



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	
				L	T	P		Theory						Practical								
								ESE		PA		Total		ESE		PA		Total				
								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
		Chemistry			2	-	4					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.**



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 namely 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 useful to find slope of the curve, maxima and minima of the function, radius of curvature. Integral calculus helps in finding the area. Differential equation is used in finding the curve and its related applications for various engineering models. Numerical integration is used to find the area of the functions especially whose integration cannot be evaluated easily with routine methods. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in engineering.

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 civil engineering related broad-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:

- Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
- Solve the given problems of integration using suitable methods.
- Apply the concept of integration to find area and volume.
- Solve the differential equation of first order and first degree using suitable methods.
- Apply the concept of numerical integration to investigate the area.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Credit (L+T+P)	Examination Scheme										
L	T	P	Theory						Practical						
			ESE		PA		Total		ESE		PA		Total		
				Paper Hrs.	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	1	--	4	3	70	28	30*	00	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 LOs 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, 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 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.

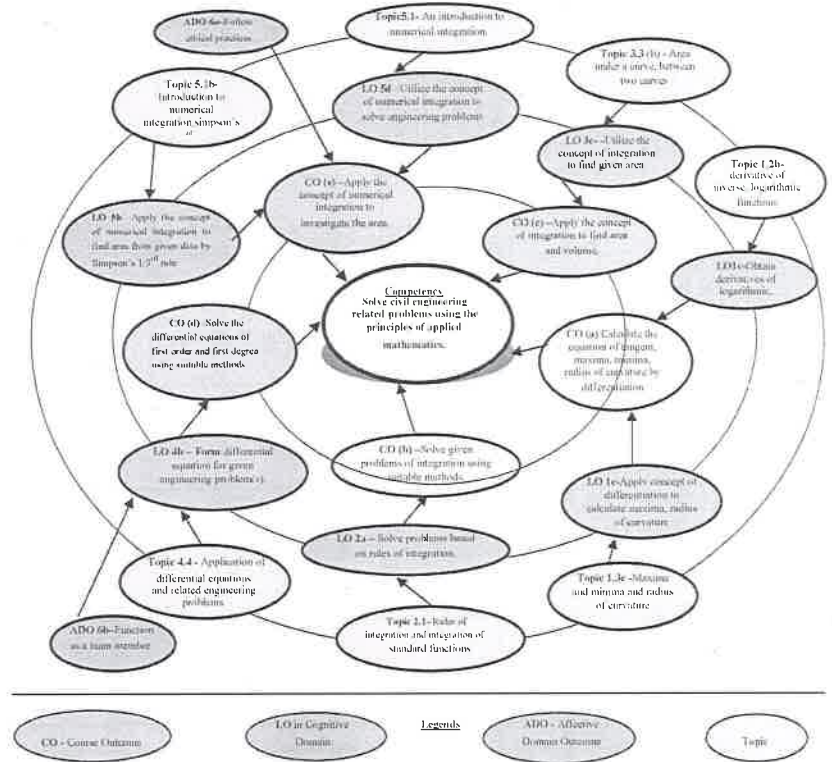


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are LOs (i.e 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 function at different points	I	1
2	Solve problems to find derivatives of implicit function and parametric function	I	1
3	Solve problems to find derivative 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, 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 curve, 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 to related engineering problem.	IV	1
13	Develop a model using the concept of linear differential equation to related engineering problem.	IV	1
14	Solve problems based on Trapezoidal rule	V	1
15	Solve problems based on Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ 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 revision and practice.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED:

- Not applicable -

7. UNDERPINNING THEORY COMPONENTS

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

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

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



Unit	Major Cognitive Domain Learning Outcomes	Topics and Sub-topics
	based on linear differential equations.	
Unit –V Numerical Integration	5a. Apply the concept of numerical integration to find area from given data by Trapezoidal rule. 5b. Apply the concept of numerical integration to find area from given data by Simpson's $1/3^{rd}$ rule. 5c. Apply the concept of numerical integration to find area from given data by Simpson's $3/8^{th}$ rule. 5d. Utilize the concept of numerical integration to solve related engineering problems.	5.1 An introduction to numerical integration. a. Trapezoidal rule. b. Simpson's $1/3^{rd}$ rule. 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 'Application 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	08	12	24
II	Integral calculus	12	02	06	08	16
III	Applications of Definite Integration.	08	02	02	04	08
IV	First Order First Degree Differential Equations	06	02	02	04	08
V	Numerical integration	08	02	05	07	14
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 teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

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:

- Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
- Use graphical software's: EXCEL, DPLOT, and GRAPH for related topics.
- Use Mathcad as Mathematical Tools and solve the problems of Calculus.
- Identify problems based on applications of differential equations and solve these problems.

- Prepare models to explain different concepts of applied mathematics.
- Prepare a seminar on any relevant topic based on applications of integration.
- 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:

- 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 LOs/COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking 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 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 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 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:

- Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
- Prepare models using the concept of radius of curvature to bending of railway track.
- Prepare charts displaying the area of irregular shapes using the concept of integration.
- Prepare charts displaying volume of irregular shapes using concept of integration.
- Prepare models using the concept of differential equations for mixing problem.
- Prepare models using the concept of differential equations for radio carbon decay.
- Prepare models using the concept of differential equations for population growth.
- Prepare models using the concept of differential equations for thermal cooling.
- Prepare charts displaying the area of irregular shapes using the concept of Simpson's $1/3^{rd}$ rule.
- Prepare charts displaying the area of irregular shapes using the concept of Simpson's $3/8^{th}$ rule.

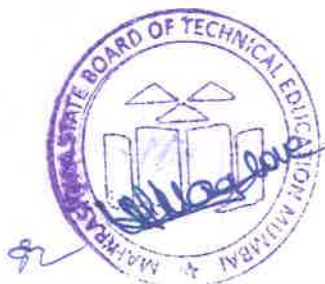


12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi , 2013 ISBN- 8174091955
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	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
4	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN: 9788121903455
5	Engineering Mathematics, Volume 1 (4 th edition)	Sastry, S.S.	PHI learning, New Delhi, 2014 ISBN-978-81-203-3616-2,
6	Comprehensive Basic Mathematics, Volume 2	Veena, 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, 2009 ISBN: 0199731241
8	Engineering Mathematics (3 rd edition).	Croft, Anthony.	Pearson Education, New Delhi,2010 ISBN: 978-81-317-2605-1

13. SOFTWARE/LEARNING WEBSITES

- a. www.scilab.org/ - SCI Lab
- b. www.mathworks.com/products/matlab/ - MATLAB
- c. Spreadsheet applications
- d. www.dplot.com/ - DPlot
- e. www.allmathcad.com/ - MathCAD
- f. www.wolfram.com/mathematica/ - Mathematica
- g. <http://fossee.in/>
- h. <https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig>
- 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

Diploma engineers have to deal with various materials and machines. The study of concepts and principles of science like elasticity, viscosity, surface tension, motion, thermo couples, photo-sensors, LASERS, X-Rays, metals, alloys, cement, lime, refractory materials water treatment and analysis, fuel and combustion will help the student to select and use relevant materials and methods which will be economical and eco-friendly.

2. COMPETENCY

This 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:

- Select relevant material in industry by analyzing its physical properties.
- Apply laws of motion in various applications.
- Use LASERS, X-Rays and photo electric sensors..
- Select the relevant metallurgical process related to industrial applications.
- Use relevant water treatment process to solve industrial problems.
- Use relevant fuel in relevant applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Credit (L+T+P)	Examination Scheme											
L	T	P	Theory						Practical							
			ESE		PA		Total		ESE		PA		Total			
Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min			
2	-	4	8	90	70*#	28	15*	00	100	40	25@	10	25	10	50	20
2	-	-	-	Min			15*	00			25@	10	25	10	50	20

(*): 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 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

Note: Practical of Chemistry and Physics will be conducted in alternate weeks for each batch.



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.



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
Physics			
1	Use Searle's method to determine the Young's modulus of given	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	wire		
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 photo electric effect experiment. ii) Find the dependence of the stopping potential on the intensity of light source in photo electric 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.	VI	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 (Gravimetric analysis)	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 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 %
1	Preparation of experimental set up	20
2	Setting and operation	20

S. No.	Performance Indicators	Weightage in %
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:

- Follow safe practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- 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 administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Searle's apparatus (with slotted mass of 0.5 kg each)	1
2	Liquid container	2
3	Solid body (different size and materials)	3,4
4	Stoke'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	Photo electric 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, pan size 100 mm, response time 3-5 sec.; power requirement 90-250 V, 10 watt.	All
18	Electric oven inner size 18''x18''x18''; temperature range 100 to 250 ^o C with the capacity of 40 lt.	14,16
19	Bomb calorimeter	15



S. No.	Equipment Name with Broad Specifications	Exp. No.
20	Muffle furnace, Temperature up to 900°C, digital temperature controller with an accuracy of $\pm 3^{\circ}\text{C}$	14,16
21	Nephelometer ; Auto-ranging from 20-200 NTU, $\pm 2\%$ of reading plus 0.1 NTU, power 220 Volts $\pm 10\%$ AC 50 Hz	13

