HERBERT MORRISON TECHNICAL HIGH SCHOOL

Motto: Strength and Perseverance

Established 1976

Home of Science, Technology and Technical/ Vocational Education

"Promoting a Culture of Excellence"

INDUSTRIAL ARTS DEPARTMENT

TECHNICAL DRAWING

Grades 10 & 11

COURSE OUTLINE

Revised for June 2017 Examination

Prepared by Mr. B. Burke

COURSE OUTLINE

Academic year: 2020 - 2022

Course: Technical Drawing ***(Building Drawing)***

Teacher: Mr. Campbell/ Mr. Dixon

MONTH	WEEKS		OJECTIVES/ CONTENT	ASSESSMENTS
SECTION 1: FUNDAMENTALS OF TECHNICAL DRAWING 1A: OCCUPATIONAL HEALTH, SAFETY AND THE ENVIRONMENT				
September		**REVISION**	**1. Safety, health and welfare standards** (a) Standards for: (i) workshop/laboratory; (ii) equipment; (iii) materials. **1A: OCCUPATIONAL HEALTH, SAFETY AND THE ENVIRONMENT (cont'd)** (b) Occupational Health and Safety (OHS). (c) Guidelines for: (i) working safely; (ii) enhancing wellness; (iii) preventing injury and accident.	Research assignments, Tests, and Role play for portfolio Assessment.
September			**2. Safety, health and welfare requirements** (a) Inventory of materials, tools and equipment.	Research assignments, Tests, and Role play for portfolio Assessment.

		REVISION	(b) Workshop/laboratory and equipment maintenance plans. (c) Workshop/laboratory layout and shop organisation diagrams. (d) List of danger points. (e) Safety signs and symbols. (f) Safety lanes. (g) Personal Protective Equipment (PPE). (h) Equipment guards.	
September		**REVISION**	**3. Safety resources** (a) PPE: (i) for different tasks; (ii) preparing labelled diagrams of safety gear and accessories.	Research assignments, Tests, and Role play for portfolio Assessment.
		REVISION	**4**. **Fires and fire-fighting equipment** (a) Types of fires: (i) Class A; (ii) Class B; (iii) Class C; (iv) Class D.	Research assignments, Tests, and Role play for portfolio Assessment.

			(b) Fire-fighting equipment: (i) fire extinguishers (Class A, Class B, Class C and Class D); (ii) colour codes for fire extinguishers; (iii) fire hydrants; (iv) fire hoses.	
		REVISION	**5**. **Using a fire extinguisher** (a) Safety guidelines and procedures for the various ranges of fires. (b) Preparing and maintaining report of usage. (c) Storage and maintenance of fire extinguishers	Research assignments, Tests, and Role play for portfolio Assessment.
		REVISION	**6**. **Accident, injury and emergency** (a) Differences. (b) Examples (falls, electric shock, minor damages to the eyes, broken bones, cuts).	Research assignments, Tests, and Role play for portfolio Assessment.
		REVISION	**7**. **First Aid** (a) First Aid kit station.	

			(b) Responsibilities of a First Aider. (c) Treating: (i) burns; (ii) electric burns; (iii) cuts and abrasions; (iv) heavy bleeding; (v) practising mouth-to-mouth resuscitation and recovery position.	
		REVISION	**8**. **Getting professional help** (a) Procedures for reporting an accident. (b) Emergency contacts: (i) police; (ii) fire services; (iii) hospital and ambulance service; (iv) Red Cross; (v) the defence force. (c) Preparing an accident report.	Research assignments, Tests, and Role play for portfolio Assessment.
			9. **Hazards and hazardous substances** (a) Definitions: (i) hazard;	Research assignments, Tests, and Role play for portfolio Assessment.

