NATIONAL BOARD FOR TECHNICAL EDUCATION

HIGHER NATIONAL DIPLOMA (HND)

IN

CIVIL ENGINEERING TECHNOLOGY

CURRICULUM AND COURSE SPECIFICATION

2001

PLOT 'B' BIDA ROAD, PM.B. 2239, KADUNA - NIGERIA

GENERAL INFORMATION

1.0 **CERTIFICATION AND TITLE OF THE PROGRAMME**:
The certificate to be awarded and the programme title shall read:

"HIGHER NATIONAL DIPLOMA IN CIVIL ENGINEERING TECHNOLOGY"

A transcript showing all the courses taken and grades obtained shall be issued on demand.

2.0 **GOALS AND OBJECTIVES**

2.1 **Higher National Diploma Programme:**

The Higher National Diploma Programme in Civil Engineering Technology is aimed at producing technologists with a good mastery of engineering knowledge and skill in executing civil engineering works.

In addition to the ND objectives, the HND diplomates should be able to:

1. Design simple structural elements and prepare detailed drawings of such elements with minimum supervision;
2. Carry out supervision and prepare progress reports on Civil Engineering works;
3. Maintain comprehensive records of work-in-progress for the parties concerned.
4. Carry out accurate interpretation of technical data related to Civil Engineering works;
5. Test, analyse and interpret the result of materials tested for Civil Engineering works
6. Carry out engineering surveys
7. Design simple transportation schemes and prepare working drawings for their construction;
8. Supervise civil engineering construction works.
9. Design simple water and waste water schemes and distribution networks;
10. Prepare Bill of Engineering Measurements and Evaluation (BEME) and specifications for Civil Engineering works;
11. Operate and maintain water works, waste water and solid waste installation and irrigation projects;
12. Carry out environmental engineering and pollution control studies;
13. Management of Engineering facilities with emphasis on maintenance.

3.0 ENTRY REQUIREMENTS:

3.1 Higher National Diploma:

Applicants with all the following qualifications may be considered for admission into the Higher National Diploma programmes by direct entry:

1. The entry requirement for the National Diploma Programme.
2. National Diploma in Civil Engineering Technology with a minimum of lower credit pass; and
3. A minimum of one year Post-National Diploma cognate work experience in the field of Civil Engineering including three months of certified computer training.

4.0 CURRICULUM

4.1 The curriculum of the HND programme consists of four main components.
These are:

1. General Studies/Education
2. Foundation Courses
3. Professional Courses
4. Student Projects.

4.2 The General Education component shall include courses in:

Management Courses and Engineer in society. These are compulsory.

4.3 The General Education component shall account for not more than 5% of total contact hours for the programme.

4.4 **Foundation Courses** include courses in Geo-informatics, Engineering Drawing and Mathematics. The number of hours will vary with the programme and may account for about 15-20% of the total contact hours.

4.5 **Professional Courses** are courses which give the student the theory and practical skills he needs to practise his field of calling at the technician/technologist level. These may account for between 70-80% of the contact hours depending on the programme.

4.6 The student's projects shall be taken and graded during the second year of the programme.

5.0 CURRICULUM STRUCTURE

The structure of the HND programme consists of four semesters of classroom, laboratory and workshop activities in the college and a student project. Each semester shall be of 17 weeks duration made up as follows:

15 contact weeks of teaching, i.e lecture recitation and practical exercises, etc. and 2 weeks for tests, quizzes, examinations and registration.

Project shall be submitted at the end of the second semester of the final year.

6.0 ACCREDITATION

The programme offered shall be accredited by the NBTE before the diplomates shall be awarded the diploma certificate. Details about the process of accrediting a programme for the award of the ND or HND are available from the Executive Secretary, Programmes Department, National Board for Technical Education, Plot 'B' Bida Road, P.M.B. 2239, Kaduna, Nigeria.

7.0 CONDITIONS FOR THE AWARD OF THE HND

Institutions offering accredited programmes will award the Higher National Diploma to candidates who successfully complete the programme after passing prescribed course work, examinations, diploma project and the student project. Such candidates should have completed a minimum of between 90 and 100 semester credit units depending on the programme. Diploma Certificates shall be awarded based on the following classification:-

Distinction	-	CGPA 3.50 - 4.0
Upper Credit	-	CGPA 3.00 - 3.49
Lower Credit	-	CGPA 2.50 - 2.99
Pass	-	CGPA 2.00 - 2.49

8.0 GUIDANCE NOTES FOR TEACHERS TEACHING THE PROGRAMME

8.1 The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy on Education which stress the need to introduce the semester credit units which will enable a student who so wish to transfer the units already completed in an institution of similar standard from which he is transferring.

8.2 In designing the units, the principle of the modular system by product has been adopted; thus making each of the professional modules, when completed, provide the student with technician operative skills, which can be used for employment purposes.

8.3 As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the curriculum content has been written in behavioural objectives, so that it is clear to all, the expected performance of the student who successfully completed some of the courses or the diplomates of the programme. There is a slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance is expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which the performance can take place and to follow that with the criteria for determining an acceptable level of performance. Departmental submission on the final curriculum may be vetted by the Academic Board of the institution. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the polytechnic system.

8.4 The teaching of the theory and practical work should, as much as possible, be integrated. Practical exercise, especially those in professional courses and laboratory work should not be taught in isolation from the theory. For each course, there should be a balance of theory to practice depending on the course objectives and content.

TABLE OF CONTENTS

HIGHER NATIONAL DIPLOMA IN CIVIL ENGINEERING TECHNOLOGY

YEAR ONE
SEMESTER ONE

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
SUG 306	Engineering Survey II	1	0	3	2	4	SUG 208
CEC 301	Hydraulics	1	0	3	2	4	CEC 201
CEC 303	Concrete Technology	1	0	3	2	4	CEC 104
CEC 305	Theory of Structures II	2	1	0	3	3	CEC 205
CEC 307	Soil Mechanics II	1	1	3	3	5	CEC 212
CEC 309	Construction Technology	2	0	0	2	2	CEC 216
CEC 311	Civil Engineering Quantities & specifications	2	0	0	2	2	CEC 214
MTH 311	Advanced Algebra	2	0	0	2	2	MTH 112
CEC 313	Engineer in Society	2	0	0	2	2	-
CEC 315	Computer Aided Design Drafting in Civil Engineering	0	0	3	2	4	ICT 202
	TOTAL	**14**	**2**	**15**	**21**	**31**	

SEMESTER TWO

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
CEC 302	Hydrology and Hydrogeology	1	0	2	2	3	CEC 201
CEC 304	Water and Waste Water Engineering I	2	0	3	3	5	CEC 202
CEC 306	Design of structural Elements	1	1	2	3	4	CEC 206 & 305
CEC 308	Foundation Engineering	1	1	3	3	5	CEC 307
CEC 310	Advanced Construction Technology	2	0	0	2	2	CEC 309
CEC 312	Computer Aided Design & Drafting	0	0	3	1	3	ICT 302A
CEC 314	Transportation Engineering	2	0	2	3	4	CEC 204 & 307
GNS 413	Industrial Management	2	0	0	2	2	-
GIT 203	Database Creating and usage in Geo-Informatics	1	0	3	2	4	GIT 201
	TOTAL	**12**	**2**	**18**	**21**	**32**	

HIGHER NATIONAL DIPLOMA IN CIVIL ENGINEERING TECHNOLOGY

YEAR TWO
SEMESTER ONE

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
CEC 401	Project and Research Methods	1	0	5	2	6	
CEC 403	Statistical Methods in Engineering	2	1	0	3	3	
CEC 405	Advanced Reinforced and Pre-stressed Concrete Design	1	0	3	2	4	CEC 306
CEC 407	Foundation Design	2	1	1	3	4	CEC 308
CEC 409	Design in structural Steel & Timber	1	0	3	2	4	CEC 306
CEC 411	Traffic Engineering	2	0	0	2	2	CEC 314
CEC 413	Highway Engineering	2	0	2	3	4	CEC 314
CEC 417	Environmental Engineering and Pollution Control	2	0	3	3	5	CEC 304
CEC 421	Hydraulics Structures	2	1	0	3	3	CEC304 & 306
	TOTAL	**15**	**3**	**17**	**23**	**35**	

SEMESTER TWO

Course Code	Course Title	L	T	P	CU	CH	Prerequisite
CEC 402	Project	0	2	6	4	8	CEC 401
CEC 428	Engineering Management	2	0	0	2	2	-
CEC 412	Alternative Transportation System	2	1	0	3	3	CEC411& 413
CEC 414	Infrastructure Planning & Management	2	0	0	2	2	
CEC 424	Irrigation and Drainage	2	0	2	3	4	CEC425 & 417
CEC 426	Water and Waste Water Engineering II	2	0	0	2	2	CEC 304
		10	3	8	16	21	
	ELECTIVES						
CEC 406	Matrix and Energy Methods in Structures	2	0	1	2	2	CEC 305
CEC 410	Geotechnical Engineering	2	0	1	2	2	CEC 307& 308
CEC 422	Water Resources Management	2	0	1	2	2	-
CEC 416	Transportation Planning	2	0	1	2	2	CEC 314
	TOTAL	**12**	**3**	**9**	**18**	**24**	

Note: Student shall choose one elective course, only.

SURVEYING AND GEO-INFORMATICS

PROGRAMME: CIVIL ENGINEERING TECHOLOGY			
Course: Engineering Survey II	**Course Code: SUG 306**	**Contact Hours: 1-0-3**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the principles of setting out compound and reverse curves.**		
	Special Learning Objective:	**Teachers Activities**	**Resources**
1	1.1 Describe the characteristics of compound curves consisting of two or more circular curves. 1.2 Explain the use of formulae to compute setting out data. 1.3 Compute data needed to set out reverse curves. 1.4 Set out reverse curve using 1.3 above.	▪ Use questions and answer techniques. ▪ Give assignments	▪ Theodolite ▪ Total station ▪ Digital level ▪ Engineers level ▪ Target
2 - 3	**General Objective 2.0: Know the principles and methods of setting out transition curves.**		
	2.1 Explain how transition curves. 2.2 Describe the geometric characteristics of transition curves. 2.3 Explain the use of formulae to compute setting out data. 2.4 Set out composite curves i.e curves consisting of circular and transition curves. 2.5 Calculate change from the initial point to the end of a route consisting of various types of curves.	▪ Lecture with worked examples.	▪ Staff ▪ Poles
4 – 5	**General Objective 3.0: Understand the principles of design and setting out of vertical curves.**		
	3.1 Explain the purposes of vertical curves. 3.2 List the types of curves used. 3.3 Identify the principal factors governing the length of vertical curves. 3.4 State the properties of the parabola as the curve normally adopted for vertical curves. 3.5 Derive formulae for computing data for a vertical curve. 3.6 Describe methods of setting out vertical curves. 3.7 Describe a vertical curve and set out data given length of the curve, gradients of the intersecting slopes and the reduced level of at least one known point.	Lecture.	- do -

6	**General Objective 4.0: Know the principles and methods of construction site surveys.**		
	4.1 Establish rectangular grid control for construction site surveys. 4.2 Describe other forms of control suitable for construction site surveys. 4.3 Explain suitable self-checking setting out methods for large construction sites with many large structures. 4.4 Set out specified levels from control levels. 4.5 Establish a permanent survey control system on completion of the major construction. 4.6 Explain how to overcome specific setting out problems due to impediments, destruction of control beacons, water obstacles, etc.	▪ Lecture	▪ Staff ▪ Poles
7 – 10	**General Objective 5.0: Understand the application of modern instrumentation and techniques in engineering surveys.**		
	5.1 Use modern survey instruments in setting out and surveying routes and structures 5.2 Carry out the application of photogrammetry in route selection, earthwork calculations, measurement of deformations of structures, as built surveys, etc. 5.3 Explain the uses and advantages of digital ground models in route surveys. 5.4 Carry out some applications of micro-computers in engineering surveys e.g in curve design and setting out, computing setting out data for large structures, creation of digital terrain models etc.	▪ Lecture with demonstration of equipment	▪ Total station, EDM, GPS
11	**General Objective 6.0: Understand the methods of surveying underground installations such as pipelines, cables, conduits, channels etc.**		
	6.1 Explain the need for surveying underground installations. 6.2 Describe the methods of locating underground installations, e.g by using detector instruments. 6.3 Describe the method of surveying underground installations applying normal surface methods e.g traversing with radiation and offsets.	▪ Lecture.	▪ GPS ▪ Total Station gyroatheodolite
12-13	**General Objective 7.0: Understand the principles of measurement of deformations and small movements with particular reference to monitoring the movements of dams**.		
	7.1 Explain the differences between deformations and small movements of structure. 7.2 Explain why measurement of deformations should be carried out e.g monitor the deformation of dams. 7.3 Describe methods to be adopted in establishing control for measurement of deformations. 7.4 Describe survey methods for monitoring horizontal deformations. 7.5 Use precise levelling in measuring vertical deformations	▪ Lecture, with slides to illustrate installations	▪ Geodetic level.

	7.6 Describe the application of photogrammetry in the measurement of deformations.		
	General Objective 8.0: Understand the principles and methods of engineering geodesy.		
14	8.1 Explain the scope of engineering geodesy (Precise engineering surveys). 8.2 Identify the distinguishing features of engineering geodesy – geodetic accuracy precise centering, use of precise instruments. 8.3 Specify the accuracy requirements of engineering geodesy and the instrumentation and observational procedures to achieve them. 8.4 Describe special computational methods used in precise engineering surveys. 8.5 Outline typical procedures for establishing micro-geodetic control systems e.g for tunnel surveys, surveys of precise large structures (radio telescopes, particle accelerators, large ships, etc) and subsequent setting-out procedures.	- do -	- do -

Assessment: Coursework 10%; Course test 10%; Practical 40%; Examination 40%

Competency The student on completion of this course should be confident to undertake most classes of survey required for Civil Engineering projects, together with all the necessary calculations.