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics 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
Physics		
Unit – I Properties of matter and Non-Destructive Testing	1a. Explain concept of elasticity and plasticity for the given material.	1.1 Deforming Force and Restoring Force, Elasticity, Plasticity, Rigidity
	1b. Establish relation between given types of moduli of elasticity.	1.2 Stress and Strain and their types, Elastic limit and Hooke's law, types of moduli of elasticity
	1c. Predict the behavior of the given metallic wire.	1.3 Stress -Strain diagram, Poisson's ratio, factors affecting elasticity
	1d. Explain pressure-depth relation for the given law.	1.4 Fluid friction, pressure, pressure- depth relation, Pascal's law, Archimedes' principle
	1e. Explain Newton's law of viscosity for the given liquid.	1.5 Viscosity, velocity gradient, Newton's law of viscosity.
	1f. Explain Stokes' law for the free fall of the body through the given viscous medium.	1.6 Free fall of spherical body through viscous medium and Stokes' law, derivation of coefficient of viscosity ' η ' 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.	2.1 Displacement, velocity, acceleration and retardation, equations of motion, equations of motion under gravity.
	2b. Calculate the angular velocity of the given body.	2.2 Angular displacement, angular velocity, angular acceleration, three equations of angular motion
	2c. Explain the relevant Newton's laws of motion for the given moving object.	2.3 Momentum, impulse, impulsive force, Newton's laws of motion and their Applications
	2d. Calculate the work/power/energy for the given situation.	2.4 Work, power and energy: potential energy, kinetic energy, work -energy principle.
	2e. Calculate the given	

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	parameters for the given projectile in motion.	2.5 Projectile motion, trajectory, angle of projection, time of flight and range of projectile with formulae.
Unit– III Photoelectricity, X-Rays and LASERS	3a. Explain the concept of the given parameters of the given material.	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.
	3b. Explain the working of the given photoelectric device.	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	3.4 Laser: properties, absorption, spontaneous and stimulated emission, applications of Laser
	3e. Explain the given terms with examples.	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.	4.1 Metallurgy: Mineral, ore, gangue, flux, slag.
	4b. Describe the extraction process of the given ore with chemical reaction.	4.2 Types of furnace: Muffle furnace, Blast furnace.
	4c. Explain purposes and preparation methods of making the given alloy.	4.3 Extraction processes of Haematite, copper pyrite ores: Crushing, concentration, reduction, refining.
	4d. Select the relevant alloy for the given application stating the properties with justification.	4.4 Properties of iron and copper: Hardness, tensile strength, toughness, malleability, ductility, refractoriness, fatigue resistance. specific gravity, specific heat, brazing, castability, stiffness.
	4e. Describe the constituents, hardening and setting process of the given type of cement.	4.5 Preparation of alloys (Fusion and compression method).
	4f. Select the relevant refractory for given application stating the properties with justification.	4.6 Ferrous alloys: Low carbon, medium carbon, high carbon steels.
		4.7 Non-ferrous alloy: Brass, Bronze, Duralumin, Tinman Solder, Woods metal.
		4.8 Cement: Types; Biocement and Portland cement; constituents, setting and hardening, applications
		4.9 Lime: classification, constituents, setting and hardening, applications.



Unit	Unit Outcomes (UOs) (in 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 5b. Describe the given process for softening of the given water sample. 5c. Describe with sketches the purification of the given type of water. 5d. Describe the given type of of waste water treatment.	5.1 Hardness; Classification 5.2 Hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges. 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). 5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization. 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. 6b. Explain the given type of analysis of the given type of coal. 6c. Calculate the calorific value of the given solid fuel using Bomb calorimeter. 6d. Describe composition, properties of given gaseous fuel with their applications. 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. 6.2 Solid fuels: Coal, Classification and composition, proximate analysis, Ultimate analysis, Bomb calorimeter. Carbonization of coke by Otto Hofmann's oven. 6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, properties. Knocking, cracking, octane number and cetane number. 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 '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
Physics						
I	Properties of matter and NDT	14	03	05	06	14
II	Types of motion	09	02	02	06	10
III	Photoelectricity, X-Ray and LASER.	09	03	04	04	11
Chemistry						



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

- Seminar on any relevant topic.
- Library survey regarding engineering material used in different industries.
- Prepare power point presentation or animation for showing applications of lasers.

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:

- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- 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 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 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:

- Elasticity:** Prepare working model to demonstrate the stress – strain behavior of different wires of different thickness and material.
- Viscosity:** Collect 3 to 5 liquids and prepare a working model to differentiate liquids on the basis of viscosity and demonstrate their applications.
- Motion:** Prepare model of ball rolling down on inclined plane to demonstrate the conservation of energy and motion of an object in inclined plane.
- Photo Sensors:** Prepare simple photo sensor using LDR.
- Properties of Laser:** Use Key chain laser to differentiate laser with ordinary light.
- Water analysis:** Collect water samples from different water sources and find the characteristics like acidity, conductivity, dissolved solids, suspended particles.
- Water treatment:** Collect 3 to 5 water samples to find the dosage of bleaching powder required for its sterilization.
- Water analysis:** Prepare model to find the soap foaming capacity of bore water on addition of soda ash.
- Fuels:** Prepare chart showing different types of liquid fuels showing their calorific values and uses.
- Cement:** Collect different samples of cement and find their initial and final setting time.
- Refractory materials:** Prepare chart showing properties of refractory materials.
- Metal properties:** Prepare chart showing different industrial application of metal and relate it with required property or properties using internet.
- Alloy steel:** Find the effect of alloying elements like Mn, Cr, Ni, W, V, Co on properties of steel. Prepare chart of 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 XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; <i>et al</i>	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
2	Physics Textbook Part I and part II - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. <i>et al</i>	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
3	Engineering Physics	Bhattacharya, D. K.; Tandon Poonam	Oxford Publishing, New Delhi, ISBN:0199452814
4	Principles of Engineering Physics -I	Md. Nazoor Khan and Simanchala Panigrahi	Cambridge university press; New Delhi, 2016 ISBN : 9781316635643
5	Engineering Physics	Palanisamy, P. K.	SCITECH Publications, Chennai, ISBN: 9788183711012
6	Principles of Physics	Walker, J.; Halliday, D; Resnick, R	Wiley Publications, New Delhi, 10 th edition ISBN: 9788126552566
7	Textbook of Engineering Physics	Avadhanulu, M. N.; Kshirsagar, P. G.	S. Chand and Co., New Delhi, 2015 ISBN: 9788121908177
8	Engineering Chemistry	Agarwal, Shikha	Cambridge university press ; New Delhi, 2015 ISBN : 9781107476417

S. No.	Title of Book	Author	Publication
9	Engineering Chemistry	Dara, S. S.; Umare S.S.	S.Chand and Co. Publication, New Delhi, 201, ISBN: 8121997658
10	Engineering Chemistry	Jain & Jain	Dhanpat Rai and sons; New Delhi, 2015. ISBN : 9352160002
11	Engineering Chemistry	Vairam, S.	Wiley India Pvt. Ltd. New Delhi, 2013, ISBN: 9788126543342
10	Chemistry for engineers	Agnihotri, Rajesh	Wiley India Pvt.Ltd. New Delhi, 2014, ISBN: 9788126550784

14. SOFTWARE/LEARNING WEBSITES

- <http://nptel.ac.in/course.php?disciplineId=115>
- <http://nptel.ac.in/course.php?disciplineId=104>
- <http://hperphysics.phy-astr.gsu.edu/hbase/hph.html>
- www.physicsclassroom.com
- www.fearofphysics.com
- www.sciencejoywagon.com/physicszone
- www.science.howstuffworks.com
- <https://phet.colorado.edu>
- www.chemistryteaching.com
- www.visionlearning.com
- www.chem1.com
- www.onlinelibrary.wiley.com
- www.rsc.org
- www.chemcollective.org
- www.wqa.org
- www.em-ca.org



Program Name : Mechanical, Civil Chemical and Fabrication Technology and Erection Engineering Program Group
Program Code : AE/CE/CH/FG/ME/PT/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 functions. 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, moments and their effects on structural elements, which will 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, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Identify the force systems for given conditions by applying the basics of mechanics.
- Select the relevant simple lifting machine(s) for given purposes.
- Determine unknown force(s) of different engineering systems.
- Check the stability of various force systems.
- Apply the principles of friction in various conditions for useful purposes.
- 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											
L	T	P	Theory						Practical							
			Paper Hrs.		ESE		PA		Total		ESE		PA		Total	
3	1	2	6	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.