		REVISION	(ii) hazardous substance. (b) Materials Safety Data Sheet. (c) Storing materials and supplies safely.	
		REVISION	**10. Mock Drills** (a) Emergency procedures for a fire, an earthquake and a volcano. (b) Preparing mock drill reports.	Research assignments, Tests, and Role play for portfolio Assessment.
September	**SECTION 1: FUNDAMENTALS OF TECHNICAL DRAWING** 1B: EQUIPMENT, TOOLS, MATERIALS, LETTERING, LINE WORK, DIMENSIONS AND SCALES			

	WEEKS		OJECTIVES/ CONTENT	ASSESSMENTS
			Importance of Technical Drawing as a universal language (a) To the manufacturing industries. (b) To engineering. (c) To architecture. (d) To designers.	Research assignments, Role play and Testing Instruments, for student assessment and/or portfolio Development.
			International standards (a) AISI, ISO, BS standards. (b) Building codes and standards. (c) Engineering codes.	Research assignments, Role play and Testing Instruments, for student assessment and/or portfolio Development.
			Lettering and dimensioning (a) Principles, guidelines and techniques for lettering: (i) styles; (ii) guidelines; (iii) uniformity and spacing; (iv) size; (v) pencil size and techniques; (vi) calligraphy;	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			(vii) fonts/texts; and (viii) annotation. (b) Principles, guidelines and techniques for dimensioning: (i) unidirectional and aligned style of dimensions; (ii) dimension lines, extension lines, leaders, arrow heads; (iii) circles, arcs, radius, diameter; (iv) tolerances, limits and fits; (v) numbers (standard, metric and decimal); and (vi) dimension toolbar (CAD).	
			Scales (a) Reading and interpreting: (i) draftsmen; (ii) engineers; (iii) architects; and (iv) standard and metric. (b) Measuring with scales. (c) Converting units of measurement.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			(d) Applying ratios in engineering and construction drawings according to codes and regulations.	
		REVISION	**Free-hand sketching** (a) Using grid and plane papers. (b) Pictorial and orthographic drawings. (c) Sketching in proportion. (d) Graphic symbols. (e) Line work. (f) Sketching of building and engineering components	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			The design process (a) Identification of the problem. (a) Design of initial ideas to solve the problem.	Research assignments, Role play and Testing Instruments, for student assessment and/or portfolio Development.

			(b) Proposed solution. (c) Development and testing of models/prototypes. (d) Development of working drawings, notes and sketching to explain each step in the process.	
			Principles and Elements of design ***(a) Elements of design:*** (i) line; (ii) space; (iii) form; (iv) proportion; (v) harmony; (vi) dominance; and (vii) finishes. (b) Principles of design: (i) aesthetics; (ii) ergonomics;	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			(iii) economics; (iv) material; and (v) construction.	
			Drawings Skills in the design process (a) Working drawings. (b) Principles of Projection. (c) Manual and computer-aided drafting/design.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Designing building and engineering components (a) Implementing the design process using simple building and engineering components. (b) Codes and regulations. (c) Scales. (d) Materials. (e) Design presentation and evaluation.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
		SECTION 2A: GEOMETRICAL CONSTRUCTION: PLANE GEOMETRY		
	WEEKS		**OJECTIVES/ CONTENT**	**ASSESSMENTS**

			1. Solid and plane geometry (a) Definitions: (i) solid geometry; (ii) plane geometry. (b) Differences: (i) functions and features of plane and solid geometry. (ii) geometric terms and concepts	Research assignments, Role play and Testing Instruments, for student assessment and/or portfolio Development.
			Analytic geometry (LOCI) (a) Definition, properties and characteristics of ellipse, parabola and hyperbola. (b) Constructing an ellipse using the foci (major and minor axis), rectangular and concentric circle methods. (c) Constructing a parabola using the locus (distance of the vertex from the directrix) and rectangular methods (span and height). (d) Constructing a hyperbola with a given ratio 3:2 (transverse axis and the F focus). (e) Constructing an ellipse using trammel method. (f) Constructing the tangents and normal to the curves. (g) Constructing an Archimedean spiral given the pole and the longest and shortest radii. (h) Constructing an involute given the diameter of the circle, triangle, square and regular polygon.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			Path of points in simple mechanism Collaboration with industry, firms and the industrial technology programmes to access the use of simple mechanisms or representatives of: (a) sliding ladders; (b) rotating cranks; (c) screws threads; (d) cones; (e) helical and square springs; (f) the cycloid.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
		SECTION 2B: GEOMETRICAL CONSTRUCTION: SOLID GEOMETRY		
MONTH	**WEEKS**		**OJECTIVES/ CONTENT**	**ASSESSMENTS**
			1. Pictorial drawings (a) Types of pictorial drawings:	Practical drawing exercises done on paper or CAD to assess the

