness gauge containing openings for aggregate sizes 63, 50, 40,31.5, 25,20,16,12.5,10 & 6.3mm as per IS:2386(Part I)-1963 | 2 |
| 2 | Length gauge containing openings for aggregate sizes 63, 50, 40,31.5, 25,20,16,12.5,10 & 6.3mm as per IS:2386(Part I)-1963 | 3 |
| 3 | Ring and Ball test apparatus (Hot plate 160mm dia, with magnetic stirrer, brass ring, steel ball and glass vessel 600ml and glass thermometer $+80^0$c. | 5 |
| 4 | Standard Penetrometer with penetration needle 100gm weight, container 55mm dia. and 53mm ht. as per IS:1203. | 6 |
| 5 | Pensky Marten's Flash and Fire Point test apparatus 100x200x240mm with measurement range 0-95 as per IS.1209-1953 | 7 |
| 6 | Ductility Testing Machine with ductility mould and base plate | 8 |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit—I Overview to Highway Engineering** | 1a. Describe key features of the given type of road.<br>1b. Explain significant aspects of the given road development plans as per IRC.<br>1c. Explain ideal road alignment | 1.1 Scope and Importance of roads in India and its' Characteristics.<br>1.2 Different modes of transportation.<br>1.3 General classification of roads.<br>1.4 Road classifications in India (Nagpur plan), Third road development |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | and its requirements.<br>1d. Prepare the list of factors affecting given type of road alignment.<br>1e. Suggest the ideal requirements of road alignment for the given road condition. | (Lucknow ) plan.<br>1.5 Development of Urban roads.<br>1.6 Requirements of an ideal road alignment and the factors affecting road alignment. |
| **Unit—II Geometric Design of Highway** | 2a. Explain various functional terms related to geometrics of of the given type of highway with sketches.<br>2b. Describe the given type of road curves and their necessity.<br>2c. Calculate SSD, Super-elevation, and widening of roads required for the given road construction problem.<br>2d. Sketch the cross sections of roads in embankment and cutting for the given site condition. | 2.1 Various terms used in Highway: Camber: Definition, purpose, types as per IRC – recommendations.<br>2.2 Kerbs: Road margin, road formation, right of way.<br>2.3 Design speed and various factors affecting design speed as per IRC – recommendations.<br>2.4 Gradient: Defintion, types as per IRC – Recommendations.<br>2.5 Sight distance (SSD): Definition, types IRC – recommendations, simple numerical.<br>2.6 Curves: Necessity, types: Horizontal, vertical curves.<br>2.7 Widening of roads: types and problems<br>2.8 Super elevation: Definition, formula for calculating minimum and maximum Super elevation and method of providing super-elevation<br>2.9 Standards cross-sections of national highway in embankment and cutting. |
| **Unit—III Construction of Road Pavements** | 3a. Describe the properties of given type of road materials<br>3b. Explain function/s of components of given type pavements with sketches/s.<br>3c. Describe with sketches the construction method for the given type of road pavement.<br>3d. Explain procedure for testing the given parameter of road construction.<br>3e. Describe with sketches the road construction method for the given situation. | 3.1 Types of road materials and their Tests – Test on aggregates-Flakiness and Elongation Index test, Angularity Number test, test on Bitumen-penetration, Ductility, Flash and Fire point test and Softening point test.<br>3.2 Pavement Definition, Types, Structural Components of pavement and their functions<br>3.3 Construction of WBM road, Merits and demerits of WBM road.<br>3.4 Construction of Flexible pavement / Bituminous Road, Types of Bitumen and its properties, Emulsion, Cutback, Tar, Terms used in BR-prime coat, tack coat, seal coat, Merits and Demerits of |

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | | BR.<br>3.5 Construction of cement concrete-methods of construction-Alternate and Continuous Bay Method, Construction joints, filler and sealers, merits and demerits of concrete roads. |
| **Unit—IV Traffic Engineering.** | 4a. Prepare survey plan for the traffic volume for congested road intersection.<br>4b. Interpret the observations recorded in traffic volume study to suggest the suitable solutions for traffic problems.<br>4c. Explain the given collision diagram to express various causes of accidents.<br>4d. Explain with sketches the working of various traffic control devices with their functions.<br>4e. Suggest suitability of traffic control device for the given situation with justification. | 4.1 Traffic Volume Study(TVS)-Definition of Traffic Volume and Traffic Density. Objectives of TVS<br>4.2 Passenger Car Unit (PCU) and factors affecting it.<br>4.3 Traffic control devices – road signs. marking, Signals, Traffic island, Signals-Types,<br>4.4 Road signs-Types-Regulatory. Prohibitory and Informatory, Sketches of road signs. Types of road markings.<br>4.5 Traffic island-Types-Divisional, Channelizing. Pedestrian. Rotary.<br>4.6 Road intersections- Grade and grade separated intersections<br>4.7 Accident studies with causes. Collision Diagram. |
| **Unit—V Hill Roads** | 5a. Describe with sketches the given components of the hill road<br>5b. Suggest the dramage protective works on hill roads for the given situation with justification.<br>5c. Explain with sketches the causes of landslides in the given type of hill road.<br>5d. Suggest preventive measures to check landslide for the given condition with justification. | 5.1 Hill roads, its components. functions<br>5.2 Types of hill road curves.<br>5.3 Drainage of hill roads: Side drains, catch water drains, cross drains,<br>5.4 Construction procedure of hill roads.<br>5.5 Landslides- Types and Causes<br>5.6 Prevention of landslides. |
| **Unit—VI Drainage, Maintenance and Road Repair.** | 6a. Describe with sketches the relevant method of providing drainage in the given type of field.<br>6b. Interpret the information of the causes of failure of given type of pavement.<br>6c. Suggest suitable preventi | 6.1 Drainage-Definition. necessity and methods .<br>6.2 Surface drainage: side gutter. catch<br>6.3 Water dram. Subsurface drainage-Longitudinal and Cross drains.<br>6.4 Classification and necessity highway of maintenance. Causes of failure of flexible pavement-WBM road. |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | measures to avoid failures in the given type of pavement with justification.<br>6d. Suggest the maintenance and repair works of given type of defective road | Bituminous road.<br>6.5 Causes of failure of rigid pavement-Cement concrete road<br>6.6 Need for highway maintenance. Classification of maintenance.<br>6.7 Special repair of flexible and Rigid pavements. |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Introduction to Highway Engineering | 04 | 02 | 02 | -- | 04 |
| II | Geometric Design of Highway. | 14 | 04 | 06 | 06 | 16 |
| III | Construction of Road Pavements | 10 | 04 | 06 | 06 | 16 |
| IV | Traffic Engineering | 08 | 04 | 04 | 06 | 14 |
| V | Hill Roads | 06 | 02 | 04 | 04 | 10 |
| VI | Drainage, Maintenance and Road Repair. | 06 | 02 | 04 | 04 | 10 |
| **Total** | | **48** | **18** | **26** | **26** | **70** |

***Legends:*** *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
*Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Undertake micro-projects related to road construction.
b. Observe the components of roadway and record the details of the same with necessary sketches.
c. Collect the information of NH and SH constructed and under construction across the country.
d. Visit the crowded area i.e. city/town/village and note down the traffic control devices to suggest the possible action for smooth traffic flow
e. Collect the typical samples of drawings and legal documents required for road project form PWD office.
f. Search the software/freeware on the course content and prepare the detailed report stating their applications

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
e Guide student(s) in undertaking micro-projects.
f. Demonstrate various concepts using videos of construction work of flexible and rigid pavement.
g. Encourage students to refer different websites to have deeper understanding of new concepts of road works.
h. Recommend the students to collect statistical and physiological data of present road conditions across the country.

## 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three*.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Collect all the details of all types of existing NH, SH across the country.
b. Evaluate the camber and gradient of any one road of each type of pavement in the vicinity of area of college
c. Develop the photographic model of typical pavement structure for actual visited site
d. Advance Techniques of repairs like CBTR , White topping, Preventive maintenance, overlays, MSA ( Million Standard Axle Load), utility system, encroachment , forest land under roads
e. Any other micro-projects suggested by subject faculty on similar line.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Highway Engineering | Khanna S.K. , Justo, C E G and Veeraragavan, A. | Nem Chand and Brothers, Roorkee, 2010, ISBN 978-8185240800 |
| 2 | Road, Railways, Bridge and Tunnel Engg | Birdi, Ahuja, | Standard Book House, New Delhi, March 2010, ISBN: 978-8189401337 |
| 3 | Traffic Engineering and Transport Planning | Kadiyali, L.R. | Khanna Publishers, New Delhi, 2008, ISBN: 978-8174092205 |
| 4 | Principles, Practice and Design of Highway Engineering, | Sharma, S.K. | S. Chand Publication, New Delhi, 2012, ISBN:9788121901314 |
| 5 | Laboratory Manual in Highway Engineering | Duggal, Ajay K. and Puri, V. P. | New Age International (P) Limited, Publishers, New Delhi, 2010, ISBN: 9788122403107 |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=1fc4NVP9wXk
b. https://www.youtube.com/watch?v=m8U76Bm8kDY
c. https://www.youtube.com/watch?v=IORJZ1shRIM
d. https://www.youtube.com/watch?v=Xf89KDiblFE

**Program Name** : **Civil Engineering Program Group**

**Program Code** : **CE/CR/CS**

**Semester** : **Third**

**Course Title** : **Mechanics of Structures**

**Course Code** : **22303**

## 1. RATIONALE

Design and analysis of structure and its components, needs the basic understanding and application of mechanical properties of material and their behavior under different loading and stress conditions. Concepts and principles of structural analysis shall be well understood by students, which is important for design of reinforced cement concrete and steel structures and the same has been covered in this course. Analysis of determinate structure under action of transverse loading along with analysis of members under direct loading will also be studied in this course. The approach of teaching the course shall focus on development of students' analytical and critical thinking while solving structural problems. The experiments expected to be conducted in laboratory will integrate knowledge and required skills as regards to the structural behavior of components and materials.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Analyze structural components using different methods.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Articulate practical applications of moment of inertia of symmetrical and unsymmetrical structural sections.
b. Interpret structural behaviour of materials under various loading conditions
c. Select material considering engineering properties for various structural applications.
d. Interpret shear force and bending moment diagrams for various types of beams and loading conditions.
e. Determine the bending and shear stresses in beams under different loading conditions.
f. Check the column safety for various loading and end conditions.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| L | T | P | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | 2 | 2 | 7 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 |