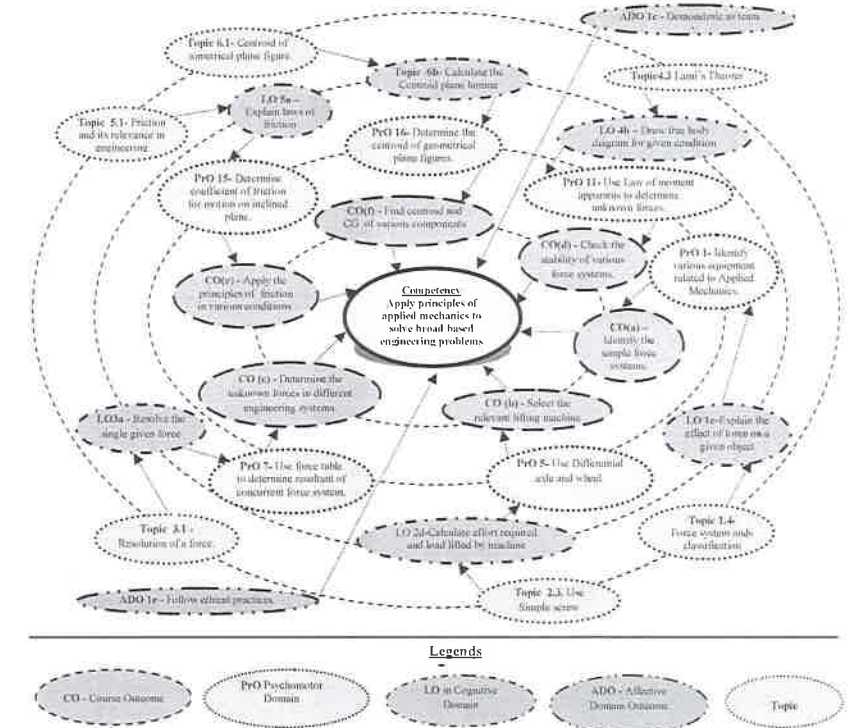


Figure 1 - Course Map

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 various equipment related to Applied Mechanics.	I to VI	02
2	Use Differential axle and wheel.	II	02*



8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics 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
Unit – I Mechanics and force system	1a. Explain concepts of the given terms. 1b. Use the relevant units of various quantities in the given situations. 1c. Explain effects of a force on the given object. 1d. Identify the force system for the given situation.	1.1. Significance and relevance: Mechanics, applied mechanics, statics, dynamics. 1.2. Space, time, mass, particle, body, rigid body. 1.3. Scalar and vector quantity, Units of measurement (SI units)- Fundamental units and derived units. 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. 2b. Differentiate the working principle of the given two types of simple lifting machines. 2c. Determine velocity ratio, efficiency and law of the given simple lifting machine. 2d. Calculate effort required and load lifted by the given simple lifting machine. 2e. Interpret the graphs after drawing them with the given data. 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. 2.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 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. 2.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.
Unit- III Resolution and composition	3a. Resolve the given single force. 3b. Calculate the resultant of the given force system analytically. 3c. Determine graphically the resultant of the given force system. 3d. Find the resultant of the given force system using	3.1 Resolution of a force - Orthogonal and Non Orthogonal components of a force, moment of a force, Varignon's Theorem, 3.2 Composition of forces – Resultant, analytical method of determination of resultant for concurrent, non concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces. 3.3 Graphic statics, graphical representation

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	law of triangle and law of parallelogram.	of force, Space diagram, force diagram, polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.
Unit– IV Equilibr m	4a. Draw the free body diagram for the given condition. 4b. Determine unknown force in the given situation using Lami's theorem. 4c. Identify the types of beams required for the given situation. 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, 4.2 Equilibrium of force systems analytically 4.3 Lami's Theorem, 4.4 Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, UD load, couple), span of beam. 4.5 Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and UD load or Vertical Point load and couple. 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. 5b. Describe the conditions for friction for the give situation. 5c. Determine friction force in the given situation. 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, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 5.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. 5.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. 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. 6b. Calculate centroid of the given composite plane lamina 6c. Determine centre of gravity of the given solids. 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) 6.2 Centroid of composite figures composed of not more than three geometrical figures 6.3 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) 6.4 Centre of Gravity of composite solids composed of not more than two simple solids.



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	Mechanics and Force System	04	02	02	02	06
II	Simple Lifting Machines	08	02	04	06	12
III	Resolution and Composition	10	02	04	08	14
IV	Equilibrium	10	02	02	10	14
V	Friction	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 (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:

- Collect five different photographs indicating concurrent, parallel, general force system in equilibrium
- Prepare a table of type of machine and relevant industrial application.
- Collect five different situations where law of moment plays an important role
- Prepare models representing various types of supports (hinged, roller and fixed)
- Illustrate situations wherein friction is essential and not essential
- 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:

- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for co-curricular activities.
 - 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 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:

- Types of Forces:** Prepare chart showing real-life examples indicating various types of forces
- 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 in "MECHANO" and "MECHANIX"
- Types of support:** Prepare chart showing actual and corresponding schematic diagram of various type of support
- Beams:** Prepare models of beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.
- 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
- 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: 9788121916431
2	Engineering Mechanics	Ramamrutham, 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: 9781107499836
4	Engineering Mechanics- Statics, Vol. I	Meriam, J. L.; Kraige, L.G.	Wiley Publication, New Delhi, ISBN: 978-81-265-4396

14. SOFTWARE/LEARNING WEBSITES

- <http://www.asnu.com.au>
- www.youtube.com for videos regarding machines and applications, friction
- www.nptel.ac.in
- www.discoveryforengineers.com



Program Name : Civil Engineering Program Group
Program Code : CE/CR/CS
Semester : Second
Course Title : Construction Materials
Course Code : 22204

1. RATIONALE

Construction material is the key element in the construction project. A diploma civil engineer (also called technologist) has to constantly deal with selection of materials for various engineering project of constructions such as residential/ commercial buildings, roads, metro railways, bridges, dams, tunnels, and fly-over. The development of advance technology generates the necessity of new engineering materials. It is a challenging job for the civil engineer to select relevant material which is durable, economical and eco-friendly. New materials are introduced every day in the market. Modern techniques are developed to handle and use materials for economic and safer designs of engineering structure. At diploma level, students are expected to study about these aspects so as to develop their understanding, performance oriented abilities in order to apply their knowledge in construction industry

2. COMPETENCY

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

- Select relevant building material to fulfill construction requirements.

3. COURSE OUTCOMES (COs)

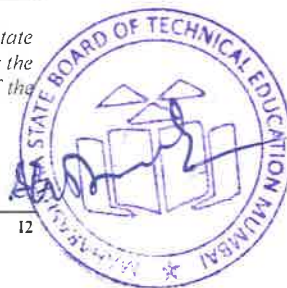
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- Identify relevant construction materials.
- Identify relevant natural construction materials.
- Select relevant artificial construction materials.
- Select relevant special type of construction materials.
- Select relevant finishing materials for construction.
- Identify processed construction materials.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Examination Scheme												
L	T	P	Credit (L+T+P)	Theory						Practical						
				ESE		PA		Total		ESE		PA		Total		
				Hrs.	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 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.

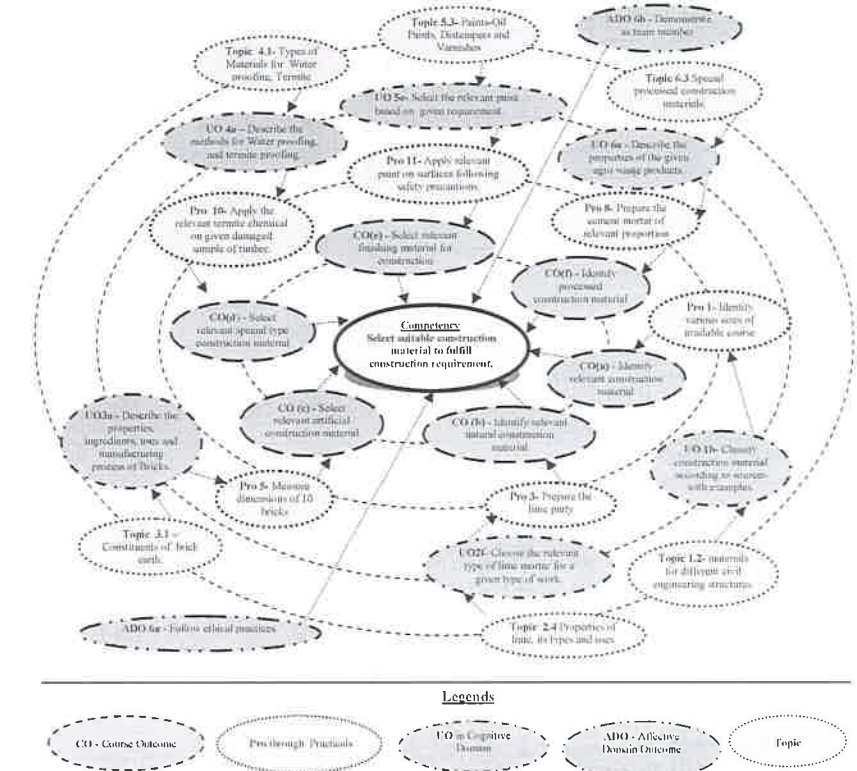


Figure 1 - Course Map

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 the various sizes of available coarse aggregates from sample of 10 kg in laboratory and prepare report (80, 40, 20, 10)	1	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	mm)		
2	Identify the available construction materials in the laboratory on the basis of their sources.	I	02
3	Identify the grain distribution pattern in given sample of teak wood in the laboratory and draw the various patterns. (along and perpendicular to the grains)	II	02*
4	Prepare the lime putty by mixing lime (1 kg) with water in appropriate proportion and prepare report on slaking of lime.	II	02
5	Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I	II	02
6	Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I	II	02
7	Select first class, second class and third-class bricks from the stake of bricks and prepare report on the basis of its properties.	III	02*
8	Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.	III	02*
9	Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.	III	02
10	Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti- skid tiles, chequered tiles, paving blocks and prepare report about the specifications. Part I	III	02*
11	Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti- skid tiles, chequered tiles, paving blocks and prepare report about the specifications. Part II	III	02
12	Apply the relevant termite chemical on given damaged sample of timber. Part I	IV	02*
13	Apply the relevant termite chemical on given damaged sample of timber. Part II	IV	02
14	Prepare the finished piece of glass of given dimension from broken and damaged pieces of glass and asbestos using standard cutting and filing tools with safe practices. Part I	IV	02
15	Prepare the finished piece of glass of given dimension from broken and damaged pieces of glass and asbestos using standard cutting and filing tools with safe practices. Part II	IV	02
16	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I	V	02*
17	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part II	V	02