			(i) isometric; (ii) oblique; (iii) perspective. (b) Characteristics and uses of each type. (c) Advantages and disadvantages of each type. (d) Principles of projection for points, lines and planes from one view to the other.	different competencies of each objective.
			Producing pictorial drawings ***(a) Isometric drawings:*** (i) regular shaped objects; (ii) irregular shaped objects; (iii) objects with inclined surfaces; (iv) given the plan and front elevation; (v) drawings with isometric circles; (vi) drawings with isometric curves; (vii) exploded isometric drawings. ***(b) Oblique drawings:***	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			(i) drawing geometric solids in cavalier and cabinet projections; (ii) drawing figures with curves and circles in cabinet and cavalier oblique projections. ***(c) Perspective drawings*** (i) drawing geometric solids in 1-point perspective; (ii) drawing geometric solids in 2-point perspective.	
			First and third angle projections Principles relating to the planes of projection: (a) horizontal plane; (b) vertical planes; (c) plans; (d) elevations.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Orthographic drawings of geometrical solids (a) Simple models. (b) Truncated solids: (i) rectangular prism and pyramid; (ii) hexagonal prism.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			Sectioned surfaces of geometric solids (a) Right cones. (b) Cylinders. (c) Prisms. (d) Pyramids.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Determining true lengths of straight lines Methods: (a) revolution; (b) auxiliary methods.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Auxiliary views (a) Types: (i) primary auxiliary views; (ii) auxiliary views that include curved lines; (b) Uses and characteristics of the different types.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Preparing auxiliary drawings (a) Planes of projection: - *inclined and sloping surfaces.* (b) Oblique planes inclined to horizontal and vertical planes.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			Surface development *Uses of surface development for oblique solids and frustum of solids (relevant to the sheet metal industry).* **Constructing surface developments of oblique and frustum solids** (a) Applying parallel line and radial development methods for constructing: (i) prisms; (ii) cylinders; (iii) cones; (iv) pyramids; (v) truncated hexagonal pyramid, truncated cylinder; (vi) intersecting cylinders joined at angles; (vii) cylinders joined at 90 and 60 degree angles (large and small cylinders). (b) Determining true lengths and shapes of the surfaces.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Curves of interpenetration (a) Importance: - Lines of intersection and their importance in joining solids.	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			(b) Constructing curve of interpretation of geometric solids with their axes in the same plane, *horizontal sections, and angles of axes of joined solids.* (c) Finding the intersecting lines of two prisms. (d) Drawing the curve of interpenetration of two cylinders.	
			Helical spring ***(a) Circular cross-section of:*** (i) helix curves; (ii) pitch; (iii) lead; (iv) helical and square spring helix. ***(b) Constructing a single helical curve on a cylinder.***	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			Drawing orthographic views (a) Horizontal and vertical planes of projection. (b) Plans and Elevations. **Preparing pictorial drawings** (a) Isometric. (b) Oblique. (c) Perspective. **Solving drawing problems** (a) Using pictorial drawings:	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.

			(i) isometric; (ii) oblique; (iii) perspective. (b) Using First and Third Angle orthographic projections.	
			Sectional drawings (a) Types. (b) Characteristics. (c) Uses. ***(d) Preparing sectional drawings:*** (i) full sections; (ii) half sections; (iii) offset sections;	Practical drawing exercises done on paper or CAD to assess the different competencies of each objective.
			SECTION 3A: BUILDING DRAWING	
MONTH	**WEEKS**		**OJECTIVES/ CONTENT**	**ASSESSMENTS**
			1. STANDARDS (a) BSI. (b) ISO. (c) CUBIC. (d) Local standards.	