References:
1. Land Information System Management – Peter F. Daley, John D. Mclanughlin, Claredon Press, Oxford
2. "Photogrammetry" F.H. Maffit and E.M. Mikhail, Harper and Row Publishers, London, 4th.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Engineering Surveying II	**Course Code: SUG 306**	**Contact Hours: 1-0-3**	
Course Specification: Practical Content			
WEEK	**General Objective: Introduce the students to the Design of Horizontal and Vertical Surveys, Establish permanent controls, use of photogrammetry and computers in engineering surveys.**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
1-2 3-4 5-6 7-8 9 10	1.0 Compute and set out reverse curves. 2.0 Set out composite curves. 3.0 Design a vertical curve of a road profile, calculating, setting out data given length of the curve, gradients of the intersecting slopes and the reduced level of at least one known point. 4.0 In site surveys, set out specified levels from control levels and establish a permanent survey control system on completion of the major construction. 5.0 Use relevant Geo-Informatics instruments for: (i) route selection (ii) as-built surveys etc. 6.0 Use micro computers in engineering surveys.	▪ Guide students in the computation and setting out of traverse curves from survey data. ▪ Supervise students to calculate all elements required for the design of a vertical curve. Design grades and the connecting curve. ▪ Supervise students to carry out a grid survey and establish control points. Identify point. ▪ Demonstrate the use of appropriate soft ware packages for curve designs and set out for large structure.	▪ Calculates theodolite pegs, tape, Total Station. ▪ Calculator, Drawing boards, complete set of drawing instruments. ▪ Level, staff pegs, ranging rods, Total station, Targets. ▪ PC highway engineering soft ware packages, Computer laboratory, LISCAD, SKI SURFER.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Engineering Surveying II	**Course Code: SUG 306**	**Contact Hours: 1 – 0 -3**	
Course Specification: Practical Content			
WEEK	**General Objective: Introduce the students to the surveys of dam sites.**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
11 12 - 13 14 15	Use any of the survey methods to monitor horizontal deformations. Use precise levelling in measuring vertical deformation e.g in dams or tall buildings. Apply photogrametry measurements in deformations in dams, bridges and tall structures. Carry out survey of a large structure using total station.	Supervise the surveys undertaken and operation of the equipment. Supervise out precise levelling procedure on a foundation pad over a period of say 3 to 6 months and observe any minute deformation and explain the details to students. Guide the students to do the same. Demonstrate the use of aerial photograph for estimating deformation of a structure. Demonstrate the use of a print photography in Nuta solution.	Geodetic level, and staff, etc. Gyro-theodolite, digital level, preview equipment. Supply set of photographs taken on different dates. Resistivity meter.

References: i. Land Information System Management – Peter F. Dale, John D. McLanghlin, Claredun Press, Oxford.
ii. "Photogrammetry", F.H. Maffit and E.M. Mikhail, Harper & Row Publishers, London, 4th Ed.

Assessment Coursework 10%; Course test 10%; Practical 40%; Examination 40%

Competency: The student on completion of this course should be confident to undertake most classes of survey required for civil engineering projects, together with all the necessary calculations.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: GIS Data-Base Creation and Usage	**Course Code: GIT 203**	**Contact Hours: 1 – 0 - 3**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand database structures and data classification.**		
	Specific Learning Outcomes	**Teachers Activities**	**Resources**
1 – 2	a. Define database (with examples) Database structures, database classification. b. Explain the principles of database structures e.g. relational networking, object-original etc. c. Enumerate the classes of database e.g. planimetric, altimetric, etc. d. Explain the uses of database system.	1 hour lecture with 3 hours practice using the system. Supervision by lecturer	GIS workstation
	General Objective 2.0: Understand the principles of and procedures for data layer and creation of data files.		
3 – 5	2.1 Explain data layer and data files**.** 2.1 Explain types of data layer. 2.2 Explain types of data files. 2.3 Explain the principles of referencing common features. 2.4 Describe creation of data files. 2.5 Enumerate the procedures for linking data layers and data files. 2.6 Create data file for different layers.	- do -	5 computer minimum digitizing table
	General Objective 3.0: Understand the principles and procedures for data capture.		
6 – 7	3.1 Explain the principles for data capture using digital photogrammetry work station, analytical plotters etc. 3.2 Explain the procedures for data capture using digital acquisition tools tablets, scanners, digital photogrammetry work station, analytical plotters etc. 3.3 Capture data using the tools in 3.2 above. 3.4 Edit errors arising from data capture technique.	- do -	
	General Objective 4.0: Understand the storage of spatial and non-spatial data. Teachers Activities Resources		
8	4.1 Describe spatial data and non-spatial data. 4.2 Explain the characteristics of spatial data. 4.3 Explain the characteristics (attributes) of Non-spatial data.	1 hour lecture with 3 hours practice using the system. Supervision by lecturer	
9 – 11	4.4 Acquire spatial data using the tools in 3.2 above. 4.5 Correct for errors arising from the acquisition of 4.4 above. 4.6 Input non-spatial data and tabular database. 4.7 Correct for errors arising from inputting the non-spatial data in 4.6 above. 4.8 Link spatial and non-spatial data of 4.5 and 4.7 above.	- do -	

	General Objective 5.0: Understand basic operations on geographic database.		
12 – 14	5.1 Explain the basic operations on a geographic database. 5.2 Select various training features (one after the other) and display graphically). 5.3 Carry out simple analysis of information derivable from the graphic displays. 5.4 Request for displays and their associated attributes.	- do -	

Assessment: Coursework 10%; Course test 10%; Practical 40%; Examination 40%.

Competency: The student on completing this course should be able to create analyse and manage Geographic data Civil Engineering works.

References:
1. "Principles and Applications of GIS" Ed. C.U. Ezeigbo, Unilag (Survey Dept)
2. Geographic Information Systems "Vol. I: Principles and Applications; Vol. II: Applications – MAGUIRE, David J. (Principal): GOOD CHILD, Michael F.: RHIND David W. Longman Scientific and Technical, 1991.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: GIS Data Base Creation and Usage	**Course Code: GIT 203**	**Contact Hours: 1 – 1 - 3**	
Course Specification: Practical Content			
WEEK	**General Objective: Conduct Practicals to improve the understanding of the theoretical content**		
	Specific Learning Outcomes	**Teachers Activities**	**Resources**
1 - 2	1.1 Carry out simple analysis of information derivable from the graphic displays	▪ Supervise student work in the various sections. ▪ Demonstrate the use of tools, instruments and equipment.	▪ Computer PC, Printers, Software digitalizers, A4, A3, A1 Scanners, A4, A3 digital photogrammetry workstation plotters etc.
3	1.2 Create data files for different layers.		
4	1.3 Create simple data base tables		
5 - 6	1.4 Capture data using tablets, scanners digitalizers, digital photogrammetry workstation analytical plotters etc.		
7 - 8	1.5 Acquire special data using 4 above.		
9 - 10	1.6 Provide queries to created tables.		
11- 14	1.7 Design simple database table using digital acquisition tools.		
15	Revision		

INFORMATION AND COMMUNICATION TECHNOLOGY(ICT)

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY		
Course: COMPUTER AIDED DESIGN IN CIVIL ENGINEERING	**Course Code: CEC 317**	**Contact Hours: 0/0/3**

Course Specification: To give the students the skill needed to use Civil Engineering computer package for the analysis and design of Civil Engineering facilities. The learning methodology emphasizes the actual use of these packages by students in order to establish competence.

Theoretical Content

WEEK	**General Objective: Understand the principles of operation, capabilities and system requirements for CAD and GIS in Civil Engineering.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 2 3 4 - 5 6 - 7	1.1 Know the commonly used CAD software packages in Civil Engineering. 1.2 Categorized these packages in terms of Analysis and Design packages. 1.3 Utilize any of the commonly used packages in the following specialty. a. Structural Analysis b. Structural Design (Steel, Reinforced Concrete and Timber) c. Water Network Analysis d. Hydraulic Analysis and Design e. Highway Design 1.4 Know how to Prepare and Input data for: a. Structural Analysis b. Structural Design c. Water Network Analysis and Design d. Highway Design 1.5 Using any of P-Frame, S-frame, or Q-Frame or Stead-suite packages: Prepare and Input the following data for a typical roof truss; a. Initialization Data (Project Information) b. Joint Data c. Member Connectivity Data d. Member Property Data e. Load Data	▪ Ask students to explain advantages and disadvantages of CAD and GIS in Civil Engineering. ▪ Ask students to research and find out available packages in Civil Engineering. ▪ Ask students to install any of the packages available and move around its suites with a view to having personal understanding of its operation. ▪ Ask students to prepare the input data. ▪ All joints must be numbered and their co-coordinators determined. ▪ Ask students to input all the necessary data and observe the analysis procedure. Ask students to interprete the results obtained.	▪ ▪ Complete Computer Sets. ▪ One computer to 2 students ▪ 1 large format Printer to two students. ▪ One Digitizer to two students. ▪ Well equipped computer studio.

8	1.6 Using any of Scale, Risa2D, SAP2000 or Staad-suite. Carry out the design of the following members of the typical roof truss. a. Compression Member (Struts) b. Tension Member	▪ Ask students to explain the details of the design ▪ Result.	
9	1.7 Using any of Flow-Master Hydro CAD etc, carry out a network analysis of a simple reticulation system.	▪ Ask students to Carry out this analysis and design.	
10	1.8 Using any of MR3, Auto Civil, SurvCADD, carry out an alignment design for a typical road project. Assume input data from Highway. Design Manual of Federal Ministry of Works and Housing.		
11	1.9 Using any of MapInfo, Maptech, Arcinfor, Arcview to produce a simple map of your Polytechnic. Showing the layout of some essential infrastructional facilities such as Water Supply Line, telecommunication lines, road network etc.	▪ Ask students to obtain their survey field data and ▪ use them for the design. ▪ Ask students to use a GPS in locating positions ▪ within the campus.	
12-13	1.10 Carry out detailed analysis and design of a four storey framed structure in reinforced concrete using computers.	▪ Student Design Exercise.	
14-15	1.11 Carry out detailed horizontal and vertical alignment design of a typical road within the Polytechnic Complex.	▪ Student Design Exercise.	

CONSTRUCTION

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Construction Technology	**Course Code: CEC 309**	**Contact Hours: 2 – 0 - 0**	
Course Specification: Theoretical Content:			
WEEK	**General Objective 1.0: Understand how to organize a site.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 List the main items to be considered in the layout of a new construction site. 1.2 Outline the principal factors which affects layout of materials, storage facilities and work shops on site.	▪ Use questions and answers techniques. ▪ Demonstrate proper layout of materials, relationship lecture.	▪ Charts ▪ Pictures ▪ Video ▪ OHP ▪ Chalkboard
2	1.3 Explain the basis of the client-engineer-contractor relationship in Civil engineering contractors. Itemise the principal duties of a resident engineer.		
3	1.4 Outline a recommended procedure for lifting heavy or bulk objects on site to minimize the risk of injury. Outline safety procedures on construction sites.		
	General Objective 2.0:Understand the techniques, procedures and plants involved in large scale earth movement		
4	2.1 List factors which influence the choice of earth moving equipment. 2.2 Explain the operation of the following types of earth moving plants: a. back-acting excavator b. dragline c. scraper d. grader e. bulldozer	Lecture Display types of equipments	Charts Pictures OHP Chalkboard
5 - 6	2.3 Explain procedures for site control of earthworks (in-situ moisture and density tests etc). 2.4 Explain the use of top soil on site. 2.5 Define borrow pit. 2.6 Explain the use of imported back fill materials on site, outline the correct compaction procedure.		
7	2.6 Apply studies to estimate the plants required for a model earthwork.		
	General Objective 3.0: Understand the principles and construction of formwork, trusses and flood.		
8	3.1 Describe by means of sketches how formwork is supported for: a. a reinforced concrete column b. a large reinforced concrete wall	▪ Lecture ▪ Display sketches ▪ Give assignments	▪ Sketches ▪ Chalkboard ▪ OHP

	c. a suspended beam d. excavation in soft soil		▪ Pictures ▪ Drawings
9	3.2 Summarise the requirements of formwork. 3.3 Describe briefly the following types of formwork: timber; steel, plastic; pneumatic tubing, etc.		
10	3.4 Write brief notes on the following: a. release agents; b. exposed aggregate; c. "knock-off finish d. striking of formwork.		
11	3.5 Sketch a typical steel roof truss with welded connections illustrating methods of fixing the roof truss to a universal column stanchion. 3.6 Explain the principle of triangulation in relation to roof trusses.		
13 - 14	3.6 Explain with the aid of sketches, a typical timber roof truss of short to medium span indicating methods of securing the members together. 3.7 Sketch details of forming openings and ducts in the following types of suspended floors: a. timber b. solid reinforced concrete c. precast concrete 3.8 hollow pot in-situ reinforced concrete.		
15	3.9 Sketch details of forming openings and ducts in the following types of suspended floors: a. timber b. solid reinforced concrete c. precast concrete d. hollow pot in-situ reinforced concrete. 3.10 Organise and visit sites.		