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
18	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I	V	02
19	Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part II	V	02
20	Prepare the cement mortar of proportion 1:3 or 1:6 using artificial sand as a special processed construction material.	V1	02*
21	Prepare mortar using cement and Fly ash or Granite/marble polishing waste in the proportion 1:6 or 1:3.	V1	02
Total			42

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 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	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:

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- 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	Exp. No.
1	Weighing balance	2 to 5
2	Pan, spade	2 to 6
3	Steel Tape	5 to 6
4	Saw of different types (Rip saw having 4 to 6 mm pitch, cross cut saw with tooth pitch 2 to 3 mm, panel saw)	2
5	Painting brushes of different size for oil, acrylic painting and rollers of different size for smooth finishing work.	11
6	Manual Glass cutter with diamond tip at end	13
7	Trowels (Brick, Buttering, Pointing) , triangular, ranging in size up to about 11 inches (279.40 mm) long and from 101.6 mm to 203.2 mm wide i.e. (4 to 8 inches wide).	1,3,7,8, 12
8	Portable Hammer , Spade, Pans (Ghamela), Thread, lime	1,3,4,7, 8,12
9	Square, mason's level, and straightedge 28.57 mm to 38.10 mm and the middle portion of the top edge from 152.40 mm to 254 mm wide	3,5,12
10	Ordinary Portland Cement	8
11	Bricks of standard size 230 mm x 115 mm x 75 mm,	4,5
12	Fly ash or Granite/marble polishing waste	12
13	Paints-OBD, acrylic, plastic emulsion.	11
14	Broken pieces of Glass	13



8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics 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
Unit – I Overview of Construction Materials	1a. Describe the civil engineering applications in the given field of civil engineering. 1b. Classify the given construction material according to sources with examples. 1c. Describe the criteria to select the construction materials for the given situation. 1d. Suggest the construction material in the given situation with justification.	1.1 Scope of construction materials in Building Construction, Transportation Engineering, Environmental Engineering, Irrigation Engineering (applications only). 1.2 Selection of materials for different civil engineering structures on the basis of strength, durability, Eco friendly and economy. 1.3 Broad classification of materials – Sources of materials, Natural, Artificial- special, finishing and recycled.
Unit – II Natural Construction Materials	2a. Describe the properties and structure of the given natural construction material. 2b. Explain the given type of defect(s) in timber. 2c. Explain the procedure of preservation of timber in the given situation. 2d. Select the natural construction material for the given situation with justification. 2e. Choose the relevant type of lime mortar for the given type of construction work with justification.	2.1 Requirements of good building stone; general characteristics of stone; quarrying and dressing methods and tools for stone. 2.2 Structure of timber, general properties of good timber, seasoning, preservation and defects in timber and uses, use of bamboo in construction. 2.3 Asphalt, bitumen and tar used in construction, properties and their uses. 2.4 Properties of lime, its types and uses. 2.5 Types of soil and its suitability in construction. 2.6 Properties of sand and uses. 2.7 Classification of coarse aggregate according to sizes and its uses.
Unit- III Artificial Construction Materials	3a. Describe the properties, ingredients, uses and manufacturing process of the given type of brick. 3b. Classify the given artificial construction materials. Classify different artificial construction material 3c. Select relevant type of artificial	3.1 Constituents of Brick earth, Conventional / Traditional bricks, Modular and Standard bricks, Characteristics of good brick, Classification of burnt clay bricks and their suitability, Special bricks, Common Field tests on Bricks, Manufacturing process of burnt clay brick.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	material for the given type of construction work with justification. 3d. Select the type of precast concrete products for the given civil structure with justification. 3e. Select relevant type of ferrous metal for the given type of construction work with justification. 3f. Select relevant type of non-ferrous metal for the given type of construction work with justification.	3.2 Flooring tiles – Types, uses 3.3 Manufacturing process of Cement - dry and wet (only flow chart), types of cement and its uses. 3.4 Pre-cast concrete blocks- hollow, solid, pavement blocks, balustrades, and their uses. 3.5 Plywood, particle board, Veneers, laminated board and their uses. 3.6 Types of glass: soda lime glass, lead glass and borosilicate glass and their uses. 3.7 Ferrous and non-ferrous metals and their uses.
Unit– IV Special Construction Materials	4a. Describe the method used for water proofing, termite proofing, thermal and sound insulation in the given situation. 4b. Select the relevant material required for the given operations with justification. 4c. Describe the fibers required for the given construction material. 4d. Select features of the given fiber which can be used as construction material with justification. 4e. Describe the features of the given type of geopolymer cement.	4.1 Types of material and suitability in construction works of following materials: Water proofing, Termite proofing; Thermal and sound insulating materials. 4.2 Fibers – Types –Jute, Glass, Plastic Asbestos Fibers, (only uses). 4.3 Geopolymer cement : Geo-cement: properties, uses and applications
Unit– V Finishing Materials	5a. Choose the relevant proportion adopted in mortars for the given type of construction work with justification 5b. Select the relevant type of POP board for the given type of work with justification. 5c. Describe properties of the given type of paint. 5d. Select the relevant type of paint to be used for the given situation with justification. 5e. Choose the relevant type of finishing material for the given situation with justification.	5.1 Lime Mortar, Cement Mortar, Special Mortars and their uses as plastering material. 5.2 Constituents and uses of POP (Plaster of Paris), POP finishing boards, sizes and uses. 5.3 Paints-Oil Paints, Distempers and Varnishes with their uses (situations where used).
Unit– VI Processed	6a. Describe the properties of the given industrial or agro waste	6.1 Industrial waste materials- Fly ash, Blast furnace slag, Granite and



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Construction Materials	products used for the given type of work. 6b. Describe the salient properties of the given modern construction material. 6c. Describe the salient properties of the given special construction material. 6d. Select the relevant processed construction material for the given situation with justification.	marble polishing waste and their uses. 6.2 Agro waste materials - Rice Husk, Bagasse, coir fibres and their uses. 6.3 Special processed construction materials; Geosynthetic, Ferrocrete, Artificial timber, Artificial sand and their uses

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 Construction Materials	04	04	04	--	08
II	Natural Construction Materials	12	04	08	04	16
III	Artificial Construction Materials	14	06	08	04	18
IV	Special Construction Materials	06	00	04	04	08
V	Finishing Materials	06	02	04	04	10
VI	Processed Construction Materials	06	02	04	04	10
Total		48	18	32	20	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:

- Undertake a market survey of different construction materials and compare the following points.
 - Structure
 - Properties
 - Applications.
- Prepare journals consisting of sketches of construction materials.
- Undertake a market survey from local dealers for procurement of civil engineering material.
- Inspect the various activities related to Construction material at sites of different civil structures.
- Teacher guided self-learning activities

- f. Course/ library /internet based mini-projects.
- g. Literature survey of available at institute library regarding construction material used for different purposes and situations.
- h. Develop Power point presentation or animation for demonstrating laying and fixing the construction materials.
- i. Seminar on any relevant topic related to construction materials.

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 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 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. Collect the market rates for following construction materials from various dealers/suppliers of local market for different brands.

- i. Bricks.
 - ii. Stone / aggregate (20 mm, 40 mm and 80 mm)
 - iii. Teak wood.
 - iv. Flooring tiles.
 - v. Ordinary Portland Cement
 - vi. Oil paint
 - vii. Cement Paint
 - viii. Plaster of Paris
 - ix. Plastic paints
 - x. Recent types of paint.
- b. Download the IS 456 and IS 800 and attach the printout for following materials.
 - i. Steel section (I-section and ISA)
 - ii. Mortar of proportion 1:6 and 1:4
 - iii. Cement concrete mix of 1:2:4, 1:3:6 and 1:4:8.
 - c. Collect the technical brochures of following construction materials.
 - i. Ordinary Portland Cement
 - ii. Vitrified flooring tiles.
 - iii. Particle boards used for aluminum partitions.
 - iv. Paints.
 - d. Undertake a market survey for the cost and technical specification of different brands of following construction Materials and prepare comparison chart.
 - i. Cement
 - ii. Tiles
 - iii. Glass
 - iv. Paints.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Construction Materials	Ghose, D. N.	Tata McGraw Hill, New Delhi, 2014 ISBN: 9780074516478
2	Building Materials	Varghese, P.C.	PHI learning, New Delhi, 2014 ISBN: 8120328485
3	Engineering Materials	Rangwalla, S.C.	Charator publisher, Ahmedabad, 2015. ISBN: 9789385039171
4	Civil Engineering Materials	Somayaji, Shan	Pearson education, New Delhi, 2015 ISBN: 9788131766316
5	Engineering Materials	Rajput, R.K	S. Chand and Co., New Delhi, 2015 ISBN 8121919606
6	Engineering Materials	Sharma	PHI Learning, New Delhi, 2015 ISBN: 812032448X
7	Building Materials	Duggal, S. K.	New International, New Delhi, 2014 ISBN: 8122414354

14. SOFTWARE/LEARNING WEBSITES

- a. <https://www.quora.com/What-is-geocement>
- b. <http://apis-cor.com/en/about/blog/geocement-new-generation-hightech-material>
- c. <http://www.nbmw.com/concrete/10827-geopolymer-concrete-a-new-eco-friendly-material-of-construction.html>



- d. <https://www.youtube.com/watch?v=1fc4NVP9wXk>
- e. <https://www.youtube.com/watch?v=m8U76Bm8kDY>
- f. <https://www.youtube.com/watch?v=IORIZ1shR1M>
- g. <https://www.youtube.com/watch?v=Xf89K.Dib1FE>



Program Name : Civil Engineering Program Group
Program Code : CE/CR/CS
Semester : Second
Course Title : Basic Surveying
Course Code : 22205

1. RATIONALE

Development and planning process for any civil engineering project needs survey of that area to be carried out and various types of survey maps are to be prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and construction process. The diploma pass outs/technicians should therefore know the various methods and instruments required for surveying. They should also have the skill and information to handle and operate the needed survey instruments. This course is therefore one of the core courses required for civil, mining, environmental and transportation engineers. Students are advised to master the desired skills 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:

- Undertake civil engineering surveys.