			2. TYPES OF DRAWINGS USED IN THE BUILDING INDUSTRY ***(a) Types:*** (i) site plans; (ii) location plans; (iii) building plans; (iv) elevations and sectional views ***(b) Uses and characteristics of each type of plan.*** ***(c) Labelled sketches of each type of plan.***	
			TYPES OF ARCHITECTURAL DRAWINGS ***(a) Types:*** **(**i) block; (ii) site; (iii) general location plans; (iv) foundation plans; (v) floor plans; (vi) building plans; (vii) elevations and sectional views. ***(b) Uses of each type of drawing.*** ***(c) Scales used in preparing the different types of drawings.*** ***(d) Conventional symbols and sketches.***	
			4. STANDARD ARCHITECTURAL PRACTICES (a) Line characteristics. (b) Lettering and dimensioning. (c) Symbols. (d) Conventions. (e) Labelling. (f) Notes and annotations.	

			ARCHITECTURAL DRAWINGS **(A) PREPARING A DRAWING SHEET** (i) Selecting paper size. (ii) Checking alignment. (iii) Drawing border line. (iv) Preparing title block. (v) Line characteristics. (vi) Lettering and dimensioning. **(b) Producing 2D and 3D solid model drawings of a building or its component** **- CAD application;** **(c) Drawing working plans of building sites** (i) Importance of site investigation. (ii) Common site clearance practices (demolishing, salvaging, cutting, burning, earth-moving and disposing). (iii) Preparing site plans: (iv) Factors important to site layout: - slope; - layout of land; - drainage; - sewer disposal; - fencing; - locating boundaries;	

			- building regulation for site layout. - components of site plan; - introduction to sub-soils.	
			(D) DRAWING FOUNDATIONS (i) Preparing simple working drawings of foundation work. (ii) Sketching concrete foundations of buildings. (iii) Preparing orthographic, pictorial and freehand sketches of: simple reinforcement of foundation work: - simple working drawings of foundation work (simple concrete foundations for level and sloping ground); - preparing drawings of common footings used in building construction (instruments drawings/section details); drawing foundation plans (position of foundation wall and footing, line type, line weight, layer, hatching, offset).	
			(E) DRAWING FLOORS (i) Preparing drawings of various types of floor and floor section – timber and concrete. (ii) Preparing drawings of solid, hollow and suspended ground floor and floor coverings (tiles, screed, hardwood, others).	

			(F) DRAWING FLOOR PLANS AND ELEVATIONS (i) Sketching of floor plans. (ii) Designing and laying out simple floor plans from given specifications: - orientation and relationship of rooms, positioning of walls, windows, floors, doors, stairs, arches, bathroom and kitchen symbols; - line work, dimensioning, annotation; - measuring to scale. - drawing floor plans to given scales; - drawing elevations of buildings; - Projections and orientation; - Ground line, floor line, doors and windows in elevation, height of roof, fascia, eve, rendering.	
			(G) DRAWING INTERNAL AND EXTERNAL WALLS AND FINISHING: ***(i) Types of walls:*** - stone rubble; - concrete block; - brick;	

			- composite walls. ***(ii) Differentiating between internal and external load bearing and non-load bearing walls (construction of walls in blocks and timber).*** - drawing detailed framed timber partition (treatment of openings in walls); - preparing working drawings of wall details; - Internal and external rendering (sectional details) of load and nonload bearing walls, treatment of openings in walls, lintels and ring beams/belt beams, plastering to walls and ceilings.	
			(H) DRAWING ROOFS: **Types of roofs in the Caribbean region.** ***(i) preparing plans and elevations of various types of roofs and roof structures***	

			– flat roofs in timber and reinforced concrete and roof construction with various coverings – treatment of gutters, parapets and vent pipes; ***(ii) preparing working drawings of roof anchorage systems (hurricane clips/straps, bolts;*** ***(iii) preparing working drawings of roofs showing truss details (simple contemporary timber trusses);*** ***(iv) preparing working drawings showing open and closed eaves;*** - eave details; - dimensioning and annotations.	
			(I) DRAWING DOORS AND WINDOWS ***(i) Types of doors and windows.*** ***(ii) Preparing drawings of internal and external doors and windows with linings and frames.*** ***(iii) Preparing detailed section of a sliding window in a masonry wall (horizontal and vertical sliding windows).*** ***(iv) Preparing typical sectional drawings which show door and window details and fittings.*** ***(v) Positioning of hinges and locks, plastic hinges and locks.***	
			(J) PREPARING SECTIONAL DRAWINGS:	

