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:

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
					Theory							Practical				
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	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.
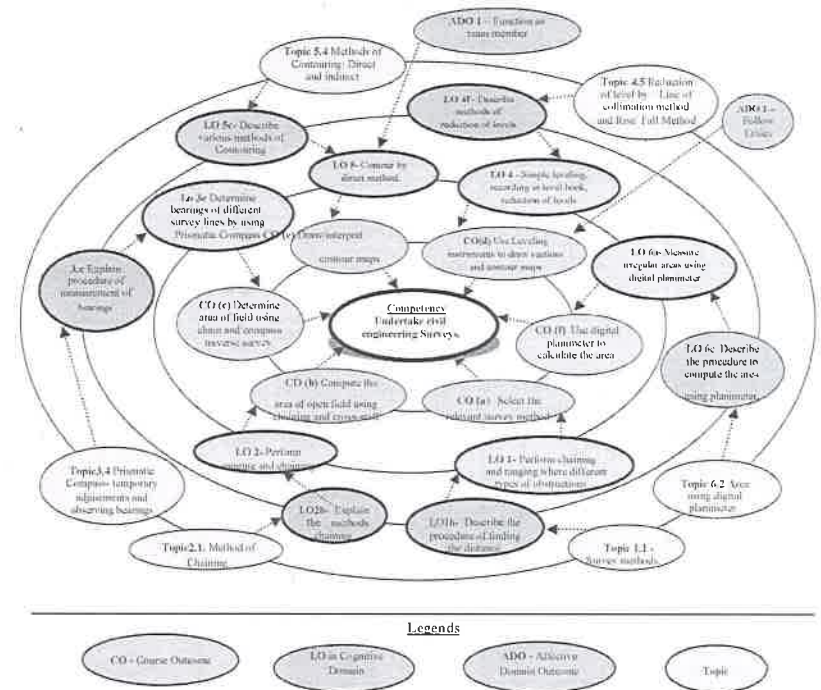

Figure 1 - Course Map

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*
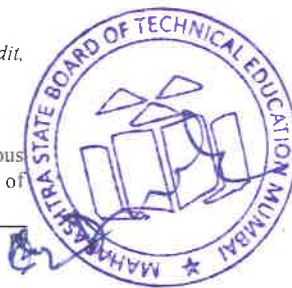
S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
3	Undertake reciprocal ranging and measure the distance between two stations. Part I	II	02*
4	Undertake reciprocal ranging and measure the distance between two stations. Part II	II	02
5	Determine area 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 5or 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 5or 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 5or 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 5or 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 *Survey Project* 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 *Survey Project* 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 *Survey Project* 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 *Survey Project* 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 *Survey Project* mentioned at practical No.30. Part I	V	02
32	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* mentioned at practical No.30. Part II	V	02
33	Plot the contours on A1 size imperial drawing sheet for data collected in *Survey Project* 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

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 judicial mix of minimum 24 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. Hence, the 'Process' and 'Product' related skills associated with each 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:
a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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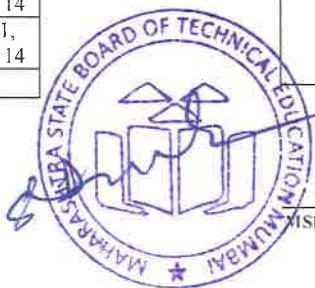
7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED
The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

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 – 1973specifications 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	1a. Classify given type of survey based on purpose, instruments used and nature of field and place. 1b. Explain the given basic principles of surveying. 1c. Describe given type of scale. 1d. Select the type of survey for given situation. 1e. Select the type of scale for given situation.	1.1 Survey- Purpose and Use, Principles of Survey 1.2 Types of surveying- Primary and Secondary classification, Plane, Geodetic, Cadastral, Hydrographic, Photogrammetry Aerial, Layout survey, Control survey, Topographical survey, Route survey, Reconnaissance survey. 1.3 Scales: Engineer's scale, RF and Diagonal scale.
Unit– II Chain and cross staff Survey	2a. Describe the procedure of finding the distance between two given inter-visible and not inter-visible survey stations. 2b. Explain the methods of ranging and measuring the length of the given survey line with examples. 2c. Explain the corrections in measurement of distance with chain in given situation. 2d. Compute the area of given field using principle of triangulation. 2e. Compute area of given open field by using chain and cross staff. 2f. Select type of chaining for given situation.	2.1 Chain survey Instruments: Metric Chain, Tapes, Arrow, Ranging rod, Open cross staff, Optical square (No questions to be asked for exams) 2.2 Chain survey Station, Base line, Check line, Tie line, Offset, Tie station, obstacles in chaining; Types of offsets: Perpendicular and Oblique 2.3 Ranging: Direct and Indirect Ranging. (No questions to be asked for exams) 2.4 Errors in length: Instrumental error, personal error, error due to natural cause, random error 2.5 Principle of triangulation 2.6 Location Sketch of survey station and running measurements of building. 2.7 Conventional Signs, Recording of measurements in a field book. 2.8 Area Calculations (Numerical problems)
Unit– III Chain and Compass traverse Survey	3a. Carry out the traversing in given situation by using compass and chain. 3b. Convert given whole circle bearing to reduced bearing and vice versa to find included angle with examples. 3c. Explain construction and functions of given parts of the given type of compass. 3d. Determine correct bearings from the given observed	3.1 Compass Traversing: open, closed. 3.2 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 o 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:
   a. Construct a plain scale 1 cm = 3 m to read up to a meter and represent 27 m on the scale.
   b. Draw a neat labeled sketch of a 20m chain and show its salient features.
   c. Explain one method each to measure the distance between points on either side of obstacles in case of following: River, Lake, Building.
   d. Explain different obstacles encountered in chain survey.
   e. Explain the relation between the whole circle bearing and reduced bearing with the help of neat sketches and covert the given set of five WC to RB and vice versa.
   f. 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.
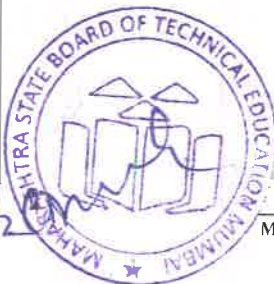
g. Find the deflection angles at each vertex of a give traverse with internal angles.

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 Vidyarthi 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 1	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/cerp

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/7dN3Iku0Bns

o. https://youtu.be/S8exEaGMi9c