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%
Competency: On completing the course, the student should be able to supervise basic Civil Engineering Works.
Reference:
1. R.L. Fullerton, "Building Construction in Warm Climate" 2nd Ed. Oxford University Press Vol. 2, 1983.
2. D.E. Warland, "Construction Processes and Materials, Hodder and Stroughton, London, 1979.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Advanced Construction Technology		**Course Code: CEC 310**	**Contact Hours: 2 – 0 - 0**
Course Specification: Theoretical Content:			
WEEK	**General Objective 1.0: Understand the techniques, materials and procedures involved in sheet pilling, under-pinning and dewatering and the construction of retailing walls.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Define sheet pilling. 1.2 Describe the circumstances in which sheet piles are used. 1.3 Sketch a section of an interlocking steel sheet pile. 1.4 Describe how steel sheet piles may be used to form a rectangular cofferdam around an excavation including the method of driving. 1.5 Describe a method of extracting steel sheet piles. 1.6 Explain the procedure to be adopted to remove particularly stubborn piles.	▪ Lecture ▪ Display drawings and pictures of materials and methods of construction. ▪ Give assignments.	▪ Chalkboard ▪ OHP ▪ Pictures ▪ Drawings
2	1.7 State the primary functions of retaining walls. 1.8 Show by means of a sketch the various forces acting on a retaining wall. 1.9 Sketch typical reinforced concrete retaining wall explaining how the building of water pressure behind may be prevented. 1.10 Sketch typical cantilever retaining walls that may be constructed where there is both sufficient and restricted working space behind the wall.	- do -	- do -
3	1.11 Define under-pinning. 1.12 Describe with sketches the continuous method of under-pinning to lower of an existing strip foundation supporting a wall. 1.13 Sketch a system of raking shores and a typical flying shore. 1.14 List the reasons for dewatering the sub-soil of an excavation. 1.15 Describe the "pumping from sumps" method of dewatering. 1.16 State the precautions that are necessary to prevent damage to an existing structure when carrying out an underpinning operation. 1.17 Carry out under-pinning operation.	- do -	- do -
	General Objective 2.0: Know the principal construction techniques, and procedures involved in.		
4	2.1 State the circumstances in which the following types of scaffolding are used: Putlog; Independent; Mobile Tower. 2.2 Draw a line diagram to present a mobile tower summarizing the precautions which should take when using such a scaffold. 2.3 Draw, line diagrams of putlogs and independent scaffolds. 2.4 Describe the erection procedures of 2.3 above.		

	2.5 List safety requirements related to the use of scaffolding. 2.6 Explain the requirements of ladders used in scaffolding.		
5	2.7 Sketch the following standard steel section indicating the range of serial of normal sizes in which they are manufactured: Universal columns; Universal beams, Standard angles,; Channels. 2.8 Sketch six different types of butt welds and a section of a fillet weld. 2.9 Describe method of connecting steel members together with black, turned and high strength friction grip bolts. 2.10 Outline the situations in which members in 2.9 are used. 2.11 Sketch a detail of universal column to concrete base by means of holding down bolts ensuring that a column is accurately positioned to the correct line and level.	- do -	- do -
6	2.12 Sketch details of forming each of the following structural steel connections: a. beams to webs and flanges to columns; b. column splices; c. beams to beams. 2.13 Describe the erection procedure for steel frame for a building up to four storeys high. 2.14 Describe with sketches the conventional method of providing fire resistance to structural steel.	- do -	- do -
7	2.15 Draw a detail of reinforced concrete column and base. 2.16 Take-off bills of engineering measurements, detail construction and prepare a method statement. 2.17 Outline the method of positioning the reinforcement during its construction.		
8	2.18 Describe with sketches details of reinforced concrete beam to column and reinforced concrete ground beam, ground floor slab construction with particular reference to the fixing of the reinforcement. 2.19 Describe with sketches the construction of a non-load bearing brick panel. 2.20 Illustrate two methods of attaching a brick panel to a reinforced concrete frame.		
9	2.21 Sketch the construction of a timber framed infill panel illustrating how the external cladding may be made weather proof, the internal cladding fire resistant showing the position of a vapour barrier and thermal insulation.		

10	2.22 Describe by means of sketches how a coated steel window may be fixed to a concrete lintel, a concrete sill and at the jambs to a brick panel wall. 2.23 Sketch sections through an aluminium window to illustrate the methods of fixing within a concrete frame. 2.24 Explain what is meant by patent glazing. 2.25 Sketch a detail of aluminium patent glazing showing the method of fixing vertical glazing bars to concrete, glass to the glazing bars and the method of weather proofing the head and sill. 2.26 Fix vertical bars to concrete, glass to glazing bars etc.		
	General Objective 3.0: Understand the construction of drainage system, flexible and rigid pavements, and calculation of surface water drainage		
11	3.1 Explain the procedure for laying pipes under the following headings: trench excavation bedding piles; testing; backfilling. 3.2 Describe with sketches trapped and untrapped gully pots used for the collection of surface water drainage from roads stating their different applications.		
12	3.3 Explain how the construction of a manhole may be tested for water tightness. 3.4 Explain with the aid of a sketch the construction of a deep concrete manhole. 3.5 State when a backdrop manhole is used and sketching the details that makes it different to a standard manhole construction.		
13	3.5 Describe safety precautions to be exercised in surface water and foul drainage systems under the following headings: collapse of excavations; guardrails; breathing equipment and flooding. 3.7 Distinguish between the construction of flexible and rigid pavements.		
14	3.8 Summarise the functions of the various layers of construction of the types of pavement. 3.9 Carry out external works and services in building		

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%
Competency: On completing, the student should be able to supervise major Civil Engineering works .
Reference:
1. Gerwich B.C. Jr., " Construction of Off-Shore Structures", John Wiley and Son Interscience, Canada, 1986.
2. King R.W. and R. Huson, "Construction Hazard and Safety Handbook". Butterworth and Co. Ltd, 1985.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Concrete Technology	**Course Code: CEC 303**		**Contact Hours: 1- 0- 3**
Course Specification: Theoretical Content:			
	General Objective 1.0: Review Properties of Material		
WEEK	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
1	1.1 Define cement 1.2 State its uses. 1.3 State the constituents and types of cement. 1.4 State their physical properties e.g (fineness, specific surface, setting time, soundness tensile strength, compressive strength.	▪ Lecture ▪ Carry out tests	▪ Cement finess test, vicat apparatus compression machine soundness tester.
2	1.5 Determine the above properties by tests. 1.6 Use the results to determine good concrete. 1.7 State the qualities of good aggregates(both fine and coarse aggregate) and water.		
	General Objective 2.0: Understand the properties of Aggregate and Water Mixtures		
3	2.1 Grade coarse aggregate into standard diameter sizes. 2.2 Determine the relative density of coarse and fine aggregates. 2.3 Grade by sieve analysis-fine and coarse aggregates. 2.4 Combine aggregate to meet particular grading requirements. 2.5 Define light weight aggregates. 2.6 State properties of light weight aggregates. 2.7 Explain the uses of water in concreting 2.8 Specify quality of water for bad and good concrete. 2.9 Illustrate the effects of bad water on the strength of concrete..	▪ Lectures ▪ Carry out tests.	▪ Sieves, shakers thermometers Los Angeles Abbrasion testing machine.
4	2.10 Determine moisture of fine and coarse aggregates. 2.11 Determine bulk densities of aggregates. 2.12 Determine fineness modulus. 2.13 Determine percentage bulking of moist sand. 2.14 Determine by experiment clay and silt content and other impurities in and		Aggregate impact tester and crushing values apparatus
5	2.15 State different types of concrete admixtures (accelerators, plasticizers, retarders, air entrainers, colourants, water proofers). 2.16 State the compositions of the different additives and admixtures. 2.17 State their uses. 2.18 Select them for appropriate uses.		▪ Oven, trays cylinders, moisture content balances test Apparatus Soil hydrometers stop watches

	General Objective 3.0: Know concrete mix.		
6	3.1 Define concrete. 3.2 Explain the different mix proportioning methods (by weight or by volume). 3.3 Describe thermal effects on design mixes. The concept of prescribe and design mix. 3.4 State the influence of voids in fine and coarse aggregates of mix design. 3.5 Demonstrate the influence of voids on concrete by mix experiments. 3.6 State the purpose of mix design. 3.7 State the steps needed to get a good mix.	▪ ▪ Give examples ▪ Set coursework.	▪ Mixer headpan, vibrators rammers, barrow shovels cement box aggregates/sand box slump cones concrete crushing machine.
	General Objective 4.0: Know the importance of water/cement ratio in concrete mix design		
7	4.1 Define water/cement ratio 4.2 Describe the influence of water/cement ratio on concrete strength. 4.3 Draw graph to illustrate relationships between water /cement ratio and compressive strength. 4.4 Illustrate by chart the relationship between age and concrete strength. 4.5 Design concrete mixes. 4.6 Test concrete cubes of various water/cement ratio. 4.7 Determine the relative density of wet concrete for various water/cement ratios. 4.8 Determine water content for various slumps from tables. 4.9 Determine an acceptable mix specification and control procedure from above results. 4.10 Determine by experiment the effects of the following on concrete (cement to aggregate ratio, fine to course aggregate ratio, mixing time, degree of compaction method and age	▪ Use question and answer techniques ▪ Set coursework	▪ Cube moulds cylindrical moulds bean moulds flexural testing machine crushing machine charts, graphs etc. Curing tank
	General Objective 5.0: Understand statistical methods in mix quality control.		
8	5.1 State a statistical equation for mean and characteristic strength. 5.2 Define target mean strength, characteristic strength, average strength, standard deviation, current margin, population and sample mean. 5.3 Draw curve of normal probability distribution of concrete strength. 5.4 State the criteria for acceptance or rejection of concrete.		
	General Objective: 6.0 Know the importance of quality control in concrete works.		
9	6.1 Define quality control in concrete practice. 6.2 State the hazards of uncontrolled concrete mix. 6.3 State the implications of quality control vis-à-vis workability, batching, mixing, vibration, curing, checking and tests on all the above. 6.4 Describe types of mixes. 6.5 Select them for appropriate usage.		

	6.6 State the purpose of curing concrete. 6.7 Describe the methods of curing concrete. 6.8 Select the best method of curing concrete for different weather conditions, types of concrete and additives used. 6.9 Carry out tests on all the above.		
	General Objective 7.0: Know how to determine the strength of concrete		
10	.1 Define concrete cube strength. 7.2 Determine cube strength by experiment 7.3 Determine cylinder strength, tensile strength, flexural, shear strength		▪ Flexural Machine, crushing machine, Cube, Cylindrical and beam moulds
11	7.4 Explain the effect of weather on the durability of concrete. 7.5 Determine volumetric stability of concrete by testing for shrinkage, creep, moisture movement, temperature changes. 7.6 Determine resistance of concrete to chemicals, water penetration and corrosion of reinforcement.	▪ Use question and answer techniques	▪ Flexural machine, crushing machine, Cube, Cylindrical and beam moulds
	General Objective 8.0: Know the uses of reinforced concrete.		
12	8.1 Describe heat insulation and sound insulation properties of concrete. 8.2 State the reasons of reinforcement in concrete. 8.3 Describe the various types of steel used as reinforcement in concrete. 8.4 State the uses of each type of reinforcement (mild steel, high tensile, cold drawn, steel fabrics, etc). 8.5 State the required concrete cover for different conditions of use.	- Ditto -	- Ditto -
13	8.6 Define pre-cast concrete. 8.7 State the advantages and disadvantages of pre-cast concrete. 8.8 Illustrate the handling and transportation of pre-cast elements prior to use.	- Ditto -	- Ditto -
	General Objective 9.0: Know the construction methods of pre-stressed concrete		
14	9.1 Define pre-stressed concrete. 9.2 Describe the various methods of pre-stressing concrete elements. 9.3 Describe the safety precautions for handling the following: tendons, sheaths, tensioning apparatus, anchorages, ducts and grouting.	- Ditto -	- Ditto -
15	9.4 Describe pre-tensioning and post-tensioning techniques in pre-stressed concrete. 9.5 Carry out field trips as appropriate.		- Ditto -

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%

Competency: On completion of this course, the student should The student should be able to undertake tests on concrete and to organize the quality control of concrete construction.

References

1. Neville, A.M. "Properties of Concrete", 1994.
2. Murdoch, L.J. and Brook, K.M. "Concrete Materials and Practice", 1979.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Concrete Technology	**Course Code: CEC 303**	**Contact Hours: 1 – 0 – 2**	
Course Specification: Practical Content			
WEEK	**General Objective: Conduct experiments to understand the properties of concrete**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
1 - 2	Determine Initial, and final setting time of Cement	▪ Supervise Technologist in preparing. Equipment and materials. ▪ Specify laboratory procedures. ▪ Assessment of results, score results.	▪ VICAT, cement, spatula, beaker, water, knife, Any other suitable apparatus including the VICAT.
3	Analysis for fine and coarse aggregates and prepare grading curves and particular size Distribution charts.	▪ Supervise Technologist in preparing Equipment and materials. ▪ Specify laboratory procedures for Technologist and students. ▪ Assess results and score results.	▪ Sieves (ASTM and BS). Sieve shaker and Aggregates.
4	Determine by experiment the relative densities of (a) fine and coarse aggregates (b) wet concrete with various water/cement ratio (c) prepare cubes and determine their compressive strength..	▪ Supervise Technologist in preparing equipment and materials. ▪ Specify laboratory procedure. ▪ Assess and score results.	▪ Density bottles, Scales, beakers. ▪ Distilled water.
5-6	Determine experimentally the (a) bulk densities (b) percentage bulk densities of aggregates (c) percentage bulking of moist sand (d) clay and silt content of fine aggregates by silt test (e) specific gravity of aggregates (f) angularity (g) impact testing and hardness test on rocks (h) standard flakiness and elongation tests (i) aggregates crushing values ($^1/_4$, $^2/_{16}$, $^1/_{18}$).	▪ Supervise Technologist/Technicians to prepare all necessary equipment and materials. ▪ Specify procedures, assess and score results.	▪ Bulk density cylinders, aggregates, scales, measuring scoops, log setting velocity apparatus, specific gravity test, apparatus, flakiness apparatus Abrasion machines.
7-9	Carry out the (a) slump test (b) compaction tests (c) compressive, cube strength -flexural for cement mortar and concrete. Also, carry out non-destructive tests like ultrasonic, Schmidt rebound tests etc. BS 882 and BS 1881.	▪ Supervise Technologist/Technician to prepare equipment and materials. ▪ Specify procedures. ▪ Assess and score results.	▪ Slump cone complete with base, tamping rod; Compaction machine, cube moulds, cylindrical mould, flexural load frame/moulds, ultrasonic testing machine, schmidt, rebound hamer, cement, water, aggregates, mixers, shovels, pan.