*(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 Marks the average of 2 tests to be taken*

*during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.*

***Legends:*** *L-Lecture; T Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination, PA - Progressive Assessment*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

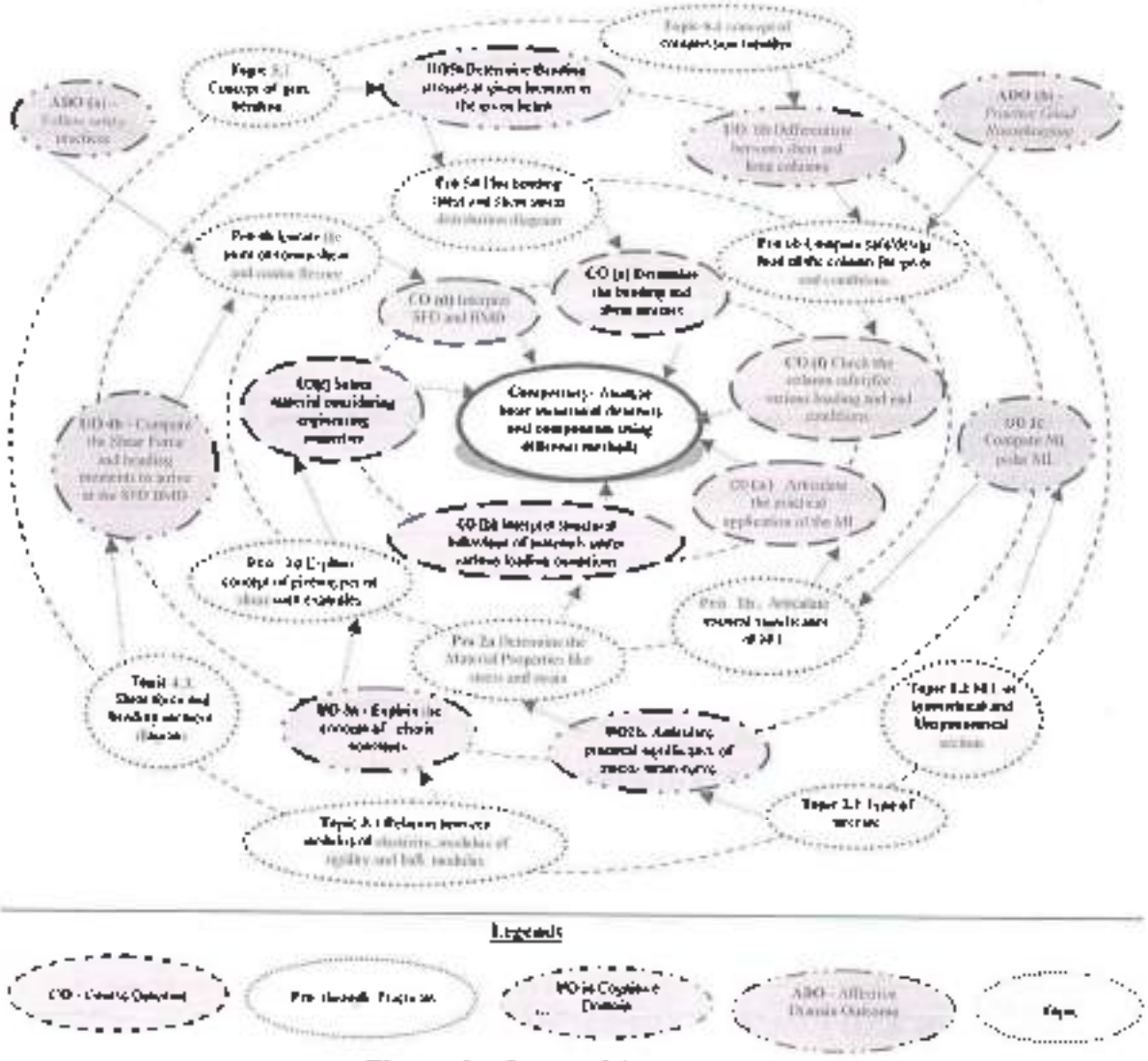


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 1. | Conduct compressive and tensile tests on sample test pieces using Universal Testing Machine along with introduction to other tests to be conducted on UTM. | II | 02 |
| 2. | Conduct compression test on sample test piece using Compression Testing Machine | II | 02 |
| 3. | Perform Tension test on mild steel as per IS:432(1) | II | 02* |
| 4. | Perform tension test on Tor steel as per IS:1608,IS:1139 | II | 02 |
| 5. | Conduct Izod Impact test on three metals. E.g. mild steel/ brass/aluminum/ copper /cast iron etc as per IS:1598 | II | 02 |
| 6. | Conduct Charpy Impact test on three metals. E.g. mild steel/ brass/aluminum/ copper /cast iron etc as per IS:1757 | II | 02* |
| 7. | Determine Water Absorption on bricks per IS:3495 (part II), IS:1077 or tile IS:1237 | II | 02* |
| 8. | Determine Compressive strength of dry and wet bricks as per IS:3495(part I), IS:1077 | II | 04* |
| 9. | Conduct Abrasion Test on flooring tiles (any one) e.g. Mosaic tiles, Ceramic Tiles as per IS: 13630(part7), Cement Tile as per IS: 1237 | II | 02 |
| 10. | Perform Single Shear and double shear test on any two metals e.g. Mild steel/ brass/aluminum/copper / cast iron etc as per IS:5242 | III | 02* |
| 11. | Conduct Compression test on timber section along the grain and across the grain as per IS:2408 | II,VI | 02 |
| 12. | Plot Shear force and Bending Moment diagrams of cantilever, simply supported and overhanging beams for different types of loads two problems on each type of beam | IV | 06 |
| 13. | Conduct Flexural test on timber beam on rectangular section in both orientation as per IS:1708, IS:2408 | I,V | 02* |
| 14. | Conduct Flexure test on floor tiles IS:1237,IS:13630 or roofing tiles as per IS:654,IS:2690 | V | 02 |
| 15. | Field test on TMT bars. | II | 02 |
| | **Total** | | **34** |

*Note*

*i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

*ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

| S.No | Performance Indicators | Weightage in % |
|---|---|---|
| a. | Preparation of experimental set up | 20 |
| b. | Setting and operation | 20 |