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:

- Select the type of survey required for given situation.
- Compute area of open field using chain, tape and cross staff.
- Conduct traversing in the field using chain and compass.
- Use leveling instruments to determine reduced level of ground points.
- Draw/interpret contour maps of an area collecting field data.
- Use digital planimeter to calculate the areas.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				ESE		PA		Total		ESE		PA		Total		
				Hrs.	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 LOs 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, 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 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.

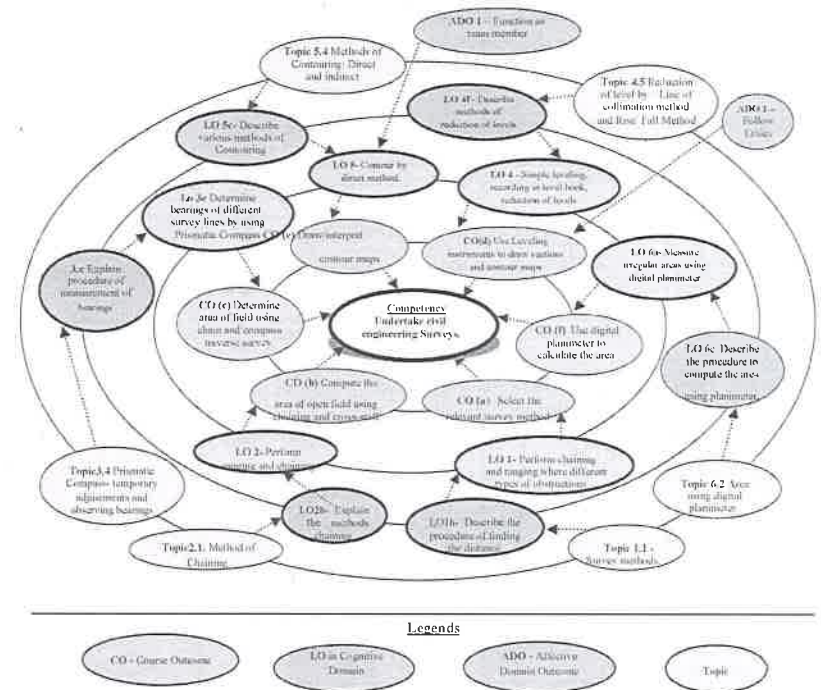
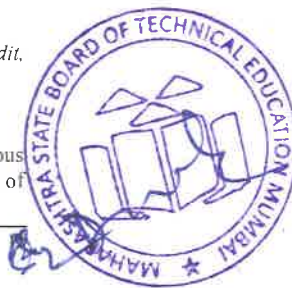


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs), to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Study & use of Metric Chain, Tapes, Ranging rods, Arrows	II	02
2	Measure distance between two survey stations using chain, tape and ranging rods to when two stations are inter visible. Part I	II	02*



S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
3	Undertake reciprocal ranging and measure the distance between two stations. Part I	II	02*
4	Undertake reciprocal ranging and measure the distance between two stations. Part II	II	02
5	Determine area of open field using chain and cross staff survey. Part I	II	02*
6	Determine area of open field using chain and cross staff survey. Part II	II	02
7	Determine area of open field using chain and cross staff survey. Part III	II	02
8	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part I	III	02*
9	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part II	III	02
10	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass. Part III	III	02
11	Measure Fore Bearing and back bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction. Part I	III	02*
12	Measure Fore Bearing and back bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction. Part II	III	02
13	Measure Fore Bearing and back bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction. Part III	III	02
14	Measure Fore Bearing and back bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction. Part IV	III	02
15	Undertake Survey Project with chain and compass for closed traverse for minimum 5 sides around a building. (Compulsory)	III	1* Full Day
16	Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.15. Part I	III	02
17	Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.15. Part II	III	02
18	Undertake simple leveling using dumpy level/ Auto level and leveling staff. Part I	IV	02*
19	Undertake simple leveling using dumpy level/ Auto level and leveling staff. Part II	IV	02
20	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff. Part I	IV	02*
21	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff. Part II	IV	02
22	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using	IV	02

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
	dumpy level/Auto Level and leveling staff. Part III		
23	Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff. Part I	IV	02
24	Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff. Part II	IV	02
25	Undertake <i>Survey Project</i> with Leveling instrument for Profile leveling and cross-sectioning for a road length of 500 m with cross-section at 30 m interval. (Compulsory)	IV	1* Full Day
26	Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in <i>Survey Project</i> mentioned at practical No.25. Part I	V	02*
27	Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in <i>Survey Project</i> mentioned at practical No.25. Part II	V	02
28	Conduct block contouring for the area of 40m x 40m to draw its contour plan. Part I	V	02
29	Conduct block contouring for the area of 40m x 40m to draw its contour plan. Part II	V	02
30	Undertake <i>Survey Project</i> for plotting contour map using block contouring method for a block of 150m x 150m with grid of 10m x 10m. (Compulsory)	V	1* Full Day
31	Plot the contours on A1 size imperial drawing sheet for data collected in <i>Survey Project</i> mentioned at practical No.30. Part I	V	02
32	Plot the contours on A1 size imperial drawing sheet for data collected in <i>Survey Project</i> mentioned at practical No.30. Part II	V	02
33	Plot the contours on A1 size imperial drawing sheet for data collected in <i>Survey Project</i> mentioned at practical No.30. Part III	V	02
34	Measure area of irregular figure using Digital planimeter. Part I	VI	02*
35	Measure area of irregular figure using Digital planimeter. Part II	VI	02
	Total		82

Note

- A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicious 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.
- Hence, the 'Process' and 'Product' related skills associated with each LO 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 Conclusion	20

S. No.	Performance Indicators	Weightage in %
6	Answer to sample questions	10
7	Submission of report in time	10
Total		100

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

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

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

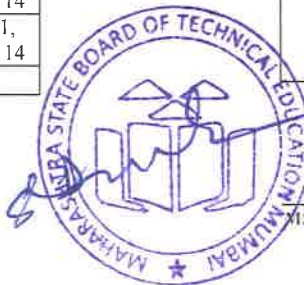
The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1	Metric Chain made from galvanized mild steel wires 4mm in dia, brass handles with swivel joints, brass tallies provided at every 5 m length of chain - 20 and 30m. Metallic tape-, Steel tape, Invar, Fiber glass tape satisfying IS 1269 (Part 1 and Part 2) : 1997 specifications	1 to 6, 11, 13 and 14
2	Pegs of length 400 mm and c/s area of 50 mm x 50 mm, Arrows 400 mm long and made up of good quality hardened and tempered steel wire of 4 mm in diameter.	1 to 6, 11, 13 and 14
3	Metallic Ranging rods of 2 m length, circular or octagonal in cross section of 30 mm diameter, Lower shoe of 150 mm long. Painted in black, white and red stripes of 200 mm each.	1 to 6, 11, 13 and 14
4	Optical square confirming to IS: 7999 – 1973 specifications and open cross staff consisting of 4 metal arms with vertical slits for sighting through.	1 to 6, 11, 13 and 14
5	Prismatic compass confirming to IS 1957-1961 with stand, made in Gun metal material having diameter of 85-110 mm and the least count of 30 minutes.	4, 5 and 6
6	Dumpy level and automatic levels confirming to IS: 9613 – 1986 with stand and internal focusing telescope of standard make.	8 to 11, 13 and 14
7	Leveling staves- 2 m and 4 m ,telescopic type confirming to IS 11961 -1986 or Folding type confirming to IS 1779 (1961), 5 mm least count	8 to 11, 13 and 14
8	Digital planimeter of standard make with Ni Cd batteries and AC adapters	16