10	Determine experimentally the workability of concrete mix using (a) Vee-Bee consistometer apparatus (b) compacting factor (BS 1881)	▪ Supervise Technologist in preparing equipment and materials. ▪ Specify procedures for experiments to be carried out under the guidance of the Technologist/Technician. ▪ Assess and score result.	▪ V-B consistometer, compacting factor apparatus. Cement, aggregates, water, work base and work tools such as spades, pans.
11-13	Study the effects of the addition of sulphates on concrete mix from different cement types.	▪ Design concrete and choose statistically sulphate ratios on specimen ▪ Prepare cubes for different ratio's of sulphur content with chosen cement types. ▪ Explain to students and Technologist/Technician to carry out tests with students. ▪ Assess and score results.	▪ Sulphur, cement, aggregates, water, mixing materials, cube moulds, compaction machine.
14 – 15	Revision		

MANAGEMENT

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Engineering in Society	**Course Code: MEC 311**	**Contact Hours: 2 – 0 - 0**	
Course Specification: Theoretical Content			
WEEK	**General Objective: 1.0 Understand the historical development of engineering and technology.**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
1 – 2	1.1 Identify, describe, technology and engineering in ancient Egypt, Rome, China, Europe, America. 1.2 State developments from military to Civil Engineering. 1.3 State the industrial Revolution in England and its spread to Europe, Asia and Africa. 1.4 State Modern technology and engineering.	▪ Ask student to name development in ancient Egypt, Rome, China, Europe and Africa which were technological in nature. ▪ Ask students to identify the developments that constituted the original industrial revolution in England. ▪ Ask students to identify which developments in transportation, automation, communication and photography ushered in modern technology and engineering.	▪ Chalkboard ▪ Audio-Visual Aid ▪ Video Pictures Charts
3	1.5 Identify the various cadres of the engineering family. 1.6 State the ideal ratio of the different cadres of engineering personnel required for an engineering project team. 1.7 Identify the various engineering discipline..	▪ Ask students to: ▪ *name the cadres in engineering. ▪ Identity the common disciplines of engineering. ▪ State ratios of technologist; Engineers and Technologist; Technician required in engineering projects.	- do -

4	1.8 Identify the pyramidal structure of the cadres in the engineering profession. 1.9 Identify the various training institutions for engineering personnel in Nigeria.	▪ Ask student to: • State in order from the apex to the base the cadres in the engineering profession. • State the institution for training technicians and technologists.	Chalkboard Audio-Visual Aid Video Pictures Charts
5 – 6	1.10 State the role of Engineering in Society 1.11 State the role of Technologist in Society 1.12 State the role of Technician in Society 1.13State the role of Craftsmen	• Use Questions and Answer techniques	- do -
7 – 8	1.14 Discuss the Nigerian Society of Engineers 1.15 Discuss the National Association of Technologists in Engineering 1.16 Discuss the Nigerian Institute of Engineering Technicians 1.17 Discuss the National Association of engineering Craftsmen.	• Give assignments	- do -
9 – 10	1.18 Describe the function of COREN 1.19 Describe the process of registration. 1.20 Discuss the consequences of non-registration. 1.21 Discuss quackery in engineering	- do -	- do -
11	1.22 Explain the progression of engineering personnel along their cadre. 1.23 Explain the requirements for transfer from one cadre to another.	- do -	- do -
12 – 13	1.24 Explain the fundamental ethics of engineering. 1.25 Explain the canons of engineering. 1.26 State the codes of conduct of engineering personnel.	- do -	- do -
14 – 15	1.27State and explain the unwritten laws of engineering in respect of one's: a. Boss b. Colleagues c. Contract work d. Clients.	- do -	- do -

Assessment: Coursework 20%, Course Tests 20%, Practical 0%, Examination 60%
Competency: The students should understand their role responsibilities and ethic of the engineering profession.
Reference: M.A. Gulma, "The Engineer in His Society" ABUP Ltd, Zaria, 1999.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Infrastructural Planning and Management		**Course Code: CEC 414**	**Contact Hours: 2 – 0 – 0**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the importance f water management of Resource Control**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
	1.0 Understand importance of planning and management for provision of infrastructural facilities.		
1	1.1 Identify the importance of infrastructural planning and management for provision of infrastructural facilities. 1.2 Identify the importance of taking early steps towards effective infrastructural planning. 1.3 Describe the steps in effective infrastructural planning and management.	• Lectures • Give examples of projects where adequate planning was not carried out. • Use question and answer techniques • Give assignments	• Computers DBMS • AutoCAD • Drawings • Charts
2	**General Objective 2.0: Know factors affecting infrastructural facilities, system and structures.**		
	2.1 Identify the factors that are affecting infrastructural facilities, system and structures. 2.2 Discuss involvement of community for project planning implementation, operation and management. 2.3 Explain the effect of Climatic change on our infrastructural facilities, systems and structures. 2.4 Explain the effect of environmental degradation on our infrastructural facilities, systems and structures.	• Use question and answer techniques • Assignments	• Charts • Video
	General Objective 3.0: Know planning and management of infrastructural provision		
3 – 5	3.1 Identify agencies in implementing planning and management of infrastructural provision. 3.2 Explain Government responsibilities in planning and management of infrastructural provision. 3.3 Discuss the Community responsibilities in planning and management of infrastructural provision. 3.4 Explain private sector involvement in planning and management of infrastructure provisions. 3.5 Explain household responsibilities in planning and management of infrastructure provision. 3.6 Explain Local Government responsibility in planning and management of infrastructure.		▪ Computers DBMS ▪ AutoCAD ▪ Drawings ▪ Charts

	General Objective 4.0: Know how to develop a management plan for infrastructure facilities, systems and structures		
6 – 7	4.1 Describe the ways to gather information. 4.2 Describe the steps to conduct a comprehensive infrastructure facility survey. 4.3 Explore and Evaluate management plan options. 4.4 Explain the ways to conduct life cycle cost analysis and explore finance options. 4.5 Develop an infrastructural management plan. 4.6 Prepare a work schedule. 4.7 Discuss ways of informing beneficiaries about the management plan. 4.8 Demonstrate ways of implementing the infrastructural management plan. 4.9 Monitor the management plan.	• Lecture • Give assignment	• Computers DBMS • AutoCAD • Drawings • Charts
	General Objective 5.0: Know how to carry out performance management of infrastructure facility.		
8	5.1 Explain performance management. 5.2 Identify the key processes fundamental to the success of the infrastructure facility. 5.3 Explain the measuring processes on the basis of feed back and performance information.		
	General Objective 6.0: Know how to conduct Asset Management		
9	6.1 Explain the role of infrastructure facility management. 6.2 Describe how to prepare an Asset Management Register, Cataloguing for each asset. a. Condition b. Serviceability 6.3 Prepare an Asset Management Plan.	▪ Set coursework	▪ Provide data.
	General Objective 7.0: Know how to carry out Maintenance Programme		
10 - 11	7.1 Identify various maintenance programmes for infrastructure facilities system and structures. 7.2 Describe the various maintenance programmes of infrastructure facilities, systems, and structures. 7.3 Discuss maintenance self-audit 7.4 Prepare maintenance self-audit] 7.5 Prepare maintenance programmes for facilities, systems and structures	- do -	- do -

	General Objective 8.0: Understand the application of GIS and Information Management packages to Infrastructure facilities, systems, and structures		
12 - 13	8.1 Identify data needs for information management for infrastructures facilities systems. 8.2 Discuss the application of GIS as a means to capture, process distribution and management information on infrastuctural facilities, system and structures. 8.3 Explain the application of GIS and other information techniques as a means for developing statistical based management reports. 8.4 Apply GIS and other information techniques to develop infrastructure planning and management. 8.5 Apply other management packages for infrastructure management	▪ Lectures ▪ Give assignments	▪ Computers ▪ GIS software ▪ Auto CADD ▪ LIS ▪ ILWIS ▪ Arch – Info ▪ GPS ▪ Map maker etc
	General Objective 9.0: Know infrastructure Regulatory Agencies and their functions		
14	9.1 Identify International and National Regulatory Agencies involved in infrastructure provision. 9.2 Discuss the functions of each International and National Regulatory Agencies involved in infrastructure provision and management.		
	General Objective 10: Know policies and regulation of various infrastructure facilities, systems and structure		
15	10.1 Identify various International and National Policies on infrastructure planning and management. 10.2 Identify various International and National regulatory laws on infrastructure planning and management. 10.3 Describe the implementation of the infrastructure policies. 10.4 Describe the implementation of the regulatory laws on infrastructure planning and management.		

Assessment: Coursework 20%; Course test 20%; Practical 10%; Examination 50%.

Competency: On the completion of this course the student should be able to develop infrastruralal planning managing programmes with the use of GIS tools and prepare reports.

References:
1. Maguire, D.J.; Goodchild, M.F. and Rhind, D.W. "Geographical Information Systems, Vol. I: Principal and Applications" Longman, 1991 And Vol. 2: Applications, Longman, 1991.
2. Hofman, W.B., Lichtendgger, H. and Collins, J. "GPS Theory and Practice" Springer – Verlag N.Y. 1993.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Water Resources Management (Elective)		**Course Code: CEC 422**	**Contact Hours: 2 – 0 – 1**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the importance of water management**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Identify the importance of water management. 1.2 Understand planning as a tool for water resources development 1.3 Identify the importance of taking early steps towards effective management 1.4 Describe the major forms of water management	▪ Lecture and discuss	▪ Government Policies ▪ and Documents on Water ▪ Resources Management
	General Objective 2.0: Understand the basic law governing the rights for the use of water		
3 – 4	2.1 Identify the water laws 2.2 Define Riparian doctrine 2.3 Define prior appropriation laws 2.4 Explain the use of appropriation rights 2.5 Identify the various groundwater laws. 2.6 Analyse and state water laws 2.7 Identify the legal definition of groundwater.	▪ Questions and answers techniques	- do -
	General Objective 3.0: Understand water pollution control		
5	Water Pollution Control 3.1 Explain the water pollution control acts. 3.2 Explain National Pollution discharge systems.	- do -	- do -
	General Objective 4.0: Understand the importance of groundwater management		
6 – 8	4.1 Explain the importance of groundwater management. 4.2 Describe the management processes involved in the development of groundwater resources to increase water supply. 4.3 Prepare groundwater contours 4.4 Interpret the contours for management decision.	- do -	- do -
	General Objective 5.0: Understand the management of waste water		
9 – 10	5.1 Identify the areas of waste water treatment management 5.2 Explain the various methods in environmental effects of waste water management. 5.3 Evaluate the merits and demerits of waste water management.	- do -	▪ Charts ▪ Drawing

	6.0 Know the importance of making water resources policy		
11 – 12	6.1 Identify the importance of water resources policy 6.2 Identify the importance of consideration to formulate water resources policy. 6.3 Propose water resources policy in your area of operation.	- do -	▪ OHP ▪ Video machine
	7.0 Understand the managerial responsibilities for operation and maintenance of water supply systems.		
13 – 14	7.1 Identify the importance of management of operation of water supply systems including the distribution network. 7.2 Identify the management responsibilities during emergencies. 7.3 Detect faults during water supply using appropriate instruments. 7.4 Propose remedies. 7.5 Carry out routine maintenance works in the water supply lines.	- do -	- do -

Assessment: Coursework – 20%; Course test – 20%; Practical – 0%; Examination 60%.
Competency: On Completion of the course, the student should be able to apply basic principles of Water Resources Management.
Reference: Donald, R "Wildland Watershed Management", John Wiley, 1992.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Engineering Management		**Course Code: CEC 428**	**Contact Hours: 2 – 0 – 0**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the historical background of construction management.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Define construction management. 1.2 Distinguish between contract management and construction management processes. 1.3 Outline the recent scientific developments in management	▪ Lectures and Discussions	▪ Case studies of old contract ▪ Documents
	General Objective 2.0: Understand the basic principles techniques and practice of management.		
2 – 4	2.1 Define the following processes of management forecasting, planning, control, organisation, coordination, motivation and communication. 2.2 Describe productivity technique, i.e. operational techniques and network analysis. 2.3 Define resource allocation and leveling cost optimisation, work flow quelling theory, flow graphs, optimum gang size. 2.4 Define work study, objectives and procedures, recording techniques, process charting and diagrams. 2.5 Apply these principles in Civil Engineering works. 2.6 Describe work measurement techniques, time study procedures timing and rating. 2.7 Describe incentives, non-financial incentives to production, procedure for determining targets for agreement concerning distribution of saving. 2.8 List relationship between incentive payments and standard wage rate. 2.9 Describe quality control techniques, organisation structures, staff and labour organisation co-ordination and relationships. 2.10 Explain objective-oriented project management concept. 2.11 Explain sequencing, scheduling and planning. 2.12 Carry out case studies using these principles.	▪ Give assignments	▪ Chalkboard
	General Objective 3.0: Understand the basic economic concepts applied in engineering.		
5 – 7	Engineering Economics 3.1 Define annual worth and rate of returns 3.2 Compare simple engineering projects with the application of annual worth or returns. 3.3 Evaluate various economic alternatives based on the concept of depreciation. 3.4 Explain the production method of calculating depreciation.	- do -	- do -

	3.5 State the circumstances tin which the production method is preferred. 3.6 Establish the differences between depreciation and amortization. 3.7 Describe with illustrations the: (a) Straight-line depreciation method (b) Declining balance method of depreciation. 3.8 Describe method of recording transaction by the journal, types of ledger accounts format, adjusting and closing procedure. 3.9 Explain the nature of special journals and ledgers for repetitive transactions. 3.10 Carry out method of making up financial statement and balance sheet. 3.11 Explain the meaning of receivable assets and long term capitals. 3.12 Explain the concept of liabilities in long and current water. 3.13 Explain the process of establishing a firm. 3.14 Explain the use of economical and financial ratio 3.15 Apply these concepts to Civil Engineering		
	General Objective 4.0: Understand the basic principles of law as it applies to Civil Engineering contracts.		
8 – 10	4.1 Identify laws governing labour unions. 4.2 Name three ways a construction contract can be terminated. 4.3 Name three types of partnership 4.4 Name the three principal forms of business ownership in construction, stating the liability limits of the owners in each case. 4.5 Describe briefly the advantages and disadvantages of a corporate form of business organisation as compared to a partnership. 4.6 Explain steps which must be taken to set up a partnership. 4.7 State reasons under which a partnership can be dissolved. 4.8 Explain the Nigerian Legal Systems as it affects the construction industry 4.9 Explain arbitration procedure 4.10 Cite relevant cases.	- do -	▪ Case studies of old contract ▪ Documents
	General Objective 5.0: Understand the simple graphic quantitative management tools used in project analysis		
11	5.1 Explain how PERT or CPM network can help management deal effectively with a large complex project. 5.2 Compare flow charts and Gantt charts 5.3 Describe how histograms can help manager make better choices 5.4 Apply these tools in Civil Engineering operations.	- do -	- do -
	General Objective 6.0: Understand the requirements for Project Site management.		
12 – 14	Projects Sites Management 6.1 Explain the purposes for site meetings 6.2 Describe the procedures for site meetings. 6.3 Explain site meeting components uses	- do -	- do -

	6.4 Define the roles of the Engineer, Engineer's representative contractor's site Agent, Sub-contractors and other participants on site. 6.5 Discuss minutes of site meeting and follow-up procedures 6.6 Carry out case studies.		
Week 15 for Revision			

Assessment: Coursework 20%; Course test 20%; Examination 60%.