| S.No | Performance Indicators | Weightage in % |
|---|---|---|
| c. | Safety measures | 10 |
| d. | Observations and recording | 10 |
| e. | Interpretation of results and conclusion | 20 |
| f. | Answer to sample question | 10 |
| g. | Submission of report in time | 10 |
| | | 100 |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S.No. | Equipment Name with Broad Specifications | PrO. S.No |
|---|---|---|
| 1 | Universal Testing machine of capacity 1000kN, 600 kN/400kN, analog type/digital type with all attachments and accessories. | 1,3,4, 10,13 |
| 2 | Extensometer with least count 0.01mm, maximum extension 25 mm with dial gauge/ digital display suitable for various gauge length. | 3,4 |
| 3 | Compression testing machine of capacity 2000kN/1000kN, analog /digital type with all attachments and accessories. | 2,8,11 |
| 4 | Tile abrasion testing machine confirming to IS:1237 and IS :1706 for determining resistance to wear and abrasion of flooring tiles complete with dial gauges , revolution counter, thickness measurement holder and abrasion powder. | 9 |
| 5 | Izod/Charpy impact testing machine confirming to IS: 1757. | 5,6 |
| 6 | Tile flexural testing machine confirming to IS:654,capacity 200Kg with uniform loading rate of 45 to 55 Kg/minute provided with lead shots | 13 |
| 7 | Hot Air Oven with thermostatic control having temp. range 100 to 105° C | 7 |
| 8 | Accessories, vernire caliper, meter scale, weighing balance, weights, punch, file, hammer, screw driver, pliers ,etc. | All |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit– I Moment of Inertia** | 1a. Compute Moment of Inertia, polar moment of inertia section modulus of given section.<br>1b. Articulate practical significance of M.I. for given section and loading condition(s).<br>1c. Compute Moment of Inertia, polar moment of inertia, section modulus of given standard section.<br>1d Compute Moment of Inertia of given unsymmetrical section. | 1.1 Moment of inertia (M.I.): definition, M.I. of plane lamina, radius of gyration, section modulus, parallel and perpendicular axes theorems (without derivation), M.I. of rectangle, square, circle, semi circle, quarter circle and triangle section(without derivation).<br>1.2 M.I. of symmetrical and unsymmetrical I-section, channel section, T-section, angle section, and hollow sections and built up section about centroidal axes and any other reference axis.<br>1.3 Polar Moment of Inertia of solid circular sections. |
| **Unit –II Simple Stresses and Strains** | 2a. Articulate practical significance of stress- strain curve for given materials under given loading conditions for their relevant use.<br>2b. Compute stresses and load shared by given Composite section subjected to direct load.<br>2c Calculate modulus of elasticity, modulus of rigidity and axial deformation under given conditions for given material.<br>2d. Compute stresses induced in given homogeneous sections under temperature variations for given conditions. | 2.1 Concept of rigid, elastic and plastic bodies, deformation of elastic body under various forces, definition of stress, strain, elasticity, Hook's law, elastic limit, modulus of elasticity, SI units.<br>2.2 Type of stresses-normal, direct, bending and shear and nature of stresses i.e. tensile and compressive stresses.<br>2.3 Standard stress strain curve for mild steel bar and tor steel bar under tension test, Yield stress, proof stress, ultimate stress, breaking stress, and working stress, strain at various critical points, percentage elongation and Factor of safety.<br>2.4 Deformation of body due to axial force, forces applied at intermediate sections, deformation of body of stepped cross section due to axial load, maximum stress and minimum stress induced.<br>2.5 Concept of composite section, conditions to have a section composite, stresses induced and load shared by materials under axial loading.<br>2.6 Concept of temperature stresses and strain, stress and strain developed due to temperature variation in homogeneous simple bar.(no composite section)<br>Introduction to strain energy and types of loadings such as gradually applied load, |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | | suddenly applied load and impact load only. |
| **Unit–III Elastic Constants** | 3a Explain the concept of elastic constants for given situation and their significance.<br>3b. Calculate change in volume of members for given stress condition.<br>3c. Explain concept of given types of shear with examples.<br>3d. Compute shear stress, shear strain and modulus of rigidity for given section. | 3.1 Longitudinal and lateral strain, Poisson's ratio, biaxial and triaxial stresses, volumetric strain, change in volume, Bulk modulus.<br>3.2 Shear stress and stram, modulus of rigidity, simple and complementary shear stress.<br>3.3 Concept of single shear, double shear and punching shear.<br>3.4 Relation between modulus of elasticity, modulus of rigidity and bulk modulus. |
| **Unit-IV Shear Force and Bending Moment** | 4a. Interpret the given types of support(s) and load(s)<br>4b. Interpret with simple sketch(s) of the given type(s) of beam, load and end conditions, relevant to the actual field situations.<br>4c. Compute the Shear Force and bending moments to arrive at the Shear force diagram, Bending Moment Diagram for given beam and load conditions.<br>4d. Locate the point of contra shear and point of contra flexure for the given SFD and BMD. | 4.1 Types of supports, beams and loads.<br>4.2 Concept and definition of shear force and bending moment , relation between load, shear force and bending moment<br>4.3 Shear force and bending moment diagram for cantilever and simply supported beams subjected to point loads, uniformly distributed loads and couple, point of contra shear and point of contra flexure.<br>4.4 Shear force and bending moment diagram for overhanging beams subjected to, point loads, uniformly distributed loads only. Point of contra shear and point of contra flexure |
| **Unit-V Bending and Shear Stresses in beams** | 5a. Identify with justification nature of bending stresses for given situation.<br>5b. Determine Bending stresses and shear stresses at given location in the given beam.<br>5c. Design the beam section for the given data.<br>5d Plot bending and shear stress distribution diagram for given beam section and given type of loading. | 5.1 Concept and theory of pure bending, assumptions, flexural, meaning of term used in equation, bending stresses and their nature, bending stuess distribution diagram.<br>5.2 Concept of moment of resistance and using flexure equation.<br>5.3 Shear stress equation, meaning of term used in equation, relation between maximum and average shear stress for rectangular and circular section, shear stress distribution diagram.<br>5.4 Shear stress distribution for square, rectangular, circle, hollow square, rectangular, circle, angle sections, channel |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | | section, I-section, T sections. |
| **Unit-VI Columns** | 6a. Differentiate between short and long columns based on given criteria.<br>6b. Compute safe/design load of the column for given different end conditions.<br>6c. Calculate the limitations of Euler's theory for the given data.<br>6d. Compute safe/design load of long column using Rankin's formula for given conditions. | 6.1 Concept of compression member, short column, long column, effective length, radius of gyration, slenderness ratio, type of end conditions for columns, buckling of axially loaded columns<br>6.2 Euler's theory, assumptions made in Euler's theory and its limitations. application of Euler's equation to calculate buckling load.<br>6.3 Rankin's formula and its application to calculate crippling load.<br>6.4 Concept of working load/safe load, design load and factor of safety |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Moment of Inertia | 08 | 02 | 04 | 04 | 10 |
| II | Simple stress and strain | 10 | 04 | 04 | 06 | 14 |
| III | Elastic constants | 06 | 02 | 02 | 04 | 08 |
| IV | Shear force and bending moment | 12 | 02 | 04 | 12 | 18 |
| V | Bending and shear stresses in beams | 08 | 02 | 06 | 06 | 14 |
| VI | Columns | 04 | 02 | 02 | 02 | 06 |
| **Total** | | **48** | **14** | **22** | **34** | **70** |

***Legends:*** *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
*Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Compare stability of different geometric shapes.
b. Correlate the actual field situations about the members subjected to different types of loading.

c. Select appropriate shape, type and material of member from day to day situations for various types of stress and strain.
d. Correlate the actual field situations with various types of beams (such as cantilever means canopy of a building, overhanging beam means slab with balcony provision). Shapes of various structural components resembling with shear force and bending moment diagrams of simple structures subjected to different types of loading. Identify the type of failure with respect to the shape.
e. Study the mode of failures due to flexure and shear from field situations and prepare a report
f. Visit site/ design office and collect the data from day to day situation about stability and strength of column for buckling load.
g. Search the software / freeware on the course content and prepare the detailed report stating their applications.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*
e. Guide student(s) in undertaking micro-projects.
f. Assign unit wise tutorials to group of 4 to 5 students for solving problems unit wise.
g. Assign micro projects to group of 4 to 5 students and let them prepare and present the project through PPT. Group shall submit a report which is limited to 5 pages.
h. Use of video animation films to explain concept, Facts and applications related to Mechanics of Structures.
i. In respect of item 10 above teacher needs to ensure to create opportunity and provisions for such co curricular activities.

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Collect the IS related to methods of testing and specifications for five materials used in actual practice
b. Select ten materials from day to day life and compare their mechanical properties and present it in a format of report.
c. Prepare prototype model of various types of support, beams and loading.
d. Prepare a report about beam sections subjected to bending and shear stresses from actual field/design office along with photographs and its justification.
e. Collect photographs along with justification about failure of short and long columns from actual field situations

## 13. SUGGESTED LEARNING RESOURCES

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Strength of Materials, Vol. I | Timoshenko, S. | CBS; 3 New Delhi; 2015, ISBN 978-8123910307 |
| 2 | Strength of Materials | Khurmi, R.S. | S Chand and Co. Ltd. New Delhi, 2015, ISBN 978-8121928229 |
| 3 | Strength of Materials | Ramamurtham, S | Dhanpat Raj and sons, New Delhi, 2015, ISBN 9788187433545 |
| 4 | Strength of Materials | Punmia B C | Laxmi Publications (p) Ltd. New Delhi, 2015, ISBN-13: 978-8131809259 |
| 5 | Strength of Materials | Rattan S.S. | McGraw Hill Education; New Delhi 2016, ISBN-13: 978-9385965517 |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=-JG9lEqRzQ4
b. https://www.youtube.com/watch?v=4VIhh6sGkrI
c. https://www.youtube.com/watch?v=EcPGKLUE04I
d https://www.youtube.com/watch?v=-ndT35aqDfAQ
e. https://www.youtube.com/watch?v=ZJn_Mj2HeNM
f. https://www.youtube.com/watch?v=KU1gHy8Adrc
g. www.slideshare.net/nell0511/columns-and-struts
h. nptel.ac.in/courses/IIT-MADRAS/Strength_of_Materials/Pdfs/4_1.pdf
i. https://www.youtube.com/watch?v=nNcf2NjJifU extofvideo nptel.iitm.ac.in/105105108/lec28.pdf
j. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/engg_mechanics/ui/Course_home_9.htm

**Program Name: Civil Engineering Program Group**

**Program Code : CE/CR/CS**

**Semester : Third**

**Course Title : Building Construction**

**Course Code : 22304**

## 1. RATIONALE

Building Construction is a core subject in Civil Engineering, which deals with the construction processes of sub structure, super structure, Building Finishes and maintenance of buildings. This course essentially imparts the knowledge of construction technology along with the processes involved in it and various construction equipments used for effective execution of various construction activities. This knowledge shall be used for effective and efficient up keeping of building after construction. This will enable the students to undertake the activities in comparatively shorter period of time.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Implement safe building construction practices.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above-mentioned competency:

a. Identify components of building structures.
b. Propose suitable type of foundation for building structures.
c. Select suitable type of masonry for building structures.
d. Propose relevant means of communications for different types of buildings.
e. Select the relevant material for finishing works.
f. Execute safe practices in building construction activities.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| L | T | P | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 |

*(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.*

*Legends: L-Lecture, T – Tutorial/Teacher Guided Theory Practice, P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