			(i) Preparing full sectional drawings of single-storey buildings: ***(ii) Using the principles of orthographic projection for:*** - foundations; - floors; - walls; - roofs - preparing details of different building components such as ridge, eaves, foundations, floors, footings and anchorage.	
			(K) DRAWING ELEVATIONS ***(i) Sketching elevations from given plans.*** ***(ii) Sketching elevations of building plans.*** ***(iii) Drawing stairs.*** ***(iv) Principles of construction of stairs (straight flight stairs with landings – timber and reinforced concrete).*** ***(v) Calculating risers from given height.*** ***(vi) Preparing sectional working drawing of a straight flight staircase.*** ***(vii) Preparing detailed drawing of the parts of a step.***	

			6. Comparing entrepreneurship and wage employment (a) Definitions. (b) Importance. (c) Characteristics of wage entrepreneurship. (d) Characteristics of wage employment.	
			7. Principles of entrepreneurship (a) Small business planning. (b) Goal setting. (c) Value creation. (d) Product marketing. (e) Sales and promotion.	
			8. Preparing a small business plan ***Group Activity:*** (a) identification of the service or product; (b) elements and format of a small business plan; (c) group presentation and evaluation.	

MONTHLY ASSESSMENT MARKS ALLOCATION

CLASS WORK -10%
Portfolio & Presentation -30%
TEST - 60%

Special Notes

- Students MUST be punctual at all times.
- **Assignments** should be handed in on the **specified due date**. Failing to comply with the specified date will result in a fifty **percent (50%)** reduction in the marks for each outstanding day. Assignments that are more than **2 days** late will **NOT BE COLLECTED.**
- At the end of this module learners will be required to complete a written and/or oral and practical internal assessment to demonstrate competence.
- Student's involvement in discussions during each session is an important aspect of the course. All students should expect to fully participate in class discussion and activities during all sessions.

READING ASSIGNMENT/QUIZZES/TESTS

1. There are a number of reference texts and support materials used for this class. Each student is expected to read the assigned reading in full, before the class, as stated on the outline.
2. Quizzes may be announced or unannounced. Quizzes cover material covered in previous classes.
3. There will be periodic tests over sections of material covered in class lectures, reading and assignments.

CHEATING, DISHONESTY AND PLAGIARISM

Any form of cheating is sufficient for an automatic zero. The facilitator is willing and available to help any student who seeks assistance. Cheating, dishonesty, plagiarism, copying portions of another student's assignment etc. are totally unaccepted. Assignments are given to aid

in the development of competency and acquisition of knowledge. Spend extra time to do your assignments with as little help from others as possible.

PORTFOLIO DEVELOPMENT

A portfolio is an organised convenient means of collection and presentation of materials which records and verifies a candidate's or student's learning achievements and relates them to the depth and breadth of work required by each topic covered. The depth and breadth of work should include a diversity of exhibits which reflects the following criteria:

- Writing, Reading and Comprehension Skills

- Critical Thinking and Problem Solving Skills

- Technology Skills - Practical Skills

- Teamwork Skills

The outline of the portfolio should include information under the following headings:

- Cover Page
- Table of Contents
- Introduction
- Supporting Evidence (Depth & Breadth of Work)
- Self Assessment/Reflection

Details of EACH Heading

Cover Page

- Name of School
- Grade and Course
- Teacher's Name
- Candidate's and Student's Name
- Year

Table of Contents

- By units or main headings
- Number pages

Introduction

- Portfolio of candidate to include personal data, background information on education and expectations.

Supporting Evidence

Provides information on the key formative and summative assignments / projects undertaken by the candidates/ students to achieve the objectives for each topic covered. All evidence supplied by the student should be reviewed by the teacher using the criteria given. Evidence must be signed and dated on the date of the review by the teacher or assessor.