Competency: Students to acquire knowledge of effective and efficient Management of Civil Engineering works.

Reference: Harris and McCaffer, "Modern Construction Management", Blackwell, Science, 1995

Ivor H. Seeley, "Civil Engineering Contract Administration and Control", Mcmillan Ed. Ltd, London.

PROGRAMME: HND CIVIL ENGINEERING		
Course: Industrial Management	**Course Code: GNS 413**	**Contact Hours: 2/0/0**

Course Specification: Theoretical Content

	Specific Learning Outcomes	**Teacher Activities**	**Resources**
Week	**General objective 1.0: Comprehend private and state control of enterprises**		
1	1.1 Identify types of enterprises: sole proprietor, limited liability, co-operative societies, public corporation, partnership. 1.2 Explain the objectives of a business organization. 1.3 Explain the business environment (e.g political, economic etc) 1.4 Examine private enterprises 1.5 Evaluate the public enterprise 1.6 Appraise the effect of private control of business. 1.7 Analyse the implications of state control of enterprises.	Treatment of 1.1 should include the structure, functions, advantages and disadvantages of each type of business organization**.**	
	General Objective 2.0: Understand the methods of management		
2 - 3	2.1 Define management 2.2 Explain the functions of management planning, organizing, controlling, staffing, directing. 2.3 Explain the purpose of managing money, men, material and machines. 2.4 Examine the concept of authority and responsibility. 2.5 Appraise management by objectives. 2.6 Analyse the roles of the Chief Executive and Board in policy formulation and implementation. 2.7 Explain motivation. 2.8 Explain the concepts of Theory X and Y 2.9 Evaluate management control 2.10 Examine problems of leadership in organization.		
	General Objective 3.0: Know elements of marketing		
4	3.1 Define “marketing” and “market” 3.2 State the marketing mix-product, price, place, promotion. 3.3 Explain product differentiation. 3.4 Explain market segmentation. 3.5 Differentiate the industrial market from the consumer market.		

5	3.6 Define a product. 3.7 Identify the stages of the product life cycle – introductory, growth, maturity, decline. 3.8 State the features of each stage in (3.7) above. 3.9 Describe the different ways a company can develop a new product – e.g improving existing products, seeking new products from external sources, inventing a new product. 3.10 Identify the different channels of distribution of a product. 3.11 Choose the most appropriate channel of distribution for a given product. 3.12 State the features of each channel in (3.11) above.		
	General objective 4.0: Understand Personnel Development		
6 - 7	4.1 Explain the concept of personnel management 4.2 Define recruitment 4.3 Explain the selection and engagement procedures. 4.4 Appraise evaluation and merit rating. 4.5 Explain the importance of education, training and development. 4.6 Explain following: skill training, attitude training, technical training, management training. 4.7 Examine the relevance of industrial training to productivity in an organization. 4.8 Examine critically different types of conditions of service. 4.9 Define trade unionism, collective bargaining, joint consultation, conciliation, arbitration. 4.10 Explain the roles of the Industrial Arbitration Panel, the Industrial Court and the Ministry of Labour in maintaining industrial harmony in Nigeria. 4.11 Explain labour's share in the organisation's income.		
	General Objective 5.0: Comprehend Quantitative Management Techniques		
	5.1 Identify types of management decisions 5.2 Explain the modern quantitative decisions techniques. 5.3 Appraise operation research.		

8	5.4 Apply the use of decision trees, diagrams, programme evaluation review techniques (PERT), critical path model, etc in operation research. 5.5 Examine the structure of linear programming problems. 5.6 Chart some linear programming problems. 5.7 Examine the simplex method in solving linear programming problems.		
	General Objective 6.0: Understand maintenance schedules and replacement strategies		
9	6.1 Explain purchasing 6.2 Analyse storage and stock ordering 6.3 Calculate the economic order quantity (EOQ) 6.4 State the importance of production in an organization 6.5 Evaluate production planning and control. 6.6 Appraise production scheduling 6.7 Explain quality control 6.8 Analyse replacement strategies 6.9 Define the following terms; preventive planned, corrective, breakdown, running and shutdown as used in maintenance 6.10 Critically examine maintenance culture in Nigeria. 6.11 Estimate depreciation and scrap value.		
	General Objective 7.0: Understand money and the financial institutions		
10	7.1 Define money 7.2 Explain the functions of money 7.3 Explain the functions of the Central Bank 7.4 Analyse the functions of a commercial bank. 7.5 Explain the functions of other financial institutions: the Merchant Bank, Mortgage Bank, Insurance Organisation, etc. 7.6 Enumerate types of insurance policy – e.g life policy, fire, marine, etc.		
	General Objective 8.0: Appreciate Investment management		
	8.1 Define investment 8.2 Explain investment objectives and decisions 8.3 Explain methods of investment forecast, e.g payback period, internal rate of return, net present value, etc.		

11- 13	8.4 Critically examine the company's finance e.g cash, balance sheet, income statement, budgetary control, cash flow 8.5 Analyse project planning. 8.6 Explain risk and uncertainty in a project. 8.7 Explain project evaluation. 8.8 Analyse types of business costs e.g fixed cost, variable cost and total cost. 8.9 Analyse contract costing. 8.10 Explain the break-even point 8.11 Calculate the break-even point 8.12 Chart the break-even.		
	General Objective 9.0: Understand data management		
14	9.1 Explain the purpose of report writing 9.2 Explain the importance of literature review 9.3 Examine methods of data collection 9.4 Explain data measurement 9.5 Apply the use of tables and graphs in data presentation. 9.6 Examine methods of data interpretation. 9.7 Evaluate oral presentation of information.		
	General Objective 10.0: Understand the industry and national economy		
15	10.1 State the importance of industry to human development. 10.2 List the factors necessary for the location of an industry. 10.3 Explain the main features of Nigeria's industrial policy. 10.4 Explain the different types of economic systems 10.5 State the importance of the national income 10.6 Examine the national economy.		

QUANTITIES AND SPECIFICATION

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Civil Engineering Quantities and Specifications		**Course Code: CEC 311**	**Contact Hours: 2 – 0 – 0**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know how to measure construction works using SMM for building and Civil Engineering works for more complex and simple industrial building of over tow stories.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Measure sub-structure of complex and special foundations, basements and piled foundations in variable ground. 1.2 Measure floors – solid and suspended ground floors, suspended slab floors and associated reinforcement and formwork. 1.3 Measure walls of brickwork, blockwork of solid cavity and hollow nature together with associated features. 1.4 Measure doors and windows, associated frames and ironmongery including adjustments for openings. 1.5 Measure roof construction and coverings of reinforced concrete roofs, steel trusses, tiles felt, asbestos, cement, corrugated sheets, lead, zinc, copper and aluminium. 1.6 Measure frames of structural steel and reinforced concrete beams and columns, both when fixed by the main contractor or prime cost. 1.7 Measure staircase-timber reinforced concrete including finishing. 1.8 Measure fittings and fixture-cupboards, shelving, skirtings, picture architraves, picture-rails, pelmets, dadoos etc. 1.9 Measure prefabricated structures: industrialized structures and building constructed mainly with standardized components off site. 1.10 Measure wall cladding and external finishings: precast concrete and cost of both where supplied and fixed by the contractor and where the subject is of a prime cost. 1.11 Measure internal finishings: ceiling, wall and floor finishings of a more complex nature, including demountable partitions and suspended ceilings, and curtain walling.	▪ Use question and answer to test the knowledge of the students. ▪ Make students take physical measurement of various items. ▪ Visit an existing site.	▪ Chalkboard, Tape ▪ CE SMM Building SMM ▪ Drawings, ▪ Specimen ▪ Specifications
3 - 4	**General Objective 2.0: Understand the measurement of drainage and utilities installations**		
	2.1 Measure drainage-excavations, pipe works, manholes, soakaway pits, septic tanks. 2.2 Measure electrical installation. 2.3 Measure water supply and sanitary appliances. 2.4 Measure external works-paths, roads, flower and tree planting, turfing, fencing and gates.	▪ Use question and answer technique. ▪ Students should be made to take physical measurement. ▪ Visit an existing site.	▪ Chalkboard tape ▪ CE SMM

	2.5 Identify the approach measurement of gas services, heating, ventilation and air-conditioning and other specialist services.		
	General Objective 3.0: Understand the different methods of processing, dimensioning building and preparing schedule.		
5	3.1 Process dimensions, abstracting, cut and shuffle bill direct. 3.2 Explain different bill formats and their uses: a. works sections bill b. elemental c. sectionalized trades bill d. annotated bill e. operational bill -No preparation required. f. activity 3.3 Prepare schedules for finishings, reinforcement opening (doors and windows), ironmongery, sanitary appliances and drains.	▪ Question and answer ▪ Give assignments	- do -
	General Objective 4.0: Understand the basic principles and scope of estimating		
6	4.1 Explain techniques of approximate estimating by the use of the following methods. a. storey enclosure b. costing c. superficial d. lump or spot prices.	▪ Explain using relevant examples ▪ Carry out at least one worked example for each method. ▪ Give students assignment.	▪ Chalkboard, chalk, duster, calculator
7	4.2 Explain the elements of prime cost under: a. material elements – delivery, unloading, storing, handling and waste. b. Plant elements (applied to unit rate): hiring, with associated charges and running costs, builders own plant, including capital cost, depreciation, insurance licenses and running cost. c. Labour element – builders own labour, all in labour rate labour – only subcontractors compare rate based on different analysis e.g. i. builders own labour subcontractors labour. ii. Builders own plant – hired plant iii. Builders own unit rate – subcontractors or suppliers' all-in quotations e.g plumbing, finishes.	▪ Use relevant examples of elements ▪ Give worked examples to illustrate. ▪ Give students assignment ▪ Explain using relevant examples.	- do -
8	4.3 Define a. prime b. project overheads c. general overheads d. special risks and consideration	▪ Explain using relevant examples	- do -

	General Objective 5.0: Appreciate contractor's activities during the tender process		
9 – 10	5.1 State the information obtained from the following sources: a. bill of engineering measurement. b. standard form of building contractor conditions. c. drawings, list, schedules, and specifications. d. Codes of practice relating to estimating. e. Labour and plant performance data. f. Manufacturer's and suppliers' specifications and quotations. g. Subcontractors requirements and quotations. h. Working rule agreement condition. i. Liaison with parties generally.	▪ Explain using relevant examples ▪ Using questions and answer techniques to ascertain level of understanding. ▪ Use relevant examples to explain ▪ Carry out preliminary planning, etc with a life project. ▪ Give the students assignments.	▪ Chalkboard
11	5.2 Explain the purpose of pre-tender liaison meetings 5.3 Use information obtained in 5.1 for preliminary planning, statement of method, plant and equipment schedule, staffing requirements, including subcontractors, material supply, and cash flow.		▪ Chalkboard
	General Objective 6.0: Understand the measurement codes and measure works in selected areas		
12 - 13	6.1 Measure works under Earth works – cutting and Embankments. 6.2 Measure works under in situ and pre-cast concrete, including ancillaries in culverts, bridges, retaining walls, dams, etc. 6.3 Measure works under roads and air-fields. 6.4 Measure works under piling and ancillary works. 6.5 Measure works in railway tracks. 6.6 Measure works in pipelines (for gas and water), sewers and drains. 6.7 Measure works in structural steel works and metal works. 6.8 Measure works in Timber. 6.9 Measure works in painting and water – proofing, fencing, tunneling, etc. 6.10 Explain preamble and preliminary clauses in Civil Engineering works. 6.11 Identify the importance of preamble and preliminary clauses. 6.12 Write typical preamble clauses for different work sections in CESMM. 6.13 Write typical preliminary descriptions for bill of engineering measurement items in accordance with CESMM.		▪
	General Objective 7.0: Understand the measurement of quantities in Civil Engineering Works in particular and BEME.		
	7.1 Measure earthwork, retaining walls, pile foundations, heavy foundations, pipelines, jetties sewers, tunnels, roads.	▪ Use question and answer ▪ Measurement and Evaluation	- do -

	7.2 Process quantities, editing and presenting Bills of Engineering measurement for Civil Engineering Works in particular. 7.3 Explain method of related charges.	(BEME) ▪ Give assignments	
	General Objective 8.0: Understand the principles of specification writing		
14 – 15	8.1 Review the meaning of specification. 8.2 Review types of specifications. 8.3 Review the importance of specification. 8.4 Discuss the basic requirements in writing a good specification. 8.5 Explain the need for liaison in writing specification. 8.6 Explain the logical development of requirements of items. 8.7 Enumerate the use of drawings in writing engineering specifications. 8.8 Explain the structure of a specification. 8.9 Discuss the use of communication in specification writing. 8.10 List the excluded items. 8.11 Discuss the use of (i) historical and background information, (ii) ancillary documents (iii) environmental aspects. 8.12 Discuss the importance of the following in specification writing: (a) Scope of operation (b) Functional characteristics. 8.13 Design specification. 8.14 Write simple specifications for minor works.	▪ Use questions and answers. ▪ Give assignments to students.	▪ Chalkboard ▪ Examples of specifications.