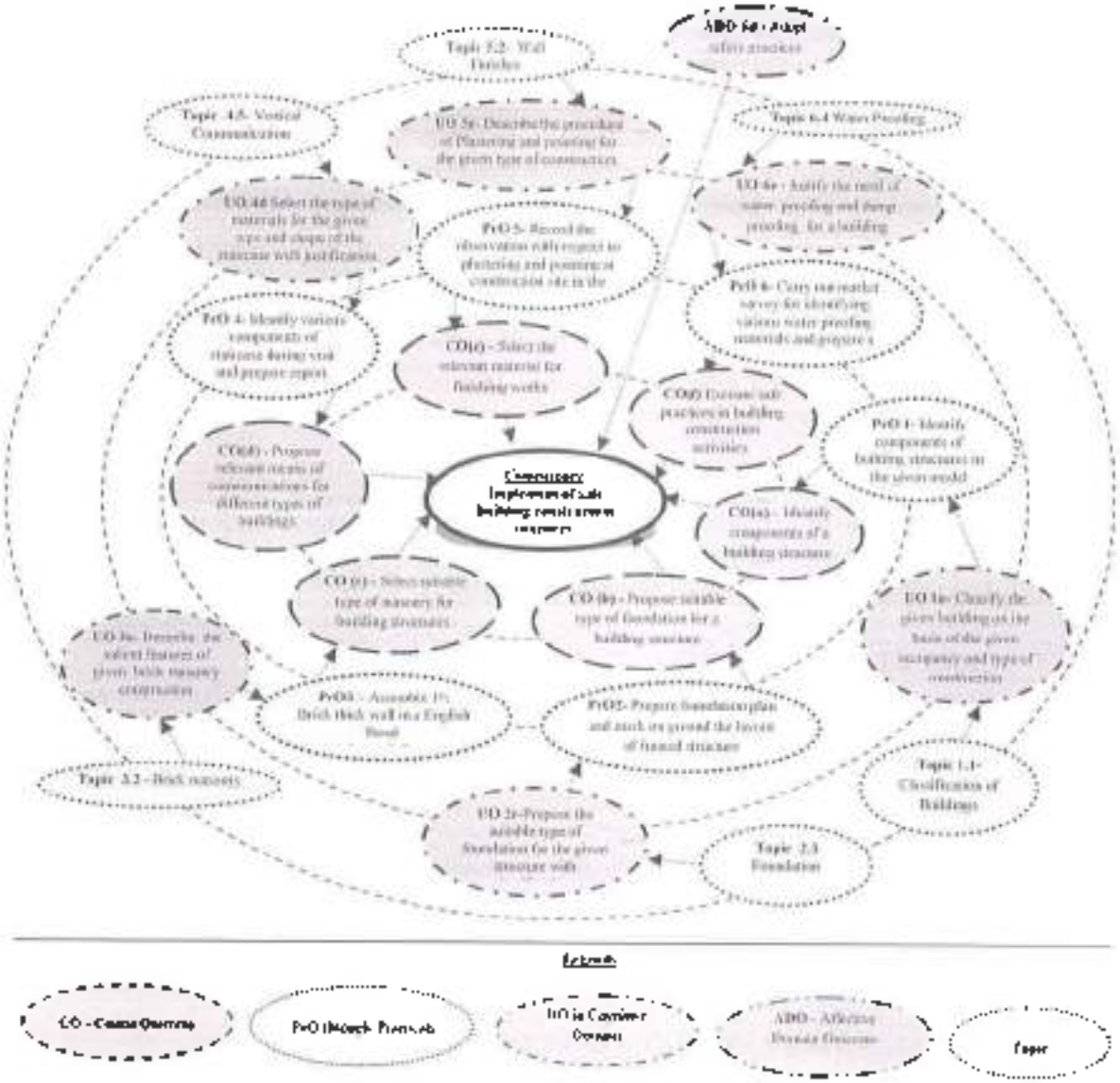


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS / EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 1 | Identify components of building structures in the given model. | I | 02* |
| 2 | Prepare foundation plan to mark layout on the ground of the load bearing structure from the given building plan.(Part I) | II | 02* |
| 3 | Prepare foundation plan to mark layout on the ground of the load bearing structure from the given building plan.( Part II) | II | 02 |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 4 | Prepare foundation plan to mark layout **on the ground** of the framed structure from the given building plan.(Part I) | II | 02* |
| 5 | Prepare foundation plan to mark layout **on the ground** of the framed structure from the given building plan.( Part II) | II | 02* |
| 6 | Assemble $1\frac{1}{2}$ Brick thick wall in a English Bond. (minimum 3 Course) | III | 02* |
| 7 | Assemble $1\frac{1}{2}$ brick thick wall in a Flemish Bond. (minimum 3 Course) | III | 02 |
| 8 | Prepare a simple stone masonry construction work. | III | 02 |
| 9 | Prepare a report on visit to construction site with respect to scaffolding, formwork and centering work.(Part I) | III | 02* |
| 10 | Prepare a report on visit to construction site with respect to scaffolding, formwork and centering work.(Part II) | III | 02* |
| 11 | Identify various components of staircase in the given model. | IV | 02* |
| 12 | Identify various components of doors and windows in the lab in the model to prepare the report with sketches. | IV | 02 |
| 13 | Identify various types of flooring and roofing materials in the lab to prepare report.(Part I) | V | 02* |
| 14 | Identify various types of flooring and roofing materials in the lab to prepare report ( Part II) | V | 02* |
| 15 | Record the observation of plastering and pointing work at construction site to prepare a report | V | 02* |
| 16 | Record the observation of painting in residential / public building work to prepare a report. | V | 02 |
| 17 | Carry out market survey for identifying various water proofing materials and prepare a report | VI | 02 |
| 18 | Prepare a sketch book consisting of all the sketches from experiment Number 1, 2. 4, 6. 7.11.12 | I to IV | 02* |
| | **Total** | | **36** |

*Note*

*i A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical UOs/unit/s need to be performed out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry*

*ii Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| a. | Preparation of experimental set up | 20 |
| b. | Setting and operation | 20 |
| c. | Safety measures | 10 |

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| d. | Observations and Recording | 10 |
| e. | Interpretation of result and Conclusion | 20 |
| f. | Answer to sample questions | 10 |
| g. | Submission of report in time | 10 |
| | **Total** | **100** |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | PrO. S. No. |
|---|---|---|
| 1 | Optical Square, Ranging rod, Pegs, Arrows, Line dori, Lime powder, Measuring Tape, Hammer of standard size and specification as per civil engineering application | 2-5 |
| 2 | Bricks, Plumbs, Mason Square, Level tube, Line dori. | 6,7 |
| 3 | Models:<br>a. Model of a civil engineering structure depicting various components.<br>b. Cut section of building showing different components<br>c. Types of Bonds in Brick masonry<br>d. Types of Door and Windows<br>e. Types of Stairs<br>f. Types of Roofs<br>g. Formwork for different RCC elements | 9-12 |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit – I Overview of Building components** | 1a. Classify the given building on the basis of the given occupancy and type of construction.<br>1b. Categorize the component parts of the given type of building.<br>1c. Explain the salient characteristics for the given building structure.<br>1d. Compare the given parameters of given load bearing and framed structure. | **1.1 Classification of Buildings**<br>As per National Building Code-Part III (2005) Group A to I Latest code may be referred<br>As per Types of Constructions- Load Bearing Structure, Framed Structure, Composite Structure.<br>**1.2 Building Components**<br>a. Building Components and their function.<br>b. Substructure – Foundation, Plinth and Plinth Filling.<br>c. Superstructure – Walls, Partition wall, cavity wall, Sill, Lintel, Doors and Windows, Floor, Mezzanine floor, Roof, Columns, Beams, Parapet. |
| **Unit – II Construction of Substructure** | 2a. Describe the procedure of line out of the given building for the given method<br>2b. Explain the precautions required in excavation for the given type of foundation.<br>2c. Propose the suitable type of foundation for the given structure with justification<br>2d. Suggest the relevant pumping method of dewatering from given excavation pit with justification. | **2.1 Job Layout** : Site Clearance, Preparing Job Layout, Layout For Load Bearing Structure and Framed Structure by Center Line And Face Line Method, Precautions<br>**2.2 Earthwork:** Excavation For Foundation, Timbering and Strutting, Earthwork for Embankment, Material For Plinth Filling, Tools and Plants Used for Earthwork<br>**2.3 Foundation:** Functions of Foundation, Types of Foundation Shallow Foundation, Stepped Footing, Wall Footing, Column Footing, Isolated And Combined Column Footing, Raft Foundation, Grillage Foundation, Deep Foundation-Pile Foundation, classification based on materials and functions, Well foundation and Caissons, Pumping Methods of Dewatering Deep wells Well points, Cofferdams. |
| **Unit- III** Construction of Superstructure | 3a. Describe the salient features of given type of brick masonry construction<br>3b. Describe the major features of the given type of stone masonry construction<br>3c. Describe the given type(s) of brick masonry bonds | **3.1 Stone Masonry:** Terms used in stone masonry- facing, backing, hearting, through stone, corner stone, cornice. Type of stone masonry: Rubble masonry, Ashlar Masonry and their types. Joints in stone masonry and their purpose and procedure. Selection of Stone Masonry, Precautions to be observed in Stone Masonry Construction |

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

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| | with sketches.<br>3d.Describe the given type(s) of joints in stone masonry with sketches.<br>3e.Compare stone masonry with brick masonry on the basis of given criteria. | **3.2 Brick masonry:** Terms used in brick masonry- header, stretcher, closer, quoins, course, face, back, bearing, bat bond, joints, lap, frog line, level and plumb. Bonds in brick masonry- header bond, stretcher bond, English bond and Flemish bond. Requirements of good brick masonry, Junctions in brick masonry and their purpose and procedure. Precautions to be observed in Brick Masonry Construction. Comparison between stone masonry and Brick Masonry. Tools and plants required for construction of stone masonry and brick masonry. Hollow concrete block masonry and composite masonry.<br>**3.3Scaffolding:** Necessity, component parts and types of Scaffolding, platforms used for multi storeyed building.<br>**3.4Scaffolding and Shoring:** Purpose, Types of Scaffolding, Process of Erection and Dismantling. Purpose and Types of Shoring, Underpinning. Formwork: Definition of Formwork, Requirements of Formwork, Materials used in Formwork. Types of Formwork, Removal of formwork. |
| **Unit– IV Building Communication and Ventilation** | 4a.Describe the type of opening for the given situation with sketches.<br>4b.Select the relevant types of doors and windows for the given situation with justification.<br>4c Select the type of fixture and fastener for given type of door or window with justification.<br>4d.Select the type of materials for the given type and shape of the staircase with justification.<br>4e Suggest the type of staircase for the given situation with justification. | **4.1Horizontal Communication: Doors** – Components of Doors, Fully Panelled Doors, Partly Paneled and Glazed Doors, Flush Doors, Collapsible Doors, Rolling Shutters, Revolving Doors, Glazed Doors. Sizes of Door recommended by BIS.<br>**4.2 Windows:** Component of windows, Types of Windows-Fully Panelled, Partly Panelled and Glazed, wooden, Steel, Aluminum windows, Sliding Windows, Louvered Window, Bay window, Corner window, clear-storey window, Gable and Dormer window, Skylight, Sizes of Windows recommended by BIS. Ventilators, Cement Grills.<br>**4.3Fixtures and fastenings for doors and windows**<br>**4.4Material used and Functions of Window Sill and Lintels, Weather, Shed/Chajja.**<br>**4.5Vertical Communication:** Means of Vertical Communication- Stair Case, Ramps, Lift, Elevators and Escalators. |

