Program Name : **Civil Engineering Program Group**

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

Semester : **Third**

Course Title : **Advanced Surveying**

Course Code : **22301**

1. RATIONALE

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

2. COMPETENCY

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

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

3. COURSE OUTCOMES (COs)

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

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory						Practical						
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 UOs required for the attainment of the COs.
Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment.*

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

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

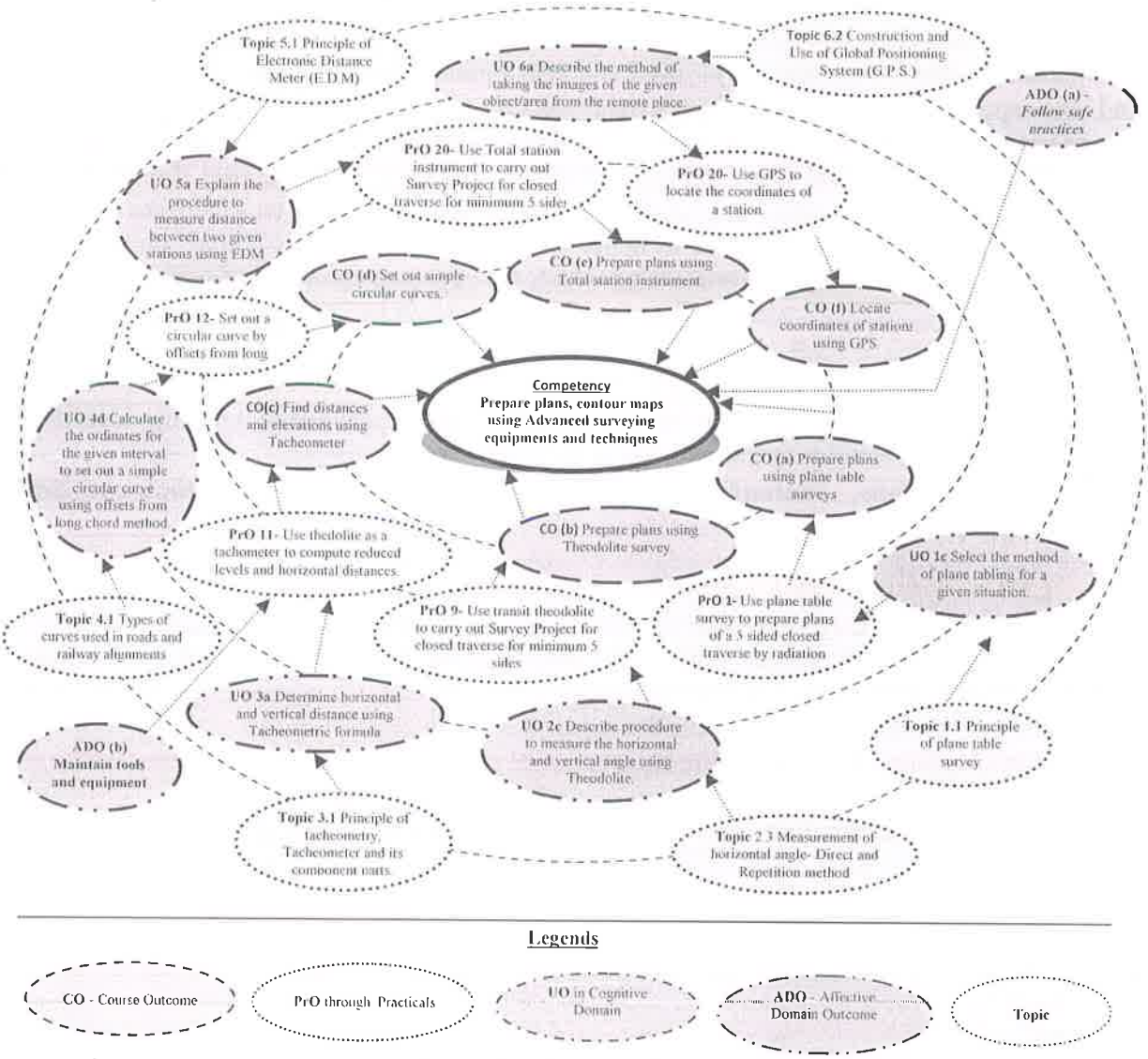

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

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

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

Note

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

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

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

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

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

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

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

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

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

8. UNDERPINNING THEORY COMPONENTS

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

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

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

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

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Plane Table Surveying	04	02	02	04	08
II	Theodolite Surveying	16	04	06	14	24
III	Tacheometric surveying	06	02	02	04	08
IV	Curve setting	06	02	02	04	08
V	Advanced surveying equipments	10	02	06	06	14
VI	Remote sensing and GIS	06	02	02	04	08
Total		**48**	**14**	**20**	**36**	**70**

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

10. SUGGESTED STUDENT ACTIVITIES

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

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

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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

12. SUGGESTED MICRO-PROJECTS

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

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

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

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

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

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Surveying and Levelling Part I and II	Kanetkar, T. P. and Kulkarni, S. V.	Pune Vidyarthi Gruh Prakashan, Pune; ISBN: 13: 9788185825007
2	Surveying and Levelling	Basak, N. N.	McGraw Hill Education (India) Pvt. Ltd.,Noida ISBN: 93-3290-153-8
3	Survey I and Survey II	Duggal, S. K.	Tata McGraw Hill Education Pvt. Ltd., Noida. ISBN:13: 978-1259029837
4	Surveying	Saikia, M D; Das B.M. and Das, M.M.	PHI Learning Pvt. Ltd., New Delhi ISBN: 978-81-203-3985-9
5	Surveying and Levelling	Subramanian, R.	Oxford University Press. New Delhi ISBN 13:978-0-19-808542-3
6	Surveying Vol. I and Surveying Vol. II	Punmia, B.C.; Jain, Ashok Kumar and Jain, Arun Kumar	Laxmi Publications Pvt. Ltd., New Delhi. ISBN: 13: 9788170088837
7	Textbook of Surveying	Rao, P. Venugopala and Akella, Vijayalakshmi	PHI Learning Pvt. Ltd., New Delhi ISBN: 978-81-203-4991-9
8	Textbook of Surveying	Venkatramaiah, C	Universities Press, Hyderabad ISBN: 978-81-737-1021-6
9	Surveying theory and	Anderson, James M	Mc Graw Hill Education, Noida

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

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/courses/105107121/
b. https://www.youtube.com/watch?v=QtEkZPEeeZk
c. https://www.youtube.com/watch?v=KQgq5xqSTUw
d. https://www.youtube.com/watch?v=zcRs3KTQzN0
e. https://www.youtube.com/watch?v=6d4mERJFPpI
f. https://www.youtube.com/watch?v=Dj06aUJ9Wjc
g. https://www.youtube.com/watch?v=Ob8LLRfo0tA
h. https://www.youtube.com/watch?v=n_EMrTbDZak
i. https://www.youtube.com/watch?v=H2AQq2jshgg
j. https://www.youtube.com/watch?v=C8UKJtZIAWE
k. https://www.youtube.com/watch?v=J6j_sJyyudI
l. http://www.asnu.com.au
m. www.oupinheonline.com