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 50%
Competency: The student on completion should be able to measure, prepare BEME and write a simple specification for Civil Engineering works.
Reference: Ivor H. Seeley, "Civil Engineering Quantities" 3rd Ed. McMillan, London
Ivor H. Seeley, "Civil engineering Specification" 2nd Ed. McMillan Edc. Ltd., London.

HYDRAULICS/HYDROLOGY

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Hydraulics		**Course Code: CEC 301**	**Contact Hours: 1 – 0 – 3**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the forces on immersed object.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Explain resultant thrust and centre of pressure on plane immersed surfaces. 1.2 Determine the thrust and centre of pressure on curved immersed surfaces.	▪ Derive from first principles the centroid of regular shapes and show that total hydrostatic pressure is equal to the product.	▪ Chalkboard ▪ Centre of Pressure
	General Objective 2.0: Know the basic principles of dimensional analysis and hydraulic modeling.		
3 – 5	2.1 Explain the concept of dimensional analysis. 2.2 List the applications of dimensional analysis. 2.3 Describe the procedure used in dimensional analysis. 2.4 Solve problems using principles of dimensional analysis. 2.5 Define similitude. 2.6 Explain the uses of similitude. 2.7 Explain the geometric, kinematic, and dynamic similarity. 2.8 Explain the application of principles of geometric, kinematic and similarity of Reynolds and Froudes Model Laws. 2.9 Solve problems using the two model laws in 2.8.	▪ Lecture and demonstrate with relevant calculations	▪ Chalkboard ▪ Stability of floating bodies ▪ Raynolds apparatus
	General Objective 3.0: Understand the basic phenomena in non-uniform flow in Channels.		
6 – 8	3.1 Define specific energy. 3.2 Define normal, sub-critical, supercritical and initial depth. 3.3 Define hydraulic jump 3.4 Determine specific energy 3.5 Determine critical depth. 3.6 Determine hydraulic jump 3.7 Describe the characteristics of surface profiles.	- do -	▪ Notcher apparatus Flow channel
	General Objective 4.0: Understand the uses and selection of pumps and turbines.		
9 – 11	4.1 Identify different types of pumps 4.2 Determine the characteristics of pumps 4.3 Determine the uses of pumps 4.4 Identify different types of turbine 4.5 Determine the uses of turbines 4.6 Determine the characteristics of turbine e.g. cavitation, efficiency power.	- do -	▪ Orifice apparatus ▪ Losser in piping system ▪ Friction loss along a pipe ▪ Flow measurement apparatus ▪ Venturi meter

	General Objective: 5.0 Understand the determination of flows and heads of nodes .		
12 – 14	5.1 Explain the friction formulae (Hazen-Williams and Darcy Weisbach) 5.2 Explain the uses of equivalent pipe. 5.3 Determine flow and heads in pipes in series and parallel. 5.4 Determine pipe flow and nodal heads using Hardy-Cross method. 5.5 Carry out practical exercise on each of the topic above under the supervision of lecturer.	- do -	Orifice apparatus Losser in piping system Friction loss along a pipe Flow measurement apparatus Venturi meter

Assessment: Coursework 20%; Course test – 20%; Practical 20%; Examination 40%.
Competency: **On completion of the course, the s**tudent should know the fluid flow in open channels and pipes
Reference: Chardurick, A. "Hydraulics in Civil Engineering" Ann Arbor Science Inc. Chicago, 1975
Malholva, D.R. "Hydraulics" Katson Pub. Lud Liraua, 1983

PROGRAMME:CIVIL ENGINEERING TECHNOLOGY			
Course: Hydraulics	**Course Code: CEC 301**	**Contact Hours: 1-0-3**	
Course Specification : Practical Content			
WEEK	**General Objective: Conduct Practicals to improve understanding of theoretical Content.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 - 15	1. Determine the behaviour of fluids under uniform flow in open channels. 2. Determine hydraulic jump 3. Determine critical depths in channels 4. Investigate discharge through orifices 5. Investigate flow through venturimeter and its application in buildings 6. Investigate energy changes in a channel . 7. Determine the flow and heads in pipes arranged in series and parallels. 8. Study head – discharge relationship for a) rectangular-notch b) and V-notch 9. Investigate flows through obstructed channels	▪ Technologist to prepare equipment under supervision of lecturer. ▪ Technologist to assist in methodology. ▪ Technologist to monitor students ▪ Technologist to assist and monitor students.	▪ Flow channel ▪ Flow measuring apparatus ▪ Hydraulic bench ▪ Reynold and transitional flow ▪ Hydraulic bench ▪ Liquid sedimentation tank ▪ Pumps and accessories ▪ Air flow rig ▪ Drag coefficient of particles apparatus ▪ Surge and water hammer apparatus ▪ Drainage seepage tank ▪ Standard 300m wide tilting flow channels and models.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Hydrology and Hydrogeology	**Course Code: CEC 302**	**Contact Hours: 1 – 0 –2**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the application of statistical methods in hydrology**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Explain the elements of probability 1.2 Illustrate the application of probability in hydrology. 1.3 Explain return period and its determination 1.4 Solve problems using probability 1.5 Determine: a. Intensity – duration curve b. Intensity – duration frequency curve. c. Depth – area duration curve.	▪ Lecture and sketch relevant graphs	▪ Rain fall and rainfall intensity records.
	General Objective 2.0: Know the effect of infiltration on soils and ground water		
3	2.1 Define infiltration and infiltration indices. 2.2 Identify the factors affecting infiltration rate. a. soil type b. soil field capacity 2.3 Perform infiltration tests . 2.4 Apply infiltration factors to drainage design.		▪ Double rain infiltrometer.
	General Objective 3.0: Know the basic factors affecting surface run-off.		
4 – 6	3.1 Explain catchment area 3.2 Define surface run-off 3.3 State the factors affecting surface run-off 3.4 Identify the factors that affect duration of run-off 3.5 Determine run-off using the following methods a. Rational method b. Hydrographic method. 3.6 Explain the principles of a unit hydrograph	▪ Lecture	▪ Hydrograms and ▪ Discharge records. ▪ Spanil graphs
	General Objective 4.0: Know the concept and importance of river gauging.		
7 – 8	River Gauging 4.1 Explain river gauging methods and instruments used. 4.2 Enumerate the merits and demerits of river gauging instruments. 4.3 Determine the discharge using common methods a. use of floats b. current meter c. weirs.	▪ Lecture	▪ Models of wairs.

	General Objective 5.0: Understand the basic principles of flood routing and hydrological forecasting.		
9 –10	5.1 Define flood and flood routing. 5.2 Describe flood routing through reservoirs and channels. 5.3 Describe hydrological forecasting method. 5.4 Describe the synthetic flow data generation techniques. 5.5 Determine the hydro-meteorological estimation of extreme flood flows	▪ Lecture and illustrate with examples.	▪ Discharge records.
	General Objective 6.0: Understand basis principles of geophysical survey		
11 – 12	6.1 Define pure and applied Geophysics 6.2 Know different methods of geophysical survey 6.3 Describe the various methods of geophysics applicable to ground water studies.		
	General Objective 7.0: Understand the principles of ground water flow acquifers and their characteristics		
13 – 14	7.1 Describe the occurrence of ground water. 7.2 Describe the movement of groundwater (Darcy's Law) 7.3 Describe the methods of permeability measurements (Lab, and field methods). 7.4 Describe methods of abstraction of groundwater in relation to hydrology 7.5 Describe methods of estimation of well yield. 7.6 Describe methods of bore hole drilling and development.	▪ Lecture	▪ Data from pumping test. ▪ Typical borehole log

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40;

Competency: Students should have a knowledge of surface water flow and prediction. They should be acquainted with ground water harnessing techniques.

References:
1. Mustafa, S. and Yusuf, A.M. "A handbook for Hydrology and water Resources. JENDS PUB., Abuja.
2. Davis, s. W. "Hdrogeology", John wiley, 1966.

PROGRAMME: Civil Engineering Technology			
Course: Hydrology		**Course Code: CEC 302**	**Contact Hours: 1 – 0 – 2**
Course Specification : Practical Content			
WEEK	**General Objective: Conduct Practicals to improve understanding of Theoretical Content**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 15	1. Carry out measurement of rainfall using rain gauges. 2. Determine infiltration capacity of soil. 3. Determine permeability of soil. 4. Carry out evaporation measurements. 5. Produce drawings or representations of interpretation graphs for precipitation and compute rainfall values 6. Investigate the validity of Bernoull's equation as applied to flow of water . 7. Investigate Laminar and turbulent flow in a pipe with applications. 8. Carry out geophysical survey and analyse in an area of field layout 9. Measure flow in a stream or river nearby and compute river discharge	▪ Technologist to be responsible for setting up, assisting students under the supervision of lecturers	▪ Rain gauges, Rain Fall Hydrograms. ▪ Infiltrometer evaporation pans, ▪ Thermometers. ▪ Anenometer, evaporation pans ▪ Flow measuring apparatus, flow channels, Hydraulic bench permeability tanks Reynolds and transitional flow pipe Surge and water hammer apparatus, Drainage seepage tank.

SOIL MECHANICS, FOUNDATION & GEOTECHNIQUES

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: : Soil – Mechanics II	**Course Code: CEC 307**	**Contact Hours:21-1-3**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know about seepage forces**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Explain seepage force in quick sand and other sands. 1.2 Explain seepage forces through homogeneous and non-homogeneous soils.	▪ Explain, Illustrate	▪ Chalkboard, 0-H Projector, wring tools.
	General Objective 2.0: Know flow nets.		
2 - 5	2.1 Define flow nets. 2.2 Sketch dimensional flow nets for confined flow.	▪ Draw, explain, Derive seepage formula.	▪ Chalkboard, 0-H Projector, wring tools.
	2.3 Calculate dimensional flow net for confined flow in earth dams. 2.4 Explain the four boundary conditions.	▪ Present, Draw, ▪ Explain.	▪ Chalkboard, 0-H Projector, wring tools.
	2.5Compute seepage and up-lift pressure from flow net 2.6 Explain the use of up-stream and down stream aprons in dams.	▪ Draw, Compute, ▪ Calculate.	▪ Chalkboard, 0-H Projector, wring tools.
	2.7 Calculate the critical hydraulic gradient.	- do -	▪ Chalkboard, 0-H Projector, wring tools.
	General Objective 3.0: Know about consolidation.		
6	3.1 Define consolidation. 3.2 Explain the theory of consolidation from first principles.	▪ Define, Explain.	▪ Chalkboard, 0-H Projector, wring tools.
7	3.3 Explain Load Compression curve for both clay and sand. 3.4 Describe the curve fitting methods. (square root and log)	▪ Draw, derive equations, explain.	▪ Chalkboard, 0-H Projector, wring tools.
8	3.5 Explain the time settlement curves in clay sand with allowance for construction period. 3.6 Perform multi-state consolidation test.	▪ Explain, demonstrate labs.	▪ Chalkboard, 0-H Projector, writing tools, soil lab.
9	4.1 Describe the shear box test. 4.2 State it uses.	▪ Describe, ▪ Demonstrate, ▪ Perform	▪ Chalkboard, 0-H Projector, writing tools.
10	4.3 Perform shear box test.		
	4.4 Describe all triaxial tests.		
11	4.5 Explain the Mohr Coulomb failure envelope and the resulting parameters in terms of effective stress (C, ∅,∅).	▪ Describe, Explain	- do -
12	4.6 Describe the relationship between shear strength and compressive Strength	- do -	- do -
13 - 14	4.7 Explain the use of confined compressive stress. 4.8 Perform triaxial text.	▪ Describe, Explain, ▪ Demonstrate, Perform.	- do -
15	Revision		

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%.

Competency: The student should have a good understanding of Soil Mechanics theory and be able to solve water flow and consolidation problems.