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Overview and Classification of Survey	<ol style="list-style-type: none"> Classify given type of survey based on purpose, instruments used and nature of field and place. Explain the given basic principles of surveying. Describe given type of scale. Select the type of survey for given situation. Select the type of scale for given situation. 	<ol style="list-style-type: none"> Survey- Purpose and Use, Principles of Survey Types of surveying- Primary and Secondary classification, Plane, Geodetic, Cadastral, Hydrographic, Photogrammetry Aerial, Layout survey, Control survey, Topographical survey, Route survey, Reconnaissance survey. Scales: Engineer's scale, RF and Diagonal scale.
Unit– II Chain and cross staff Survey	<ol style="list-style-type: none"> Describe the procedure of finding the distance between two given inter-visible and not inter-visible survey stations. Explain the methods of ranging and measuring the length of the given survey line with examples. Explain the corrections in measurement of distance with chain in given situation. Compute the area of given field using principle of triangulation. Compute area of given open field by using chain and cross staff. Select type of chaining for given situation. 	<ol style="list-style-type: none"> Chain survey Instruments: Metric Chain, Tapes, Arrow, Ranging rod, Open cross staff, Optical square (No questions to be asked for exams) Chain survey Station, Base line, Check line, Tie line, Offset, Tie station, obstacles in chaining; Types of offsets: Perpendicular and Oblique Ranging: Direct and Indirect Ranging. (No questions to be asked for exams) Errors in length: Instrumental error, personal error, error due to natural cause, random error Principle of triangulation Location Sketch of survey station and running measurements of building. Conventional Signs, Recording of measurements in a field book. Area Calculations (Numerical problems)
Unit– III Chain and Compass traverse Survey	<ol style="list-style-type: none"> Carry out the traversing in given situation by using compass and chain. Convert given whole circle bearing to reduced bearing and vice versa to find included angle with examples. Explain construction and functions of given parts of the given type of compass. Determine correct bearings from the given observed 	<ol style="list-style-type: none"> Compass Traversing: open, closed. Technical Terms: Geographic/True Magnetic and Arbitrary Meridians and Bearings, Meridian and Bearing, Whole Circle Bearing System (Azimuth) and Reduced (Quadrantal) Bearing System and examples on conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station, Dip of Magnetic needle, Magnetic Declination.(Numerical problems)



Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	bearings. 3e. Explain the methods used to plot a traverse in the given situation. 3f. Adjust the closing error of the traverse for the given data.	3.3 Components of Prismatic Compass and their Functions (No sketch) Method of using Prismatic Compass- Temporary adjustments and observing bearings 3.4 Local attraction, Methods of correction of observed bearings-Correction at station and correction to included angles, 3.5 Methods of plotting a traverse and closing error, Graphical adjustment of closing error.
Unit- IV Levelling	4a. Explain the given terms related to leveling. 4b. Describe construction and use of the given leveling instrument. 4c. Explain the given temporary adjustments of a typical dumpy level. 4d. Describe methods of reduction of levels by height of collimation and rise and fall method in the given situation. 4e. Select type of leveling for the given work with examples and justification. 4f. Compute the missing readings from the given observed readings.	4.1 Terminologies: Level surfaces, level line, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Rise, Fall, Line of collimation, Station, Back sight, Fore sight, intermediate sight, Change point, Height of instruments. 4.2 Types of levels: Dumpy, Tilting, Auto level, Digital level, Components of Dumpy Level and its fundamental axes, Temporary adjustments of Level. 4.3 Types of Leveling Staffs: Self-reading staff and Target staff. 4.4 Reduction of level by Line of collimation method and Rise/ Fall Method 4.5 Methods: To find the R. L. by H.I. method (Numerical problems) 4.6 To find R.L by Rise and Fall method with necessary checks. (Numerical problems) 4.7 Leveling Types: Simple, Differential, Fly, Profile and Reciprocal Leveling 4.8 Computation of missing readings, Errors in Leveling. (Numerical problems) 4.9 Comparison of different levels.
Unit- V Contouring	5a. Describe the importance of contour maps for the given type of topography. 5b. Explain characteristics of contours for the given terrain. 5c. Explain methods of plotting contours in the given situation. 5d. Explain factors affecting the selection of the given contour interval. 5e. Prepare contour map from the given RLs of grid points with examples.	5.1 Contour, contour interval, horizontal equivalent. 5.2 Contour maps: Characteristics and uses 5.3 Methods of Contouring: Direct and indirect 5.4 Methods of interpolation of contours: approximate, arithmetic and graphical 5.5 Toposheets: Study.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit- VI Measurement of Area and Volume	6a. Explain the theory and use of digital planimeter in the given situation. 6b. Describe procedure for measuring the given area using digital planimeter 6c. Compute the area from the given contour map. 6d. Compute the volume of reservoir from the given contour map.	6.1 Digital planimeter: Components and uses 6.2 Measurement of area using digital planimeter. (No problems to be asked for Exams) 6.3 Measurement of volume of reservoir from contour map. (No problems to be asked for exams)

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' 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 and Classification of Survey	04	2	4	-	06
II	Chain and cross staff Survey	06	2	-	6	08
III	Chain and Compass traverse Survey	12	4	4	8	16
IV	Levelling	16	6	6	12	24
V	Contouring	06	2	4	4	10
VI	Measurement of Area and Volume	04	2	4	-	06
Total		48	18	22	30	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 LOs. 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:

- Construct a plain scale 1 cm = 3 m to read up to a meter and represent 27 m on the scale.
- Draw a neat labeled sketch of a 20m chain and show its salient features.
- Explain one method each to measure the distance between points on either side of obstacles in case of following: River, Lake, Building.
- Explain different obstacles encountered in chain survey.
- Explain the relation between the whole circle bearing and reduced bearing with the help of neat sketches and convert the given set of five WC to RB and vice versa.
- Measure the bearing of Sun at noon with compass and then magnetic bearing of any line AB to find the true bearing of that line.



- g. Find the deflection angles at each vertex of a give traverse with internal angles.
- h. Find the bearing of remaining lines when the bearing of any one line of a traverse and deflection angles at respective station are given.
- i. Determine the reservoir capacity from a give contour map of reservoir.
- j. Interpret the given contour maps.(minimum five situation).
- k. Draw the representative contour maps for the following: Ridge of a mountain, Hillock, Valley, Pond/lake, Gentle slope, Very Steep Slope, Plain Surface.

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 LOs/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 processes like chaining, levelling, traversing and contouring.
- h. Prepare maintenance charts for various machineries/equipments in survey laboratory.

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 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 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. Collect the information of survey instruments available in the market with specifications.
- b. Carry out comparative study of following survey instruments of different make and brands : Auto level and Digital planimeter.
- c. Calibrate the given chain with reference to standard gauge.
- d. Collect the map of city /town and calculate the ward wise and total area using digital planimeter.
- e. Determine the RLs of the existing structures like lintels, chajja, slab. and beam.

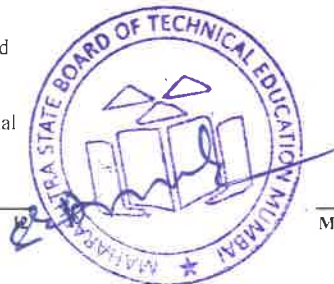
- f. Download specifications for prismatic compass, dumpy level, auto level, digital planimeter.
- g. Perform reconnaissance survey for alignment of road.
- h. Collect and interpret contour maps of different terrains available with various authorities.
- i. Construct and measure given length using Diagonal scale from a given map.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling volume I	Kanetkar, T. P., Kulkarni, S. V.	Pune Vidarthi Gruh Prakashan, Pune: ISBN:978-81-858-2511-3
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education, New Delhi ISBN 93-3290-153-8
3	Surveying	Saikia, M D.; Das, B.M.; Das, M.M.	PHI Learning, New Delhi ISBN: 978-81-203-3985-9
4	Fundamentals of Surveying and Levelling	Subramanian, R.	Oxford University Press, New Delhi, ISBN: 0-19-945472-8
5	Survey I	Duggal, S. K.	McGraw Hill Education, New Delhi, ISBN: 978-00-701-5137-6
6	Textbook of Surveying	Rao, P. Venugopala Akella, Vijayalakshmi	PHI Learning, New Delhi ISBN: 978-81-203-4991-9
7	Surveying I	Punmia, B.C, Jain, Ashok Kumar Jain, Arun Kumar	Laxmi Publications., New Delhi. ISBN: 8-17-008853-4
8	Surveying and Levelling, Volume I	Bhavikatti, S. S.	I. K. International, New Delhi ISBN: 978-81-906-9420-9
9	Textbook of Surveying	Venkatramaiah, C	Universities Press.New Delhi ISBN: 978-81-737-1021-6

14. SOFTWARE/LEARNING WEBSITES

- a. www.asnu.com.au
- b. www.oupinheonline.com
- c. www.mtu.edu/technology/undergrad
- d. www.wb.psu.edu/Academics/Degrees
- e. www.tjc.edu/info/2004134/profess
- f. www.pstcc.edu/catalog/12-13/ceip
- g. https://youtu.be/e_yabRh5GY
- h. <https://youtu.be/Z4yYHHX8N0>
- i. <https://youtu.be/2hL4wWUUSFc>
- j. <https://youtu.be/j8poe2vvD2Q>
- k. https://youtu.be/chhuq_t40rY
- l. <https://youtu.be/L54T4uvpMTg>
- m. <https://youtu.be/NdNEy-HBsoA>
- n. <https://youtu.be/7dN31ku0Bns>
- o. <https://youtu.be/S8exEaGMi9c>



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

General Civil Engineering Practices is a basic engineering course. The knowledge of basics of civil Engineering operations like masonry, mixing, concreting, finishing works is essential for technician to perform his/her duties in industries. 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 maintain tools and equipments with safety to self, co-workers and the constructed components of the building. Working in field develops the attitude of team working and safety awareness. This course provides the unique 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 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:

- Identify the various construction activities at site.
- Perform masonry job activities.
- Perform plumbing job activities.
- Identify finishing jobs related to building construction.
- Identify the various components of typical civil structures like road, culvert/bridges.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Examination Scheme											
I.	T	P	Credit (L+T+P)	Theory						Practical					
				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

(~): 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.