Suggestions for supporting evidence:

- Written Assignment
- Oral Questions (checklist format)
- Projects
- Work Samples
- Research Assignments
- Fieldtrip reports
- Summative evaluation of practical work
- Digital photographs of candidates performing critical tasks

Resources:

Green, J.N. *Technical Drawing for CSE and GCE*

Morling K. *Geometric and Engineering Drawing, Third Edition*

PROCEDURES FOR THE SCHOOL-BASED ASSESSMENT PORTFOLIO

As part of the School-Based Assessment, candidates will be required to produce a formative developmental portfolio providing evidence of candidates' progress and learning over the duration of the programme. This evidence may be in the form of sketches, design plans, quality control procedures, multi-view drawings, self-reflective statements, transcripts of interviews with industry professionals etc.

Since the portfolio is an accumulation of the candidates' ongoing learning across the course of the two-year programme, it must be started at the commencement of the Technical Drawing programme.

The pieces of evidence MUST depict the candidates' developmental progress in each section of the syllabus from which the evidence is derived. Where possible, it is advised that the topics of the content be integrated to give evidence of full coverage of each section of the syllabus.

At a minimum, the portfolio must contain the following from each Section

1. Section 1 (Fundamental of Technical Drawing):

(a) At least **FIVE PIECES** of evidence - ***TWO from OHS&E and THREE from the remaining section***;

(b) Checklist of evidence of site visit (for example, name of company, contact person, summary of organisation's health and safety practices, safety practice deficiencies identified, environmental practices, photographs or other forms of evidence);

(c) Project on various types of lines, symbols, drawing conventions and codes;

(d) Project on drawing equipment and instruments.

2. Section 2 (Geometrical Construction):

(a) At least **SIX PIECES** of evidence: ***THREE from Plane Geometry and THREE from Solid Geometry***;

(b) The evidence MUST be derived from different topics within the Section.

3. Section 3A or 3B (Building Drawing or Mechanical Engineering Drawing)

Evidence of these sections will take the following format:

Design/redesign a Building component or Mechanical Engineering device/gadget to solve a simple functional problem in one of the fourteen categories, namely:

Categories

(a) Agriculture/Fishing
(b) Business/office
(c) Communication
(d) Construction
(e) Household
(f) Education facilities
(g) Environment
(h) Health facilities
(i) Manufacturing
(j) Power
(k) Recreation
(l) Recycling
(m) Sports
(n) Transportation

For **BUILDING DRAWING**, candidates will be required to produce the following:

(a) sketch;

(b) plan/Floor Plan;

(c) at least two elevations;

(d) sectional view;

(e) foundation plan or roof plan or sectional details of foundation and eaves;

(f) a small business plan to encompass design justification and conditions

For **MECHANICAL ENGINEERING DRAWING**, candidates will be required to produce the following drawings:

(a) parts sheet;

(b) orthographic projection of plan of the assembly;

(c) sectional view of the assembly;

(d) pictorial sketch;

(e) parts list;

(f) a small business plan to encompass design justification and conditions.

SBA ASSESSMENT

The SBA assessment will contain:

- One piece from Section 1 (Specific Objectives 1.1-1.10 and 2.1; 2.2). This is a written question.
- Two pieces from Section 2 (Plane Geometry and Solid Geometry).
- The projects from Section 3 and Section 4.

SUGGESTED ACTIVITIES FOR THE SBA

The following provides some suggested activities which could be used to enhance the learning experience provided by the SBA. This is by no means an exhaustive list as teachers/facilitators are encouraged to explore other creative activities intended to transform the learning environment.

1. Oral questioning.
2. Oral presentation of design justification.
3. Presentation of design justification to teacher/facilitator or visiting Architect/Engineer in a formal atmosphere.
4. Internet exploration – evidence.
5. Freehand sketching.
6. Use of on-site situations when candidates could easily take measurements, soil tests.
7. Use of real machine parts.
8. Guest speakers from industry.
9. Peer assessment of designs.
10. Group assignments and marking.
11. Site visits.