Reference:

Soil Mechanics R.F. Craig
Terzaghi and Peck, "Soil Mechanics and Foundation Practice,", John Wiley and Sons Publishers.
CP 2002. "Management of Soil Properties in the laboratory"
British Lab. Manual or any latest code reviewed in B.S. Codes.
Busil "Soil Mechanics White"

PROGRAMME: HND I -CIVIL ENGINEERING TECHNOLOGY			
Course: Soil Mechanics II	**Course Code: CEC 307**	**Contact Hours: 2-1-3**	
Course Specification: Practical Content			
WEEK	**General Objective:**		
	General Objective:		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
3-5 6-8 9-11 12-14	1 Perform consolidation test and obtain the coefficient of consolidation using (square root and log methods). Also obtain compressibility coefficient (M_v) and compression indix C_c 1 Perform the shear box test and obtain the cohesion (c) and angle of internal friction (∅') 2 Perform the triaxial test and obtain (c' and ∅'). 3 Perform a flow net experiment	Technologist to prepare samples, equipment, and monitor the students during the practical. He is to grade students reports and submit to lecturer. Course lecturer is to supervise the above activities and collate the results of graded practicals.	Consolidation machine, stop watch. Permeability test apparatus. Undisturbed specimens. A sand model and dye or electrical analogy (paper or tank). Shear box equipment. Triaxial compression machine.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Foundation Engineering	**Course Code: CEC 308**	**Contact Hours: 1-1-3**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know about site investigation.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Give reasons for conducting site investigation. 1.2 Write down the information expected from a site investigation. 1.3 Describe all the stages of a site investigation. 1.4 Plan a site investigation 1.5 Describe boring and excavation methods for site investigations.	▪ Introduce, Describe, Desk study, Prelininary and detailed exploration and boring methods.	▪ Chalkboard, O-H Projector, Writing tools, A sample technical report, Video of site exploration.
3	1.6 Describe sampling methods (types, transportation, storage, sample classes). 1.7 Describe insitu test (e.g SPT, cone penetration test vane shear test, loading test, etc).	▪ ▪ Describe	▪ Samples from site for description by students.
4	1.8 Describe geophysical methods of site investigation.	▪ Describe	▪
5	1.9 Record a site investigation (logging) from a boring. 1.10 Interprete the results above.	▪ Record, Interprete.	▪ Undertake a field borehole exploration complete with logging, sampling and report.
	General Objective 2.0: Know the different types of earth pressures.		
6	2.1 Describe the active and passive including earth pressure at rest. Explain vertical and lateral earth pressure using Rankine and coulomb Wedge theory.	▪ Define, Explain with drawings.	- do -
7	2.2 Calculate lateral pressure in cohesion less soils on vertical wall with horizontal soil surface. 2.3 Repeat 2.3 above for inclined soil surfaces	▪ Draw, derive.	- do -
8	2.4 Calculate lateral pressure in cohesive soils on vertical wall with horizontal surface. 2.5 Repeat 2.5 above for inclined soil surface. 2.6 Calculate the depth of tension crack.	▪ Draw, derive.	- do -
	General Objective 3.0: Know the importance of stability of slopes.		
9 – 10	3.1 Describe instance when slope stability is important. 3.2 Determine factors of safety for inclined slopes in sands and clay. 3.3 Analyse slope stability by circular arc method	▪ Draw, derive, describe, explain.	▪ Undertake a field borehole exploration complete with logging, sampling and report.
11	3.4 Analyse slope stability by the Swedish method of slices. 3.5 Repeat 3.4 above by Bishop conventional method of slices.	- do -	- do -

12	3.6 Repeat 3.4 above by Bishop simplified method. 3.7 Repeat 3.4 above by charts. 3.8 Recommend measures to correct slope failures.	- do -	- do -
	General Objective 4.0: Know the bearing capacity of soil.		
13	4.1 Define bearing capacity. 4.2 Define ultimate, safe and allowable bearing capacities.	▪ Define, explain	- do -
14	4.3 Write down various equations for determining bearing capacity using C and ∅, and from in-situ tests.	▪ Derive, present, ▪ Explain.	- do -
15	4.4. Calculate bearing capacity using 4.3 above.	▪ Calculate	- do -

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%

Competency: The student should gain comprehensive knowledge of field techniques and be able to apply this to Retaining walls, slope stability and bearing capacity designs.

Reference:
1. Tomlinson, M.J., "Foundation Practice and Construction", John Wiley.
2. Bull, J.W. "Prescast Concrete Raft Units". Blackie & Sons.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Foundation Engineering		**Course Code: CEC 308**	**Contact Hours: 1-1-3**
Course Specification: Practical Content			
WEEK	**General Objective: Conduct Practicals to improve the understanding of theoretical content**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
3-14	1. Carry out cone peuetrometer tests 2. Visit a site and collect site investigation records for foundation. 3. Compute earth pressure for different soils available in the stateof the institution experimentally. 4. Determine the slope stability of soil samples by (a) circular earth method (b) swedish method of slices. 5. Recommend corrective measures to slope that have failed. 6. Determine the bearing capacities of soil around the institution that could be use to build tall building and bridges. - Revision	▪ Technologist to prepare material and manual for experiments	▪ Cone penetrometer ▪ Shear box ▪ Triaxial ▪ Consolidation ▪ Odoemeter.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Foundation Design	**Course Code: CEC 407, Pre: CEC 308**	**Contact Hours: 2-1- 1**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know various pressure distributions below loaded foundations**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 - 3	1.1 Illustrate pressure distribution by elastic theory (for point load) line load, triangular loading and strip loading. 1.2 Determine pressure distribution below loaded areas using 1.3 Boussinesq's equation, Newmark's Chart, Fadum's curves etc. 1.4 Describe the concept of pressure bulb. 1.5 Explain the importance of pressure bulb	▪ Draw, Determine/Derive, Describe, Eplain	▪ Chalkboard, O-H Projector, Writing utensils.
	General Objective: 2.0 Know bearing capacity equations for shallow and deep foundation.		
4 – 6	2.1 Differentiate between shallow and deep foundation. 2.2 Apply Terzaghi's theory to design shallow footings. 2.3 Apply Meyerhof's theory to design deep foundations. 2.4 Deduce bearing capacities from test results. 2.5 Calculate settlements of foundation from elastic and consolidation theories.	▪ Differentiate, Present Terzaghi theory, apply, deduce, calculate	- do -
	General Objective: 3.0 Know the various types of foundations and the basis of their choice.		
7 – 8	3.1 Describe the following types of foundation: strip, reinforced strip, pad, raft, pile, combined. 3.2 Explain the basis for their choice. 3.3 Design pad and combined footings for columns. 3.4 Design a raft foundation.	▪ Describe, Explain, Design.	- do -
9	3.5 Organise and undertake field trips to a construction site.		▪ Student bus, fuel.
10	**General Objective 4.0: Understand the structural design of retaining walls and abutments.**		
	4.1 Apply structural methods to design retaining walls and abutments. 4.2 Compute earth pressure on abutments and wing walls.		▪ Chalkboard, 0-H Projector, Writing tools
	General Objective 5.0: Know earth pressures on sheet piles.		
11	5.1 Explain free earth support method for anchored sheet piles. 5.2 Explain fixed earth support method for anchored sheet piles. 5.3 Explain earth pressure of braced excavation. 5.3 Design sheet piles for different support conditions.	▪ Explain, State design steps, Illustrate design.	- do -

	General Objective 6.0: Know bearing capacity for piles in clays.		
12 - 15	6.1 Explain general classification of piles. 6.2 Explain the design of piles according to mode of load transmission (end bearing and friction). 6.1 Discuss pile groups (definition efficiency, spacing, pile cap). 6.2 Calculate bearing capacity for single piles. 6.3 Repeat 1.1 above for pile groups in clays, sands and layered systems. 6.4 Apply pile driving formulae for design. 6.5 State the limitations of pile driving formulae. 6.6 Design pile foundation for a bridge, tall buildings etc. 6.9 Design pile cap	▪ Explain using pile chart, ▪ Explain, discuss, derive equations, apply equations, ▪ Explain pile driving formula, state limitations, design.	- do -

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%.
Competency: The student shall have the skill to design shallow and deep foundations including retaining walls and piles.
References:
1. Flemming, W.G.K. "Piling Engineering", John Wiley Inc.
2. Bishop, A.W. and Henkel, J. "Measurement of Soil Properties Using the triaxial Cell". Thomas Telford, London.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Foundation Design	**Course Code: CEC 407**	**Contact Hours: 2-1-1**	
Course Specification: Practical Content			
WEEK	**General Objective:**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
2 – 4	Design pad and combined footings for columns.	▪ Use appropriate codes and design charts	▪ Codes of practice ▪ Design for foundations
5 – 6	Design raft foundation		
7	Under-take a field trip to a construction site.		
8 – 12	Design pile foundation for a brodge and fall building.		
13 – 14	Design pile cap.		
15	Revision		

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Geotechnical Engineering (Elective)	**Course Code: CEC 410 (Elective)**		**Contact Hours: 2 – 1 – 0**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know foundation repair process.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Define the concept of foundation repairs 1.2 Describe foundation underpinning using continuous strip footing. 1.3 Describe foundation underpinning using pad footing. 1.4 Describe foundation underpinning using pretest method. 1.5 Describe foundation underpinning using injection (grouting) method	Lecture processes and procedures	O-H Projector, chalkboard, Writing tools.
2	1.6 Describe foundation underpinning using sheet piling. 1.7 Describe foundation underpinning using freezing methods. 1.8 Describe foundation underpinning by moving house. 1.9 Describe foundation underpinning using other techniques.	- do -	- do -
3	**General Objective 2.0: Know the principle of use of caisson foundations.**		
	2.1 Define caisson foundation and list areas of use/application. 2.2 List types and conditions for the use of caisson. 2.3 Describe box and monolith caisson and discuss design procedure. 2.4 Describe open caissons and discuss design procedure 2.5 Describe pneumatic caisson and discuss the design procedure. 2.6 Describe the risks associated with caissons and the remedies	▪ Define, list, draw ▪ Describe, design, draw	- do -
6	**General Objective 3.0: Know vibratory machine foundation.**		
	3.1 Define vibration of machinery foundation. 3.2 Describe why conventional foundations do not suit vibrating machinery. 3.3 Expose the principles of design of vibrating machinery foundation. 3.4 Define foundation mountings. Explain the cork type mounting with limitations. 3.5 Define the principles of the use of rubber carpet mountings (stand and rib types) with limitation.	▪ Introduce, describe, design, draw. ▪ Define, draw, ▪ Explain.	- do – O-H Projector, chalkboard, Writing tools.
	3.6 Define the principles of the use of the rubber bonded heavy duty mountings. 3.7 Define leaf springs. State its limitation.		

8	**General Objective: 4.0 Know complicated concepts of load combinations on strip, pad, combined pads, and raft foundations.**		
	4.1 Present the general principles of eccentric loadings on footings. 4.2 Illustrate uniform, trapezoidal and triangular footing pressing distribution. 4.3 Analyse footing with axial load and use it to define eccentrically and total reaction on footing. Present the middle third loading principle	▪ Present, illustrate, draw, analyse.	- do -
9	4.4 Analyse footing with axial and horizontal loading. 4.5 Analyse footing with axial load and applied moment. 4.6 Analyse footing with axial and horizontal loading and applied moment. 4.7 Present the generalized analysis applicable to all situations to take care of both positive and negative loadings and applied moments.	▪ Analyse, present.	- do -
10	**General Objective: 5.0 Know the principles and modes of ground improvement.**		
	5.1 Define ground improvement in relation to soft ground and clay. 5.2 Explain the general principles of pre-loading as a ground improvement technique. Apply the consolidation principle of analysis.	Define, explain, derive, explain.	- do -
11 – 12	5.3 Explain the means of achieving preloading (surcharging using sand, water tanks and vacuum methods) with merits and demerits. 5.4 Explain ground improvement with the use of radial drains with complete analysis. Present sand drain and plastic drain i.e, concepts for installation and operation.	Explain.	- do -
13	5.5 Explain ground improvement using chemical process. 5.6 Explain ground improvement using electro-drainage and osmosis. 5.7 Explain ground improvement using stone columns. 5.8 Explain ground improvement using freezing techniques (brine circulation process). 5.9 Explain ground improvement using vibro- flotation.	Explain.	- do -
	General Objective: 6.0 Culverts, Conduits and tunnels		
14 - 15	6.1 State design consideration for loads expected of culverts conduit and tunnels. 6.2 Analyse external imposed loads in culverts, conduit and tunnels. 6.3 Analyse internal conveyed loads in culverts, conduit and tunnels. 6.4 Design structural members for culverts, conduits and tunnels by	Explain	- do -

	appropriate codes of practice. 6.5 Prepare detailed drawings of culverts, conduits and tunnels using appropriate codes. 6.6 Organise and undertake field trips to construction site.		

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%

Competency On completion of the course, the student should possess enhanced knowledge of advanced techniques in Soil Mechanics and Foundation Engineering and be able to design more complex problems.

References:
1. Scott, "Soil Mechanics", Prentice Hall.
2. Ola S.A. "Tropical Soil Mechanics".

STRUCTURES

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Theory of Structures II	**Course Code: CEC 305**	**Contact Hours: 2 – 1 – 0**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand classical methods of solving indeterminate structures.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Explain the principle of virtual work. 1.2 Compute deflection of simple beams and frames by virtual work principle.	▪ Explain, compute	▪ O/H Projector, ▪ Chalkboard, Writing materials.
2 - 4	1.3 Describe the following analytical methods (a) slope deflection, (b) moment distribution (Hardy cross,) (c) conjugate beam (d) elastic load method. Draw shear force and Bending moment diagrams for indeterminate beams using the above methods.	▪ Describe, draw	- do -
5 – 6	1.4 Describe settlement of supports. 1.5 Draw final bending moment and shear force diagrams to illustrate the effect of settlement of supports.	▪ Describe, draw	- do -
7	1.6 Draw final bending moment and shear force diagrams for simple indeterminate portal frame structures.	▪ Draw	- do -
8 – 9	1.7 Draw final bending moment and shear force diagram for indeterminate portal frames with sway.	▪ Draw	- do -
	General Objective 2.0: Know application of influence lines in the analysis of determinate structures.		
10 - 11	2.1 Explain the concept of influence lines. 2.2 Discuss application of the concept to moving loads.	Explain, Construct	O/H Projector, Chalkboard, Writing materials.
	General Objective 3.0: Know the application of shear walls in buildings		
12 - 15	3.1 Define wall in the concept of a structural element 3.2 Present types of walls, their specific functions and peculiar applications. 3.3 Present design philosophy of walls in relation to reinforced concrete concepts. 3.4 Discuss code specifications for shear walls and panels. 3.5 Enumerate cast-in-situ and pre-cast method of wall construction. 3.6 Visit any on-going construction site.		Code of practice, Bus and fuel.