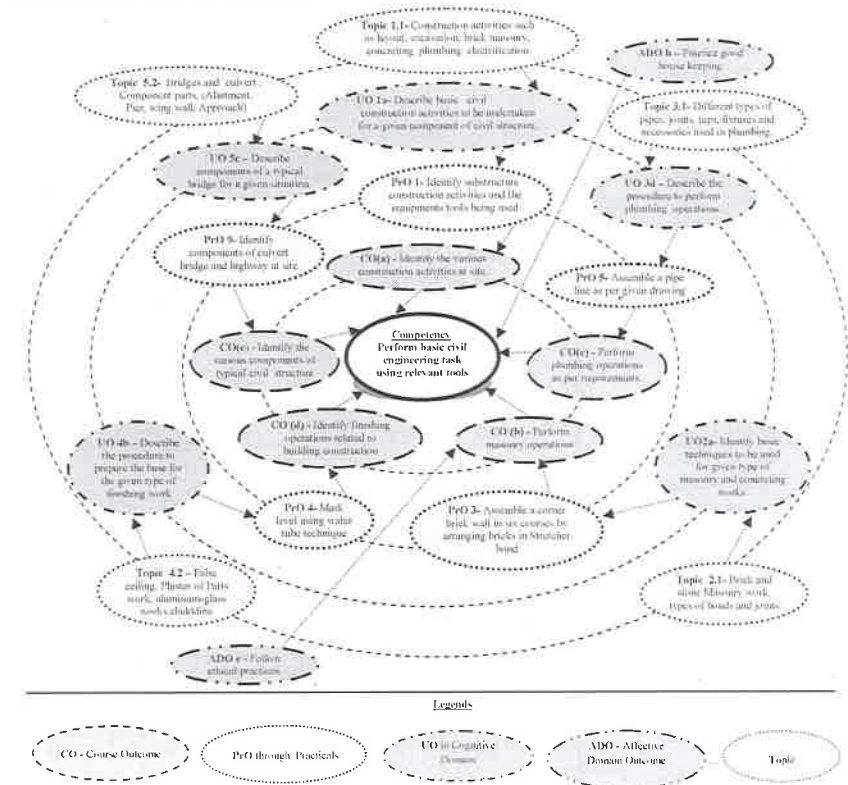


Figure 1 - Course Map

6. SUGGESTED PRACTICAL LEARNING OUTCOMES/TUTORIALS

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 substructure construction activities and the equipments/tools being used at site during the visit. Part I	I, II	02*
2	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part II	I, II	02



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
3	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part III	I, II	02
4	Identify the substructure construction activities and the equipments/tools being used at site during the visit. Part IV	I, II	02
5	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 a existing wall (Group of 10 students)	II	02*
6	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 a existing wall (Group of 10 students). Part I	II	02
7	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 a existing wall (Group of 10 students). Part II	II	02
8	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 a existing wall (Group of 10 students). Part III	II	02
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 a existing wall (Group of 10 students) Part IV	II	02
10	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part I	III, IV	02*
11	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part II	III, IV	02
12	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part III	III, IV	02
13	Identify the superstructure construction activities and the equipments/tools being used at site during the visit Part IV	III, IV	02
14	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part I (Group of 10 students)	II, IV	02*
15	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part II (Group of 10 students)	II, IV	02
16	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part III (Group of 10 students)	II, IV	02
17	Mark level of given height from ground level at different locations in the specified location using water pipe technique. Part IV (Group of 10 students)	II, IV	02
18	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe line. Part I	III	02*
19	Assemble a pipe line as per given drawing using pipes of one inch diameter, pipes of half inch diameter, nipple, reducer, union, valves T, elbow and then dissemble this pipe	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	line. Part II		
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, elbow and then dissemble this pipe line. Part III	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, elbow and then dissemble this pipe line. Part IV	III	02
22	Test the quality of cement on site/Laboratory. Part I	IV	02*
23	Test the quality of cement on site/Laboratory. Part II	IV	02
24	Test the quality of cement on site/Laboratory. Part III	IV	02
25	Identify types of bent up bar and stirrups at site during the field visit for the reinforcement for beams, column and slab. Part I	IV	02*
26	Identify types of bent up bar and stirrups at site during the field visit for the reinforcement for beams, column and slab. Part II	IV	02
27	Carry out field test on bricks at site. Part I	IV	02*
28	Carry out field test on bricks at site. Part II	IV	02
29	Carry out field test on bricks at site. Part III	IV	02
30	Identify the various components of the culvert at site	V	08*
31	Identify the various components of the bridge at site	V	08
32	Identify the various components of the highways at site	V	08
Total			64

Note

- 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 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.
- 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

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:



- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- 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	Exp. No.
1	Raw material such as bricks of standard size 230 mm x 115 mm x 75 mm,	3,8
2	Trowels (Brick, Buttering, Pointing) , triangular, ranging in size up to about 11 inches (279.40 mm) long and from 101.6 mm to 203.2 mm wide i.e. (4 to 8 inches wide).	3
3	Portable Hammer , Spade, Pans (ghamela), Thread, lime	3
4	Square, mason's level, and straightedge 28.57 mm to 38.10 mm and the middle portion of the top edge from 152.40 mm to 254 mm wide	3
5	Levels and mason's line, brushes.	3
6	String, Level / Water tube, Plumb bob, Right Angle	4
7	The mason's level to establish "plumb" and "level" lines	4
8	Plumbing materials such as pipes and accessories for different sizes and materials, pipe wrench	5
9	Pipe Bending Machine	5
10	Pipe Vice – 100 mm	5
11	Pipe Cutter- 50 mm	5
12	Ordinary Portland Cement	3,6
13	Reinforcement bar, 10 mm dia. , binding wire and bending tool	7
14	Bricks of standard size 230 mm x 115 mm x 75 mm.	3,8

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics 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
Unit – I Overview of Constructi on activities	<ol style="list-style-type: none"> Describe basic construction activities to be undertaken for the given component of civil structure. Identify the construction activities at the given site. Identify the tools used for the given type of foundation layout. Describe different safety precautions to be taken at the given construction site. 	<ol style="list-style-type: none"> Construction activities such as layout, excavation, brick masonry, concreting, plumbing, electrification, Interdependency of various activities Workmanship and Safety precautions
Unit – II Masonry and Concreting	<ol style="list-style-type: none"> Identify the basic techniques to be used for the given type of masonry and concreting works with justification. Identify the relevant quality control measures to be adopted in operations related to the given type of masonry and concreting with justification. Describe the methods of plastering and pointing to be undertaken in the given situation. Describe the methods of the formwork for the given type of building. Identify type of bonds in the given type of brickwork. 	<ol style="list-style-type: none"> Brick and stone Masonry work, Types of bonds and joints (vertical and horizontal). Line dori, plumb bob, right angle and water level tube. Plastering, Pointing. Proper mixing of concrete, concrete laying. Use of concrete Mixtures and Vibrators, different types of Vibrators. Formwork, Scaffolding. Centring and Shuttering.
Unit- III Plumbing Services	<ol style="list-style-type: none"> Identify the plumbing tools and fixtures in the given situation with justification. Select the pipe fittings, hand tools and machinery for the given type of work with justification. Select the type of plumbing tools and machinery for the given situation with justification. Describe the procedure to perform plumbing operations for the given condition. Describe the safety precautions to be undertaken for the given site. 	<ol style="list-style-type: none"> Different types of pipes, joints, taps, fixtures and accessories used in plumbing. Components (pipes, valves, bends,) used in water supply/sanitary/sewerage lines.
Unit- IV Finishing Works	<ol style="list-style-type: none"> Describe the operations to be undertaken related to the given situation of false ceiling, aluminum partitions, plastering work. Describe the procedure to prepare the 	<ol style="list-style-type: none"> Flooring, skirting and dado. False ceiling, Plaster of Paris (POP) work, aluminum – glass works, cladding. Whitewash and painting.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	base for the given type of finishing /painting work. 4c. Choose the relevant aluminum section for the given type of work with justification. 4d. Describe whitewashing and Painting procedure for the given type of walls/steel frames/wooden structure.	Tools required, brush, roller and spray painting, preparation of surface for timber and steel members for painting.
Unit– V Constructi on of Road, culverts/ bridges	5a. Identify relevant materials for the given type of road construction with justification. 5b. Describe the types and components of road for the given situation. 5c. Describe the components of typical bridge for the given situation. 5d. Describe the components of a typical Culvert in the given situation. 5e. Identify relevant materials for construction of given type of bridge/culvert.	5.1 Types of road, components of road, (carriage way, shoulder, camber, gradient). 5.2 Bridges and Culvert, component parts, (Abutment, Pier, Wing wall, Approach).

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:

- Undertake a market survey of local dealers for procurement of civil engineering materials, plumbing materials and finishing items
- Organize a visit to Construction sites of different types such as simple residential buildings, malls, multistoried buildings. Observe the course/topic based practices on the field.
- Teacher guided self-learning activities
- Course/ library /internet based mini-projects.
- 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:

- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
 - Guide student(s) in undertaking micro-projects.
 - Arrange visit to nearby construction sites for understanding various construction stages and construction activities.
 - Show video/animation films to explain various processes like, excavation, foundation, brickwork, plastering, laying water supply and sewer pipe line.
 - Prepare construction activity chart for various civil engineering stages.