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| | | Terms used in staircase-steps, tread, riser, nosing, soffit, waist slab, baluster, balustrade, going, scotia, hand rails, newel post, landing, headroom, winder. Types of staircase on the basis of shape: Straight, dog-legged, open well, Spiral, Quarter turn, Bifurcated, Three quarter turn, and Half turn, On the basis of Material: Stone, Brick, R.C.C., wooden and Metal. |
| **Unit–V Building Finishes** | 5a. Choose the flooring material for the given type of building with justification.<br>5b. Explain the procedure for laying and construction of given type of floor.<br>5c. Describe the procedure of Plastering and pointing for the given type of construction.<br>5d. Select the relevant type of paint material(s) to be used for the given type of building surface. | **5.1 Floors and Roofs**: Types of Floor Finishes and its suitability- Shahabad , Kota, Marble, Granite, Kadappa, Ceramic Tiles, Vitrified, Chequerred Tiles, Pavement Blocks, Concrete Floors, wooden Flooring, Skirting And Dado. Process of Laying- Process of laying And Construction, Finishing and Polishing of Floors, Roofing Materials- RCC, Mangalore Tiles, AC Sheets, G.I. and Painted Corrugated G.I. Sheets, Plastic and Fibre Sheets. Types of Roof: Flat roof, Pitched Roof-King Post truss, Queen Post Truss and Lean to Roof. terms used in roofs.<br>**5.2 Wall Finishes**: Plastering – Necessity of Plastering, Procedure of Plastering, Single Coat Plaster, Double Coat Plaster, rough finish, Neeru Finishing and POP. Special Plasters- Stucco Plaster, sponge finish, pebble finish, Plaster Board And Wall Claddings. Precaution to be Taken While Plastering, Defects in Plaster. Pointing – Necessity, Types of pointing and Procedure of Pointing. Painting –Necessity, Surface Preparation for painting, Methods of Application, Selecting Suitable Painting Material. |
| **Unit– VI Building Maintenance** | 6a. Suggest the techniques for repair of given type of cracks with justification.<br>6b. Describe the causes and remedial measure for settlement of foundation of the given type of building structure.<br>6c. Describe the safe procedure for demolition of the given structure.<br>6d .Justify the need of wat[illegible] | **6.1 Cracks** : Causes and Types of Cracks. Identification and Repair of Cracks. Grouting and Guniting.<br>**6.2 Settlement of Foundation:** Types, Causes and Remedial measures.<br>**6.3 Demolition:** Necessity, Method of Demolition- Hand Demolition, Machine Demolition, Controlled Blasting Demolition Implosion, Precautions During Demolition.<br>**6.4 Water Proofing:** Necessity and importance. [illegible]aterial used for Water Proofing, Non |

| | | |
|---|---|---|
| | proofing and damp proofing for the given type of building construction.<br>6e. Describe safe practices to be used during the construction of the given type of building. | conventional method of waterproofing- Introduction of crystalline waterproofing, cement base polymer coatings, conventional waterproofing methods-brick bat coba waterproofing, Box type water proofing, Injection/grouting. Plinth Protection necessity and material used, Damp Proof Course. |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

## 9.SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Overview of building components | 6 | 2 | 2 | 4 | 08 |
| II | Construction of Substructure | 10 | 4 | 4 | 6 | 14 |
| III | Construction of Superstructure | 12 | 4 | 6 | 10 | 20 |
| IV | Building Communication and Ventilation | 8 | 2 | 4 | 6 | 12 |
| V | Building Finishes | 6 | 2 | 2 | 4 | 08 |
| VI | Building Maintenance | 6 | 2 | 2 | 4 | 08 |
| **Total** | | 48 | 18 | 20 | 34 | 70 |

*Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
*Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Classify minimum three buildings near by your institute with reference to National Building Code- Part III (2005) and prepare a report.
b. Identify the components of a building by inspecting the available model and prepare a report.
c. Visit to construction site to observe brickwork, Sill, Lintel, Chajja, Slab, Parapet wall and prepare a report.
d. Identify types of foundation by inspecting available models and prepare a report.
e. Search software/freeware for the course content and write the report stating their applications.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
e. Guide student(s) in undertaking micro-projects.
f. Procure various materials required for practical exercises.
g. Arrange visit to nearby industries and workshops for understanding various construction materials.
h. Use video/animation films to explain various processes like Manufacturing of construction materials, concrete mixing, and base preparation for painting, mortar laying, carpentry work, false ceiling.
i. Use different instructional strategies in classroom teaching.
j. Demonstrate different samples of various construction materials like Stone, aggregate of different sizes, timber, lime, bitumen, Bricks, tiles, precast concrete products, Water proofing material, Termite proofing material, Thermal insulating material, plaster of Paris, paints, distemper, and varnishes.
k. Display various technical brochures of recent building materials.

## 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three.*

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a sketchbook consisting of components of building (for Sketches which are not included in Practical sketch book).
b. Collect the relevant information of recent technologies in building construction and prepare a report on it.
c. Identify the different types of cracks and remedial measures and submit a report on case study.
d. Collect the relevant information of different techniques of demolition of existing structure and submit a report on it.
e. Prepare a summary report with reference to content in any one part of National Building Code.

f. Carryout market survey for identifying various water proofing materials and prepare a report.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1. | Building Construction | S. P. Arora and Bindra | Dhanpat Rai Publication, Delhi Edition 2013,ISBN. 9788189928803 |
| 2. | Building construction illustrated | Francis D K. Ching | Wiley India,USA, 2014,ISBN: 978-1-118-45834-1 |
| 3. | Building Construction | S. C Rangawala | Charotar Publication,Dist-Anand ISBN-13: 978-8185594859 |
| 4. | Building Construction | B. C. Punmia and A.K.Jain | Firewall Media, 2005 ISBN 9788170080534 |
| 5. | Building Construction | S.K. Sharma | S. Chand and Co Pvt. Ltd., New Delhi (ISBN:978-81-219-0479-7) |
| 6. | Building Construction | Dr.Janardan Zha | Khanna Publication, New Delhi 2007. ISBN –8174091106 |
| 7. | Building Construction | S. S. Bhavikatti | Vikas Publication House Pvt. Ltd., New Delhi (ISBN: 978-93259-6079-4) |
| 8. | A to Z Building Construction | Sandip Mantri | Satya Prakashan; New Delhi (2015) ISBN-13: 978-8176849692 |

**HandBooks**

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1. | PWD Handbooks for Materials, Masonry, Building, Plastering and Pointing - Foundation | All India Council for Technical Education | All India Council for Technical Education (AICTE) |
| 2. | Practical Civil Engineering Handbook | Khanna | Khanna Publication |

**BIS/ International Codes of Practice**

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | National Building Code | BIS | Bureau of Indian Standard, New Delhi |
| 2 | BIS 962-1989 Code of Architectural and Building Drawing | BIS | |
| 3 | BIS 1038- 1983 Steel Doors, Windows and Ventilators | BIS | |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://www.learningconstruction.com/
b. http://www.understandconstruction.com/
c. http://www.constructionknowledge.net/

**Program Name** : **Civil Engineering Program Group**

**Program Code** : **CE/CR/CS**

**Semester** : **Third**

**Course Title** : **Concrete Technology**

**Course Code** : **22305**

## 1. RATIONALE

Concrete is the most widely used construction material today for different kinds of infrastructural development works. The versatility and mouldability of the concrete and its high compressive strength have contributed largely to its wide spread use in development and construction works. The contents of course will focus on learning about quality of concrete with regards to mix design, preparation, transporting and placing in position for various structures. It will also provide guidelines for effective supervision and quality control of concreting work. With good knowledge of concrete materials namely cement, aggregates, water and admixtures and concreting operation namely selection of materials, mixed design, mixing, placing, compacting and finishing, curing, one can obtain concrete of desired workability and required strength. The content of this course will also enable students to acquire knowledge and skills for carrying out various tests on different materials of concrete for quality construction works. Effective learning on above aspects will assist students to become a useful professional civil engineer contributing to the profession of construction and development works.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through active engagement in various teaching learning experiences:

- **Use relevant types of concrete in different site conditions.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use relevant types of cement in different site conditions.
b. Use relevant aggregates for required concrete works
c. Prepare concrete of desired compressive strengths.
d. Prepare concrete of required specifications.
e. Maintain the quality of concrete
f Use relevant admixtures for concreting for different weather conditions.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| L | T | P | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | - | 2 | 7 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25# | 10 | 25 | 10 | 50 | 20 |

*(*): Under the theory PA: Out of 30 marks, 10 marks of theory PA is for micro-project assessment to facilitate attainment of UOs and the remaining 20 marks is for tests and assignments given by the teacher.*
***Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice, P - Practical; C – Credit, ESE - End Semester Examination, PA - Progressive Assessment*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

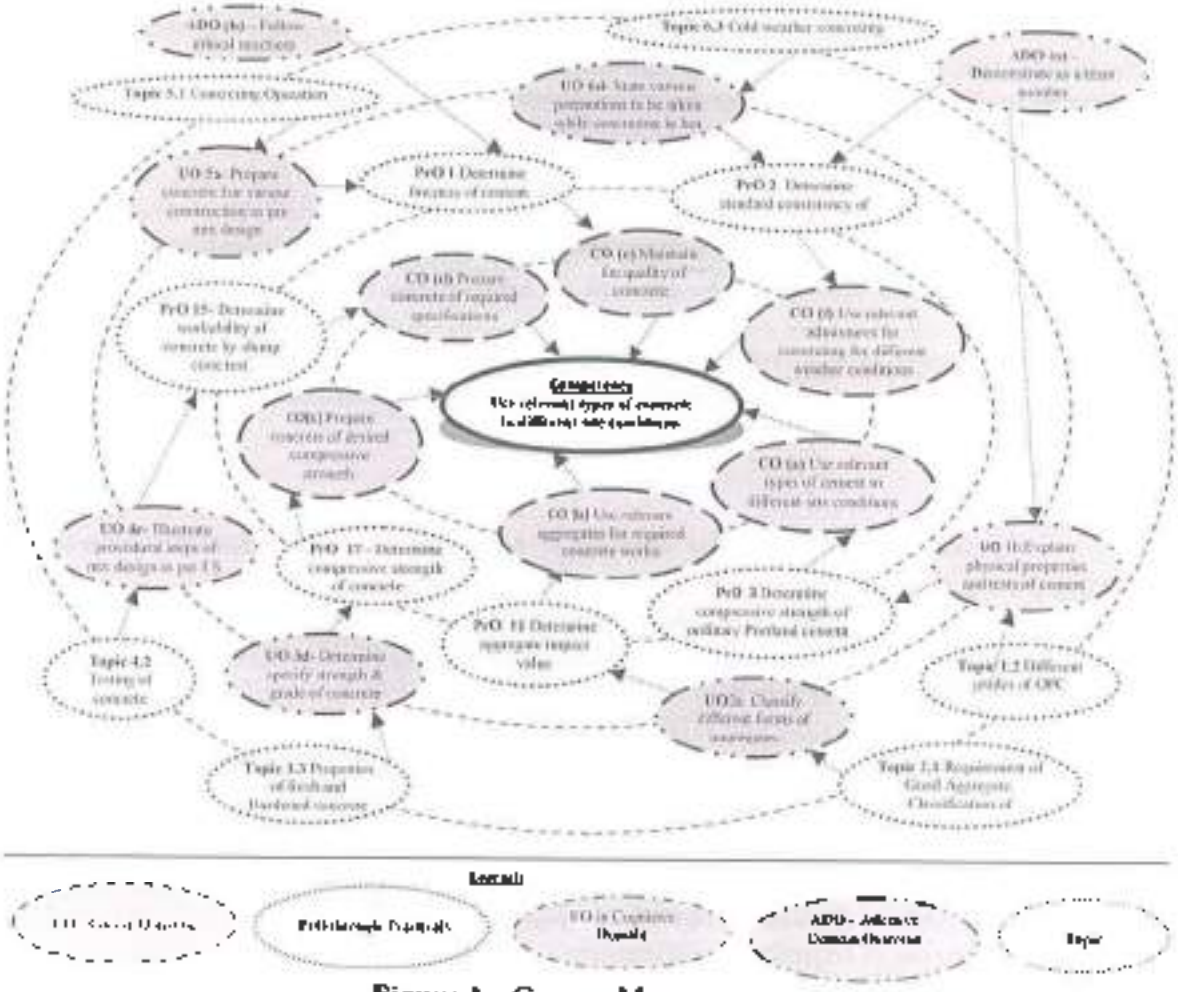


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| 1 | Determine fineness of cement by Blaine's air permeability apparatus Or by sieving. | I | 02* |
| 2 | Determine standard consistency, initial and final setting times of | I | 02* |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|---|---|---|---|
| | OPC. | | |
| 3 | Determine compressive strength of ordinary Portland cement. | I | 02 |
| 4 | Determine specific gravity of ordinary Portland cement. | I | 02 |
| 5 | Determine silt content in sand by volume. | II | 02 |
| 6 | Determine bulking of sand | II | 02 |
| 7 | Determine bulk density of fine and coarse aggregates. | II | 02* |
| 8 | Determine water absorption of fine and coarse aggregates. | II | 02 |
| 9 | Determine Fineness modulus of fine aggregate by sieve analysis. | II | 02* |
| 10 | Determine Fineness modulus of coarse aggregate by sieve analysis. | II | 02 |
| 11 | Determine aggregate impact value. | II | 02* |
| 12 | Determine aggregate crushing value. | II | 02 |
| 13 | Determine abrasion value of aggregate. | II | 02 |
| 14 | Determine aggregate elongation index and flakiness index. | I | 02 |
| 15 | Determine workability of concrete by slump cone test. | IV | 02* |
| 16 | Determine workability of concrete by compaction factor test. | IV | 02 |
| 17 | Determine compressive strength of concrete for 7 days | IV | 02* |
| 18 | Determine compressive strength of concrete by any one method of NDT. | IV | 02 |
| | **Total** | | **36** |

***Note***

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| a. | Preparation of experimental setup | 20 |
| b. | Setting and operation | 20 |
| c. | Observation and recording | 10 |
| d. | Safety measures | 10 |
| e. | Interpretation of results and conclusion | 20 |
| f. | Answer to sample questions | 10 |
| g. | Submission of report in time | 10 |
| | **Total** | **100** |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences.

a. Follow safety practices.
b. Practice good housekeeping
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.

e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| S. No. | Equipment Name with Broad Specifications | PrO. S. No. |
|---|---|---|
| 1 | Blaine's air permeability apparatus as per IS: 4031 ( part I)-1999, and sieve no. IS 90 micron - IS Brass Sieve (200 mm dia), 90 Micron size. | 1 |
| 2 | Vicats apparatus- VICAT mould of dia. 80 mm & 40 mm high glass base plate, initial needle, final needle. Consistency plunger M.S. base plate (non porous) of weight 300 gm. Vicat mould split type with camping ring. | 2 |
| 3 | Compression testing machine-2000 kN capacity, Cement mortar cube vibrator-, moulds size 50 $cm^2$ ( 7.07 cm x 7.07 cm) | 3.17 |
| 4 | Lee Chartlier flask and Kerosine | 4 |
| 5 | Measuring Cylinder of 100 ml capacity | 2,3.5,6, |
| 6 | Measuring Cylinder 1000 ml capacity | 2,3.5,6. |
| 7 | Density basket as per IS specification | 7 |
| 8 | IS sieve set ( sizes- 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µ, 300 µ, 150 µ and pan) , sieve shaker with adaptors | 1,9,10 |
| 9 | Aggregate impact testing m/c with mould, | 11 |
| 10 | Aggregate crushing mould | 12 |
| 11 | Los Angeles abrasion testing m/c | 13 |
| 12 | Elongation gauge and thickness gauge. | 14 |
| 13 | Slump cone(top dia.100mm, bottom dia.200mm, Height 300mm) | 15 |
| 14 | Compaction factor test apparatus | 16 |
| 15 | Table vibrator, moulds(150mm x150mmx 150mm) | 17 |
| 16 | NDT apparatus – rebound concrete hammer, ultrasonic pulse velocity meter | 18 |
| 17 | Hot Air Oven | 8 |
| 18 | Weighing Balance | For All |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| Unit – I Cement | 1a. Describe the given types of cement and their | Chemical Constituents of OPC and their effects, properties of OPC, Bogue's |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | relevant use with justification.<br>1b. Justify the need for the given chemical constituents for given type OPC.<br>1c. Describe the practical significance of the given types of cements for the given conditions<br>1d. Suggest the method to judge the quality of the given type of cement with justification. | compounds and their properties, hydration of cement Physical properties of OPC: fineness, standard consistency, setting time, soundness, compressive strength.<br>1.2 Different grades of OPC. 33, 43, and 53 with specifications of physical properties as per relevant IS codes.<br>1.3 Testing of OPC: Field tests and laboratory tests-fineness test, standard consistency test, setting time test, soundness test, compressive strength test, Storage of cement and effect of storage on properties of cement.<br>1.4 Physical properties, I.S. Specifications and field applications of different types of cements: Rapid hardening cement, Low heat cement, Portland pozzolana cement, sulphate resisting cement, blast furnace slag cement. White cement. |
| **Unit– II Aggregates** | 2a. Identify the type of given aggregate samples based on and source shape and size.<br>2b. Explain the methodology to suggest suitability of given fine aggregate.<br>2c. Explain the methodology to suggest suitability of given coarse aggregate.<br>2d. Describe the permissible limits of solids for using sea water in mixing concrete. | 2.1 Aggregates: Requirement of good aggregates. Classification according to source, size and shape.<br>2.2 Fine aggregates: Properties, size, specific gravity, bulk density, water absorption and bulking, fineness modulus and grading zone of sand by sieve analysis, silt content in sand and their specification as per IS 383, bulking of sand. Concept of crushed Sand.<br>2.3 Coarse aggregates: Properties, size, shape, surface texture, water absorption, soundness, specific gravity and bulk density, fineness modulus of coarse aggregate by sieve analysis, grading of coarse aggregates, crushing value, impact value and abrasion value of coarse aggregates with specification.<br>2.4 Water: Quality of water, impurities in mixing water, and permissible limits for solids as per IS: 456, use of sea water for mixing concrete. |
| **Unit– III Concrete** | 3a. Justify use of different grades of concrete and their properties for given applications, with justification.<br>3b. Select w/c for a given grade of concrete, with justification<br>3c. Interpret the given data obtained from test on given type of concrete sample | 3.1 Concrete: Necessity of supervision for concreting operation, different grades of concrete (ordinary Concrete, standard concrete and high strength concrete as per provisions of IS 456.<br>3.2 Water cement ratio Duff Abraham w/c law, significance of w/c ratio, selection of w/c ratio for different grades of concrete prepared from different grades of OPC as per graphs specified in IS 10262. maximum w/c ratio for different grades of concrete for different |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | 3d. Describe the factors affecting overall durability of given type of concrete. | exposure conditions<br>3.3 Properties of fresh concrete: Workability. Factors affecting workability of Concrete. Determination of workability of concrete by slump cone test, compaction factor test. Range values of workability requirement for different types of concrete works. Segregation, bleeding and preventive measures<br>3.4 Properties of Hardened concrete: compressive strength, durability, impermeability and dimensional changes of concrete. |
| **Unit-IV** Concrete Mix Design and Testing of Concrete | 4a. Explain the given method of concrete mix design for the given situation.<br>4b. Interpret the given data obtained from test on given type of concrete.<br>4c. Describe the need of NDT for the given field situation.<br>4d. Interpret the given data obtained from NDT on given structure. | 4.1 Concrete mix design, objectives, methods of mix design, study of mix design procedure by I.S method as per I.S. 10262-(Only procedural steps)<br>4.2 Testing of concrete: Significance of testing, determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results.<br>4.3 Non- destructive testing of concrete: Importance of NDT, methods of NDT,<br>4.4 Rebound hammer test, working principle of rebound hammer and factor affecting the rebound index, Ultrasonic pulse velocity test, specification for deciding the quality of concrete by Ultrasonic pulse velocity as per I.S.13311 (part 1 and 2) |
| **Unit –V Quality Control of Concrete** | 5a. Explain the sequential operations of concreting in given situation.<br>5b. Explain the given type of form works and stripping time.<br>5c. Select given method of waterproofing for given situation with justification<br>5d. Identify the type of construction joint to be used in given situations of concreting works, with justification. | 5.1 Concreting Operations: Batching, Mixing, Transportation, Placing, Compaction, Curing and Finishing of concrete<br>5.2 Forms for concreting: Different types of form works for beams, slabs, columns, materials used for form work, requirement of good form work Stripping time for removal of form works per IS 456-2000 provision for different structural members.<br>5.3 Waterproofing: Importance and need of waterproofing, methods of waterproofing and materials used for waterproofing.<br>5.4 Joints in concrete construction. Types of joints, joining old and new concrete, methods of joining, materials used for filling joints. |