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 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:

- Bill Preparation** (Group of 4-5 students) – Prepare bill of materials for given pipeline layout
- Masonry and concreting** – Each student will collect the information regarding the IS provisions for the construction materials like cement, bricks, reinforcement and sand.
- Finishing Work** – Collect the information from local market regarding the types, thickness, manufacturer, cost of various brands and make of aluminum extruded sections along with its specifications laid in IS code. (Individual activity)
- Plumbing** – Download the specifications for plumbing tools such as bench vice, hammers, pipe wrench and pipe accessories.
- Masonry and concreting** – Undertake a market survey of cement aggregate and sand of various specifications from local dealers (Group of five students)
- Plumbing** – Collect the technical information for various plumbing accessories such as GI/PVC pipes, bend, union, couplings of various dimensions and write a brief reports. (Individual activity)
- Masonry and concreting (Individual activity)** –
 - Collect five samples of bricks from different suppliers and test them in field to assess its quality and write a report on it with reference to its constituents and process of manufacturing.
 - Prepare a mud /cement mortar of various proportions 1:3 and apply plaster on a plain wall of 120 mm X 90 mm and observe the line, level and plumb
 - Prepare a cement concrete of proportion 1:2:4, 1:3:6 and 1:4:8 and prepare a cubical block of it to determine its strength. (Individual activity)



- iv. Masonry and concreting –Collect the list of available brand of flooring tiles with their IS specifications and make a report of it.
- f. **Masonry and concreting** (Group of five students) – Undertake the local survey for various shuttering material along with 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 concern teacher
- h. **Finishing Work** (Individual 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	Bull, J.W.	Gower Press, London, 1989, ISBN: 9780566090288
4	Basic Plumbing With Illustrations	Massey, Howard C.	Craftsman Book Co; California, ISBN: 9780934041997
5	Modern Plumbing	Baker, E.Keith Blanken	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	Mantri Sandeep	Satya Prakashan, New Delhi; 2015; ISBN : 9788176842051

14. SOFTWARE/LEARNING WEBSITES

- a. <http://www.asnu.com.au>
- b. <http://www.iamcivilengineer.com/-building-design-and.html>
- c. www.mahapwd.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/EJ/EN/EQ/ET/EX/IE/MU/EE/

EP/EU/IS/IC/AE /FG/ME/PG/PT/DC/TX/TC

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 an 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:

- Communicate effectively by avoiding barriers in various formal and informal situations.
- Communicate skillfully using non-verbal methods of communication.
- Give presentations by using audio- visual aids.
- Write reports using correct guidelines.
- Compose e-mail and formal business letters.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
L	T	P		Theory						Practical					
				ESE		PA		Total		ESE		PA		Total	
Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
--	--	2	2	--	--	--	--	--	--	35@^	14	15~	06	50	20

(~^): For only practical courses, the PA (15 marks) has two components under practical marks i.e. the assessment of practical has a weightage of 60% (i.e.09 marks) and micro-project assessment has a weightage of 40% (i.e.06 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.

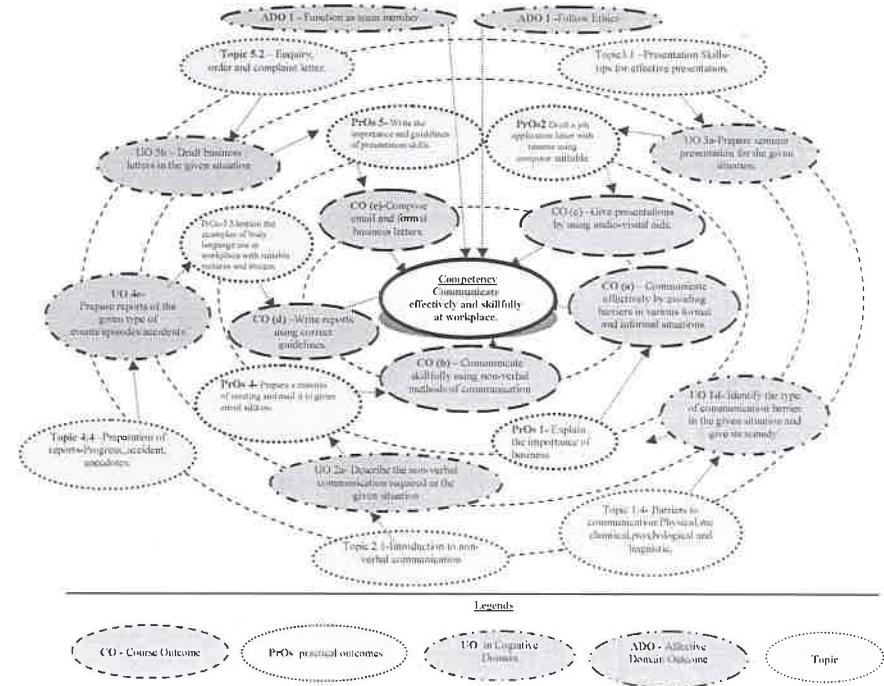


Figure 1 - Course Map

6. SUGGESTED PRACTICALS ACTIVITIES / EXERCISES (Integrate the theory in the laboratory when conducting practical)

The practical 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	Explain the importance of business communication for 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 the examples of body language use at workplace with suitable pictures and images.	II	2*
4	Prepare a minutes of meeting and mail it to given email 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 tips 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 attain the COs and competency. A judicious 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. The size of batch for the practical should not exceed more than 21 students strictly for the maximum attainment of COs and PrOs.

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

7. MAJOR EQUIPMENTS / 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	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/subtopics 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
	Writing Skills	Speaking Skills	
Unit – I Introducti on to Business Communic ation	1a. Describe the importance of the business communication in the given situation. 1b. Identify the missing element in the given communication process. 1c. Identify the type of communication in the given situation. 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. 1.2 Types (meaning and importance) –Verbal (Oral-Written), Formal, Informal, Vertical, Horizontal and Diagonal communication. 1.3 Principles of effective communication. 1.4 Barriers to communication - Physical, mechanical, psychological and linguistic. 1.5 Business communication: Meaning, characteristics and importance.
Unit– II Non- Verbal Communic ation	2a. Describe the non-verbal communication required in the given situation. 2b. Describe personal appearance required in the given communication situation. 2c. Describe the given facial expressions.	2d. Use relevant facial expressions in the given situation. 2e. Answer questions after listening to presentations.	2.1 Introduction to Non-Verbal communication (Meaning and importance) 2.2 Body Language: Aspects of body language: gestures, eye contact, posture, facial expressions, personal appearance (dressing and grooming) vocalics. 2.3 Body language - positive and negative body language.
Unit– III Presentatio n skills	3a. Prepare seminar presentation for the given situation. 3b. Prepare debate points 'for' and 'against' the given topic. 3c. Prepare the points for computer presentation	3d. Make seminar presentation 3e. Participate in debate speaking 'for' or 'against' the given topic. 3f. Make effective	3.1 Presentation skills- tips for effective presentation. 3.2 Guidelines for developing power point presentation. 3.3 Presenting Technical papers.

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

Note: To attain the COs and competency, above listed Learning Outcomes (UOs) need to be undertaken to achieve the 'Application Level' of Blooms's 'Cognitive Domain Taxonomy' Theory related topic should be covered during practical hours using multimedia.

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	02	02	01	05
II	Non-verbal Communication	02	01	02	05
III	Presentation Skills	02	01	02	05
IV	Office Drafting	02	04	04	10
V	Business Correspondence	02	04	04	10
Total		10	12	13	35

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 PrOs and 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 GUIDELINES FOR ASSESSMENT TOOL TO CONDUCT INTERNAL END SEMESTER EXAM (ESE) .

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

SUGGESTED STUDENT ACTIVITIES

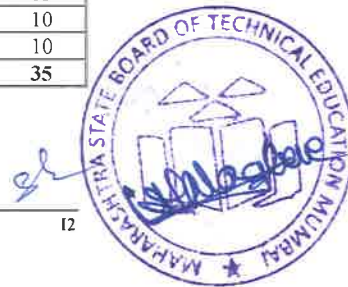
Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

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

- 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*.
- Arrange various communication activities using functional grammar.
 - Show video/animation films to develop listening skills and enhance vocabulary.
 - Use real life situations for explanation.
 - Prepare and give oral 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 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:

- Study the personal appearance and grooming of employees visiting sales store, shopping mall in the vicinity.
- Comparative study of Bio-data, Resume and Curriculum vitae.
- A detailed study of guidelines required for presentation skills.
- Summarize technical content using English newspaper, magazines or online resources.
- Prepare a booklet on aspects of body language in pictorial form.
- A detailed study of the importance, of technical paper of technical paper presentation.
- Case study on the importance of Business communication in an organization.
- Report on various formal/business activities.
- Study of oral presentation of famous business leader.
- Detailed study of business etiquettes observed in organization.
- Summarize the business article with the help 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

S. No.	Title of Book	Author	Publication
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

- <https://www.britishcouncil.in/english/learn-online>
- <http://learnenglish.britishcouncil.org/en/content>
- <http://www.talkenglish.com/>
- [languageabsystem.com](http://www.languageabsystem.com)
- www.wordsworthelt.com
- www.notesdesk.com
- <http://www.tutorialspoint.com>
- www.studylecturenates.com
- [totalcommunicator.com](http://www.totalcommunicator.com)
- www.speaking-tips.com