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit-VI Chemical Admixture in concrete, Special Concrete and, Extreme weather concreting** | 6a. Justify the need of given admixtures in concrete mix.<br>6b. Describe the characteristics and uses of given type of concrete.<br>6c. Explain effects and preventive measures in the given type of weather concreting.<br>6d. Select the type of weather concreting in the given situation with justification.<br>6e. Select the type of industrial flooring in the given situation with justification. | 6.1 Admixture in concrete: Purpose, properties and application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixture, air entraining admixture and super plasticizers.<br>6.2 Special Concrete: Properties, advantages and limitation of the following types of Special concrete: Ready mix Concrete, Fiber Reinforced Concrete, High performance Concrete and self compacting concrete, light weight concrete.<br>6.3 Cold and Hot weather concreting: Effect of cold and Hot weather on concrete, precautions to be taken while concreting in cold and hot weather condition.<br>6.4 Concrete as industrial flooring material and various techniques: Vacuum dewatering flooring, Free Movement flooring, Techniques of groove cutting and various materials used for groove filling in concrete flooring. |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Cement | 04 | 02 | 02 | 02 | 06 |
| II | Aggregates | 06 | 02 | 02 | 06 | 10 |
| III | Concrete | 10 | 02 | 02 | 10 | 14 |
| IV | Concrete Mix Design and testing of Concrete | 12 | 02 | 04 | 10 | 16 |
| V | Quality Control of Concrete | 10 | 02 | 06 | 06 | 14 |
| VI | Chemical Admixture in concrete, Special Concrete and Extreme weather concreting | 06 | 02 | 04 | 04 | 10 |
| **Total** | | **48** | **12** | **20** | **38** | **70** |

***Legends:*** *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
*Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

i. Market survey to select type of cement for various types of construction works.
ii. Visit to site under construction to collect detail information about the ingredients of concrete mix.
iii. Visit to nearby RMC plant and draw flow chart.
iv. Visit to site under construction to observe concreting operations.
v. Visit to site under construction to observe the quality of fresh concrete.
vi. Visit to site under construction to observe form work, scaffolding used and joints in concrete.
vii. Visit to site under construction and make a check list of effect of each property of Cement and aggregate on quality of concrete.
viii Search the software/freeware for the course content and prepare report stating their applications.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No 10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Assign unit wise tutorials to group of 4 to 5 students for solving problems unit wise
g. Assign micro projects to group of 4 to 5 students and let them prepare and present the project through PPT. Group shall submit a report which is limited to 5 pages.
h. Use of video animation films to explain concept, Facts and applications related to Concrete Technology.
i. In respect of item 10 above teacher needs to ensure to create opportunity and provisions for such co curricular activities

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ... Each student will have to maintain

dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs

A suggestive list of micro-projects are given here Similar micro-projects could be added by the concerned faculty:

a Undertake any one micro-projects (Group of 4 to 6 students)

i. Prepare cast in situ concrete of given grade. It includes visit to site, observations, records,field tests of cement, sand and coarse aggregate. Follow the concrete chain operations.

ii. Using IS code method of mix design obtain ingredients of concrete and prepare concrete.

**Note: Any other relevant micro project suggested by subject teacher.**

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Concrete Technology | Gambhir, M.L. | Tata McGraw Hill Publishing Co. Ltd., New Delhi, ISBN-13: 978-1-259-06255-1 |
| 2 | Concrete Technology | Shetty. M S. | S. Chand and Co. Pvt. Ltd., Ram Nagar, New Delhi-110055 ISBN, : 978-8-121-90003-4 |
| 3 | Concrete Technology | Santhakumar .A. R. | Oxford University Press, New Delhi ISBN-13: 978-0-195-67153-7 |
| 4 | Concrete Technology | Neville. A. M. and Brooks, J.J. | Pearson Education Pvt. Ltd., New Delhi ISBN 978-0-273-73219-8 |
| 5 | Properties of Concrete | Neville A. M. | Pearson Education Pvt. Ltd., New Delhi ISBN 978-0-273-75580-7 |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in
b. www.w3schools.com
c. www.engineeringcivil.com/various-lab-test-on-cement.html
d. www.engineeringcivil.com/various-lab-test-on-aggregates.html
e. www.aboutcivil.org/tests-on-concrete.html
f. https://theconstructor.org/practical-guide/non-destructive-testing-of-concrete/5553/
g. nptel.ac.in/courses/105104030/34
h. nptel.ac.in/courses/105104030/
i. nptel.ac.in/courses/105102012/38
j. https://www.youtube.com/watch?v=cbL5q0HBlnE
k. www.nbmcw.com/concrete/3834-steel-fibre-concrete-composites-for-special applicati.

**Program Name** : **Civil Engineering Program Group**

**Program Code** : **CE/CR/CS**

**Semester** : **Third**

**Course Title** : **Computer Aided Drawing**

**Course Code** : 22022

## 1. RATIONALE

An essential skill of a civil engineering diploma holder is to use Computer aided drawing as a drafting tool to draw, read and interpret the civil engineering drawings. This will facilitate the more speed, accuracy and repetitive use of drawings as and when needed. Through this technique student will be able to edit the existing drawing and create new 2 and 3-dimensional drawings and isometrics as per requirements.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Draw civil engineering drawings using Computer aided drawing software.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Interpret the given 2-dimensional drawing.
b. Use CAD software for drafting and editing 2-dimensional drawings.
c. Locate the dimensions of the drafted drawing.
d Draw the isometric and 3- dimensional drawings

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | | Practical | | | | | |
| L | T | P | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| - | - | 4 | 4 | -- | -- | -- | -- | -- | -- | -- | 50@ | 20 | 50~ | 20 | 100 | 40 |

*(~[2]): For the practical only courses, the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

***Legends:*** *L-Lecture, T – Tutorial/Teacher Guided Theory Practice; P - Practical; C Credit, ESE - End Semester Examination; PA - Progressive Assessment.*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

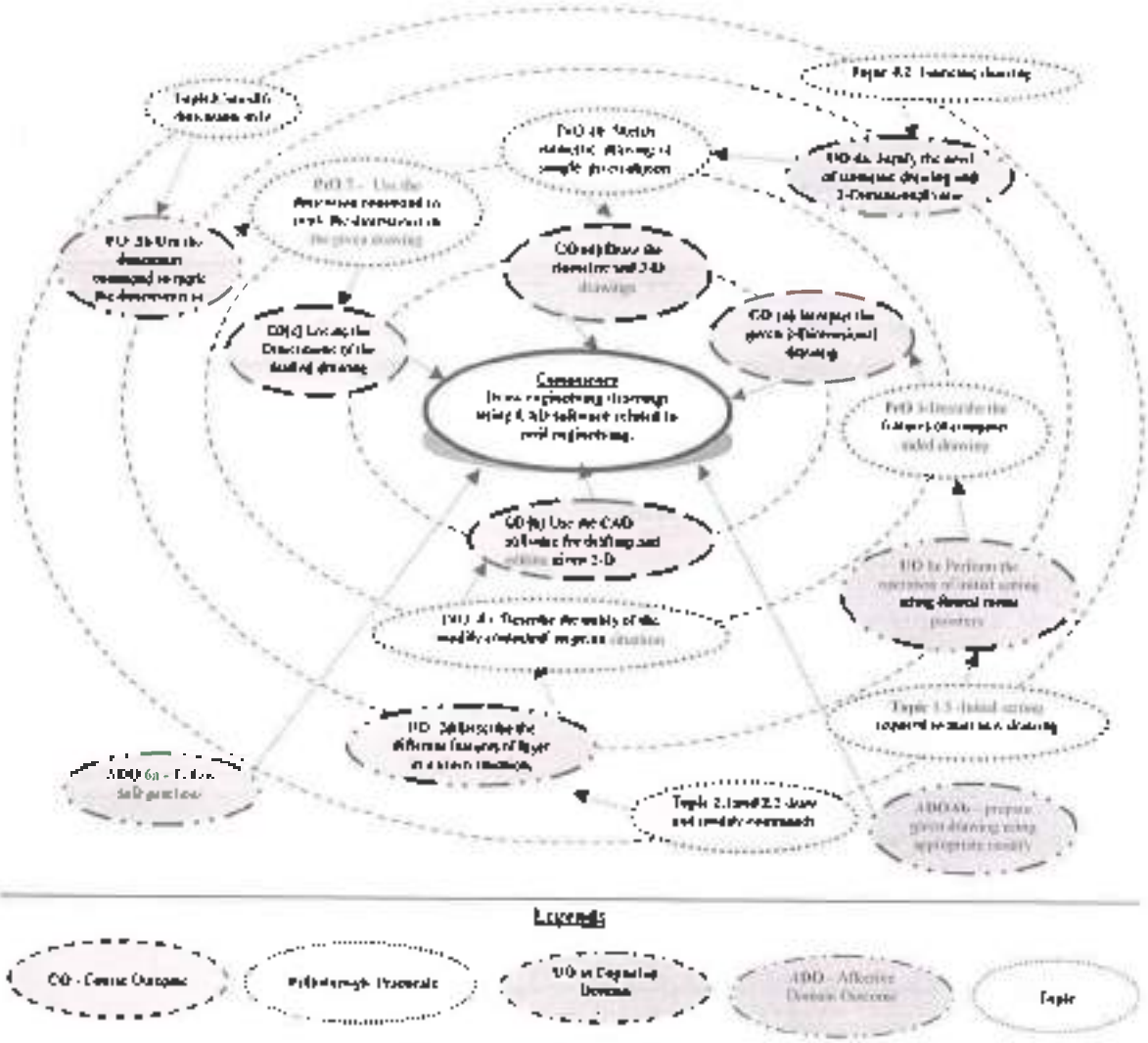


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 1 | Identify the components of CAD screen and apply the processes of Initial setting using format menu. Part I | I | 02* |
| 2 | Identify the components of CAD screen and apply the processes of Initial setting using format menu. Part II | I | 02* |
| 3 | Calculate -Cartesian coordinates (relative and absolute) Polar coordinates of given shapes.(any Two) | I | 02* |
| 4 | Calculate -Cartesian coordinates (relative and absolute) Polar coordinates of given shapes.(any Two) | I | 02* |
| 5 | Draw the given figures according to Cartesian coordinate system. (any Two) | I | 02* |
| 6 | Draw the given figures according to Polar coordinate system. (any Two) | I | 02* |

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 7 | Use " Draw and modify command" to draw the given shapes - (minimum 2 shapes) | II | 02* |
| 8 | Use " Draw and modify command" to draw the given shapes - (minimum 2 shapes) | II | 02* |
| 9 | Use " Draw and modify command" to draw the given shapes - (minimum 2 shapes) | II | 02* |
| 10 | Use " Draw and modify command" to draw the given shapes - (minimum 2 shapes) | II | 02 |
| 11 | Use " Draw and modify command" to draw given shapes - (minimum 2 shapes) | II | 02 |
| 12 | Use " Draw and modify command" to draw given shapes - (minimum 2shapes) | II | 02 |
| 13 | Use " Draw and modify command" to draw given shapes - (minimum 2shapes) | II | 02 |
| 14 | Use " Draw and modify command" to draw given shapes - (minimum 2shapes) | II | 02 |
| 15 | Use " Draw and modify command" to draw given shapes - (minimum 2shapes) | II | 02 |
| 16 | Use "Draw and modify command" to draw cross section of walls showing different building components symbols. | II | 02 |
| 17 | Use "Draw and modify command" to draw cross section of walls showing different building material symbols. | II | 02* |
| 18 | Draw plan of any one stair case from the given drawing.( Dog legged stair case / spiral stair case) | II | 02* |
| 19 | Draw sectional elevation of stair case drawn in exercise no 18. | II | 02* |
| 20 | Mark the dimensions in the figures drawn in exercise number 5 to 15,and 18.19. | III | 02 * |
| 21 | Use area command to compute the area of the given, figure, line plan (of residential and public building). | III | 02* |
| 22 | Use "Draw and modify command" to prepare line plan of given residential building. | III | 02* |
| 22 | Use "Draw and modify command" to prepare line plan of given public building. | II | 02* |
| 23 | Use "Draw and modify command" to prepare typical floor developed plan of a given framed residential building in minimum four layers. | II | 02* |
| 24 | Use "Draw and modify command" to prepare above typical floor developed plan of a given framed residential building in minimum four layers .Give labels , doors and window openings , schedule of openings , scale , north direction. | II | 02* |
| 25 | Use "Draw and modify command" to prepare elevation of given framed residential building in exercise 22. | II | 02* |
| 26 | Use "Draw and modify command" to prepare section of a given framed residential building in exercise 22. | II | 02* |
| 27 | Use "Draw and modify command" to prepare section of a given framed residential building in exercise 22. | II | 02* |

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 28 | Use "dimension command" to locate dimensions of typical floor plan, elevation and section dimensions of a given framed residential building in layer in exercise 22 to 26. | II | 02* |
| 29 | Draw isometric drawing of simple objects.(minimum 02 objects) | IV | 02* |
| 30 | Draw isometric drawing of simple objects.(minimum 02 objects) | IV | 02 |
| 31 | Draw 3-D view of simple object.(any one) | IV | 02* |
| 32 | Draw 3-D view of simple object.(any one) | IV | 02 |
| Note: 1. The term work consists of a journal with the relevant write up and output of 2-11 experiment in the form of print out as an output and soft copy as well. 2. The figures used for practical numbers from 7 to 15 are different for each practical. | | | |
| | Total | | 64 |

*Note*

i. *A suggestive list of* ***PrOs*** *is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each PrO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

| S. No. | Performance Indicators | Weightage in % |
|---|---|---|
| 1. | Prepare Initial setting necessary for given drawing. | 10 |
| 2. | Prepare given drawing using draw commands. | 30 |
| 3. | Follow Safety measures | 05 |
| 4. | Prepare given drawing using appropriate modify commands. | 20 |
| 5. | Answer the questions related to drafted drawing. | 10 |
| 6. | Submit journal report on time | 15 |
| 7. | follow Housekeeping | 05 |
| 8. | Attendance and punctuality | 05 |
| | TOTAL | 100 |

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical Practices

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the

according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

| Sr. No. | Equipment Name with Broad Specifications | PrO. S.No. |
|---|---|---|
| 1. | Computer with specification as 2GB RAM ,HDD 500GB,LCD Monitor with relevant CAD software.(with latest configuration) | 1 to 32 |
| 2. | Printer preferably for the output of A-3 size ,paper | 5to 32 |
| 3. | LCD projector. | 1 to 32 |

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit– I Fundamentals of computer aided drawing** | 1a Explain the importance of computer aided drawing in civil engineering applications.<br>1b. Describe the features of computer aided drawing screen.<br>1c. Describe the operation of initial setting using Format menu.<br>1d. Calculate coordinates in given situation. | 1.1 CAD software –meaning, various drafting software for civil engineering applications.<br>1.2 System requirement for drawing software<br>1.3 Advantages of computer aided drawing over traditional method of drawing.<br>1.4 Features of CAD screen.<br>1.5 Initial setting required to start new drawing from scratch<br>1.6 Coordinate systems used in CAD.<br>1.7 Save and plot/print command |
| **Unit-II CAD commands** | 2a. Draw the given figures using "draw commands"<br>2b. Describe the utility of the 'modify command' in given situation.<br>2c. Describe the utility of enquiry command to find the parameters like distance, area, perimeter of a given figure.<br>2d. Describe the different features of layer in a given situation. | 2.1 Draw commands-line, poly line, construction line, rectangle, polygon, circle, ellipse, hatch, boundary, text, arc, point, make block<br>2.2 Modify commands- erase, copy, mirror, offset, trim, move, extend, rotate, array, lengthen, scale, chamfer, fillet, explode, stretch, join, brake, divide.<br>2.3 Enquiry –list, area ,distance, mass property<br>2.4 Changing properties of entity-line type, color, scale, font- size, color, |

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

| | | |
|---|---|---|
| | | style<br>2.5 Layer command. |
| **Unit– III Introduction to Dimension command** | 3a. Explain the necessity of the dimensioning the given figure.<br>3b Use the dimension command to mark the dimensions in the given drawing.<br>3c. Modify the existing dimension style. | 3.1 Enter form of dimension style.<br>3.2 Type of dimensions-quick dimension, linear dimension, and continuous dimension; align dimension, angle dimension and radius, diameter.<br>3.3 Modify dimension style. |
| **Unit– IV Introduction to 3-Dimension al view** | 4a. Justify the need of isometric drawing and 3-Dimensional view<br>4b. Sketch isometric drawing of simple given objects.<br>4c. Sketch 3- dimensional drawing of simple given object. | 4.1 Necessity of 3 dimensional view<br>4.2 Isometric drawing- meaning and necessity, use of isometric snap, isometric axes, isocircle, isotext<br>4.3 3-Dimensional drawing –use of extrude ,pressfull command. |

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable -

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Collect the working drawings from builders, architect and engineers.
b. Collect the 3-Dimensional drawings from various resources.
c. Collect information of similar software other than Computer Aided drawing available in construction industry.
d. Search for the websites related to course contents.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course. These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

e. Guide student(s) in undertaking micro-projects
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Draw plan, elevation, and section of a given framed structure as it is from the available drawings using software available in laboratory.
b. Prepare construction notes, site plan, and schedule of openings from the drawings of a framed structure made available from builder/engineer/civil engineering service provider.
c. Draw plan, elevation, and section and site plan of a given load bearing structure as it is from the available drawings using software available in laboratory.
d. Prepare construction notes, site plan, and schedule of openings from the drawings of a load bearing structure made available from builder/engineer/civil engineering service provider
e. Learn latest software's of Civil Engg Drawing

## 13. SUGGESTED LEARNING RESOURCES

| S.N. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | AUTOCAD-2000 | Frey, David | BPB Publication, New Delhi. ISBN13: 9788176560801 |
| 2 | Introduction to Auto CAD 2012 for Civil Engineering Applications | Yasmin, Nighat | SDC Publication. 2011 ISBN 978-1-58503-642-4 |
| 3 | AutoCAD 2016: A Problem-Solving Approach, Basic and Intermediate | Tickoo, Shyam | CADCIM Technologies. 22nd Edition , August 2015 ISBN 13- 9781942689003 |
| 4 | Auto CAD 2010 Instructor | Leach, James | Tata Mc Graw Hill, New Delhi 2007; ISBN:9780073375410 |
| 5 | Auto CAD and its Applications-Basics | Shumaker, Terence M.; Madsen, David | Good heart- Willcox Publishers 2010; ISBN-13: 9781590707 |

| S.N. | Title of Book | Author | Publication |
|---|---|---|---|
| | 2010 | A.; Madsen, David P.: | |
| 6 | Engineering drawing | Bhatt, N D. | Charotar Publications, Anand, 2016 ISBN:978-93-80358-96- |
| 7 | Working with Auto CAD 2000 | Singh, Ajit | Mc Graw Hill Publishing New Delhi, 2002; ISBN: 9780070435964 |

## 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://www.autodesk.com/education/freesoftware/autocad
b. http://www.youtube.com/playlist?list=PLIpylybv1CupI-9xve13CxzzwK0PLL
c. www.zwsoft.com/cad accessed on 15th October 2016,
d. https://www.scribd.com/doc/260678036/ accessed on 12th October 2016,
e. medobute.pixnet.net/blog/post/123908069 accessed on 10th October2016
f. www.ndl.iitkgp.ac.in