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%
Competency The student shall analyse structures by classical and applied methods, and understand the concept of shear in buildings and shear walls.
Reference: Bungey, J.A. and Mosley, "Reinforced Concrete Design" to B.S. 8110 (and also the edition to CP110)
MacMillan Nig. Ltd, Lagos.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Design of Structural Elements	**Course Code: CEC 306**	**Contact Hours: 2 – 1 – 2**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the limit state design philosophy**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Explain the philosophy of limit states and define the various limits. 1.2 State the appropriate safety factors used in design of reinforced concrete elements	▪ Explain, State	▪ O/H Projector, chalkboard, Writing tools.
2	1.3 Design a singly reinforced rectangular section in bending.	▪ Derive equations	▪
3	1.4 Design a rectangular section with compression reinforcement at the ultimate state. 3.1 Design a flanged section in bending at the ultimate state.	- do -	▪ Plus correct codes of practice
4	3.2 Design a short column at the ultimate state. 3.3 Design a slender column at the ultimate state.	- do -	- do -
5	1.8 Design pad foundation.	- do -	- do -
6-7	1.9 Produce a structural layout of a typical floor and use it to Carry out the design of the following elements: a. a one way continuous slab b. a continuous beam c. an axially loaded short column d. an axially loaded pad foundation e. Detail (a) - (d) above	▪ Draw, explain ▪ Illustrate and supervise the comprehensive design of a 3 – storey frame.	▪ Drawing board, ▪ Pens, Paper, ▪ Design Packages.
8	**General Objective 2.0: Understand the yield line theory.**		
	2.1 Explain the collapse mechanism and yield line. 2.2 Analyse 2-way reinforced concrete slabs using the yield line theory. 2.3 Design 2-way reinforced concrete slab.	▪ Explain, analyse	▪ O/H Projector, ▪ Chalkboard, Writing tools.
9-10	**General Objective 3.0: Understand the limit state of serviceability.**		
	3.1 Explain the serviceability Limit States of fatigue, fire, impact, damage, (crack) and deflection.	Present, Explain	
11	**General Objective 4.0: Know the importance of torsion, shear and flexure in structures.**		
	4.1 Analyse for torsion, shear and flexural centres in structures. 4.2 Design for the above condition. 4.2 Design simple bolted, welded and friction connections 4.3 Design bolted, welded and friction connections for plate girders and rigid joined frames 4.3 Design for continuity at all joints and connections.	▪ Analyse ▪ Lecturer ▪ design	- do -

12 - 14	**General Objective 5.0: Know masonry structures.**		
	5.1 Design load bearing structures in brickwork, masonry, mass concrete e,g retaining wall, dam, arches, tall chimneys, abutments and piers.	▪ Design	▪ Drawing board, ▪ Plus, paper and accessories.

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%
Competency The student shall have adequate knowledge of designing safe structures using professional codes and classical analytical methods.
References: 1. Whilby, C.B. "Structural Concrete", Butterworths Co. Ltd.
2. Kalamkaror, A.L. "Composite and Reinforced elements of Construction," John Wiley.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Design of Structural Elements	**Course Code: CEC 306**	**Contact Hours: 2-1-2**	
Course Specification: Practical Content			
WEEK	**General Objective: 1.0 Know about site investigation.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
2-3 4-6 7-9 10-12 13-15	1 Design reinforced rectangular sections. 2 Design columns. 3 Design a 2-way reinforced concrete slab. 4 Design steel joints 5 Design mansory structures in load bearing.	▪ Provide Code of Practice ▪ CP 110 ▪ CP 8110 ▪ BS 3550	▪ Charts ▪ Code of Practice

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Advanced Reinforced and Pre-stressed Concrete Design		**Course Code: 405**	**Contact Hours: 1 – 0 – 3**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the behaviour of columns in biaxial.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Define the moments about the major and minor axis. 1.2 Determine the maximum bending moment capacity about the major and minor axis.	▪ Define, derive.	▪ O/H Projector, chalkboard, Writing tools.
2	1.3 Choose a column section to satisfy the interaction formula. 1.4 Design columns under biaxial bending.	▪ Explain, illustrate.	▪ - do -
3	1.5 Detail the column.	▪ Detail.	▪ Drawing tools.
	General Objective 2.0: Know design of slabs.		
4	2.1 Describe a slab. 2.2 Explain different types of slabs: solid, flat, ribbed and waffle. 2.3 Explain the principle of the design of flat slab.	▪ Describe, explain ▪ Illustrate and supervise the design of various slates.	▪ O/H Projector, chalkboard, Writing tools.
5	2.4 Determine the design moments, elaborating on column and middle strips. 2.5 Design a flat slab.	▪ Apply.	▪ Drawing equipment.
6	2.6 Explain the principles of the design of ribbed slab and waffle slab. 2.7 Design ribbed slab. 2.8 Design waffle slab.	▪ Explain, apply.	▪ Drawing equipment
7	2.9 Detail typical panel of flat slab, ribbed slabs and waffle slab. 2.10 Organise and visit construction sites.	▪ Detail.	▪ Drawing equipment, Student bus, fuel.
8 – 9	**General Objective 3.0: Understand the design of water retaining structures.**		
	3.1 Describe the general design consideration for water retaining structures (Swimming pools, water tanks) 3.2 Determine the forces in water retaining structures.	▪ Describe, Compute ▪ Give examples of design of a water retaining structure.	▪ O/H Projector, chalkboard, ▪ Writing tools.
	3.3 Design the water retaining structures.	Design.	Drawing tools
10-13	**General Objective 4.0: Understand the principles of pre-stressed concrete analysis and design.**		
	4.1 Describe types of pre-stressed concrete. 4.2 Describe the factors that cause loss of pre-stressed force and enumerate these losses. 4.3 Calculate the effects of slip, shrinkage and creep in pre-stressed concrete design and analysis. 4.4 Compute gross and effective pre-stress force in elements. 4.5 Design pre-stressed beams with eccentric. Thrusts.	▪ Describe, ▪ Compute. Design, ▪ Design project of a pre-tensioned and Post-tensioned large span beam.	▪ O/H Projector, chalkboard, ▪ Writing tools.
	4.6 Design pre-stressed beams for adequacy of serviceability criteria. 4.7 Design pre-stressed beams for stability in ultimate strength.	▪ Organise visit to a pre-stressing yard.	- do -

14 – 15	4.8 Differentiate between the design and analysis of pre-tensioned and post-tensioned members.	▪ Differentiate	- do -
	4.9 Explain the effects of residual stresses. 4.10 Carry out pre-stressed concrete design exercise under the supervision of lecturer.	▪ Design	▪ Drawing tools.

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%
Competency: The students shall have a knowledge of the design of flat slabs, water retaining structures and pre-stressed concrete.
Reference: 1. Kong F.K. and Evans, R.H. "Reinforced and Prestressed Concrete", Chapman and Hall, 1987.
Arya, C. "Design of Structural Elements" Spon 1994.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Advanced Reinforced & Pre-Stressed Concrete		**Course Code: CEC 405**	**Contact Hours: 1-1-3**
Course Specification: Practical Content			
WEEK	**General Objective 1.0: Know about site investigation.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
2-4 5-7 8 9-12 13-15	1 Design Column under bi-axial bending. 2 Design a flat slab 3 Design wattle slab 4 Design water retaining structure e.g. overhead or underground 5 Design pre-stressed beams	▪ Use appropriate Code of Practice ▪ Demonstrate ▪ Design Procedures to students	▪ Charts ▪ Code of Practice ▪ Drawings

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Matrix and Energy Methods in structures (Elective)	**Course Code: CEC 406**	**Contact Hours: 2 – 0 – 1**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand energy methods for the solution of indeterminate structures.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Compute strain energy due to direct load.	▪ Expressions, explain, apply	▪ O/H Projector, chalkboard, Writing tools.
2 – 3	1.2 Apply first and second Castigliano's theorems for solving indeterminate structures.	▪ Expression, explain, apply	- do -
4 - 5	5.1 Apply Clark - Maxwell Reciprocal. Theorem for solving indeterminate structures.	- do -	- do -
6	5.2 Apply Betti's theorem for the solution of indeterminacy in beams and frames	- do -	- do -
7	1.5 Apply complimentary energy method.	- do -	- do -
8	1.6 Apply potential energy method.	- do -	- do -
9	**General Objective 2.0: Know flexibility and stiffness methods for solving indeterminate structures**.		
	2.1 Use the flexibility/force method for solving indeterminate structures.	- do -	- do -
10 - 11	2.2 Use the stiffness/displacement method for solving indeterminate structures	- do -	- do -
11 - 12	2.3 Use the above methods to solve space frames and grid systems.	Apply	- do -
13 - 15	2.4 Carry out exercise on each topic above under the supervision of the lecturer.	Worked examples	- do -

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%
Competency: The student should analyse structures using energy and matrix methods.
References:
1. Coates, R.G; Contie, M.G. and Kong, F.K. "Structural Analysis", Van Nostrand Revinhold (U.K).
2. Strenstein, G.W. "Designing with Plastics", Haser, N.Y.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Design of Structural Steel and Timber	**Course Code: CEC 409**	**Contact Hours: 1 – 0 - 3**	
Course Specification **Theoretical Content**			
WEEK	**General Objective 1.0: Know the principles and criteria for safe design of structural steel work elements, connections, welded joints bolts, to BS 5950.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-2	1.1 Design the following steel elements simple floor beams, compound beams, or girders, plate girders, compound columns, latticed columns, root trusses, bridge trusses, crane gantry, latticed girders for building continuous members in floor beams and columns, purlins, rails.	▪ Design	▪ Teaching aids/drawing tools
3	1.2 Design column caps; splice, brackets, bases of all types.	- do -	- do -
4	1.3 Design pinned connections. 1.4 Design connections for moments and torques.	- do -	- do -
5 - 6	1.5 Design for limits of web buckling and combined stresses. 1.6 Carry out the design and detailing of a typical warehouse using BS 5950 or any current codes.	▪ Design, detail, supervise design	- do -
	General Objective 2.0: Know the elements of composite construction involving concrete and steel to current code.		
7	2.1 Analyse composite beam for different neutral axis locations 2.2 Design composite beams for cased conditions	▪ Analyse, design	- do -
8	2.3 Design concrete/steel interface connection. 2.4 Design composite (concrete/steel) column/stanchion.	▪ Design	▪ Plus steel designers manual and codes of practice.
	General Objective 3.0: Understand the principles of designing steel structures by plastic method.		
9	3.1 Explain the historical background of plastic theory. 3.2 Define collapse load. 3.3 Define mechanism 3.4 Describe conditions of collapse	▪ Explain, define, describe.	▪ Plus steel designers manual and codes of practice.
	3.5 Analyse simple beams and frames for plastic collapse situation. 3.6 Design the above for plastic collapse situation. 3.7 Use graphical methods to analyse design for plastic computation.	▪ Analyse, design, ▪ Apply	- do -
	3.8 Derive the work equation for a collapse mechanism 3.9 Compute structural capacity for various combinations of moment adjustments. 3.10 Carry out design and detailing on each of the above using these theories.	▪ Derive, Compute, design, draw, Supervise design	- do -

	General Objective 4.0: Understand the application of design principles to various structures in timber		
	4.1 Design timber roof trusses, lattice girder shorting, frame work, formwork for concrete placement. 4.2 Design connectors and connections for timber structures noting effects of shear, notching, bending and deflections.	Design, supervise design	Codes of Practice for Timber
13	4.3 Design timber built-up section and girders. 4.4 Carry out practical exercise on each of 4.1 - 4.3 above	- do -	- do -

Assessment: Coursework 40%; Course test 20%; Practical 20%; Examination 40%

Competency: The student shall be proficient in the design of efficient, safe and durable structures in steel and timber.

References:

1. Crawley, D. "Steel Buildings Analysis and Design", John Wiley and sons.
2. Bull, J.W. "The Practical Design of Structural Elements in Timbers", Gower Press, 1989.
3. Baird, J.A. 2nd and Obeltru, E.C. "Timber Designers Manual, Granada, 1984.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Design of Structural Steel and Timber	**Course Code: CEC 409**	**Contact Hours: 1-0-3**	
Course Specification: Practical Contents			
WEEK	**General Objective: Conduct Practicals to improve the understanding of theoretical content**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
2 - 4 5 - 6 7 - 8 9 -10 11-12 13-15	1. Design structural steel elements 2. Design pinned connections. 3. Design a concrete/steel or composite, beam, column/stanchion. 4. Design simple beams and frames for plastic collapse situation. 5. Design timber noof trusses, lattice girder, shorting, frame work, formwork for concrete placement. 6. Design timber built – up section and girders.	▪ Use appropriate Code of Practice to teach design method for practical purposes.	▪ Code of practice ▪ Charts ▪ Drawings.

TRANSPORTATION

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Transportation Engineering	**Course Code: CEC 314**	**Contact Hours: 2 – 0 – 2**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand transportation engineering**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Define transportation engineering,. 1.2 State the major transportation modes available in Nigeria. 1.3 Differentiate between transportation modes. 1.4 Outline transportation problems in your area of operation. 1.5 Evaluate the importance of transportation in Nigeria.	▪ Lectures and demonstration	▪ Chalkboard
3 - 5	**General Objective 2.0: Understand the various parameters of traffic engineering.**		
	2.1 State the traffic engineering characteristic that can be determined in quantities (volume, speed delays, etc). 2.2 Explain the meaning of the following terms : ADT, AADT, AHV, Journey Speed, Running Times, Journey/Travel times, Space-mean and time mean speeds, fixed delays, operating delays, destination, origin, etc. 2.3 Describe how to carry out speed studies, volume studies moving car observer studies. 2.4 Describe how to carry out the five (5) main methods of D Surveys. 2.5 Perform D Surveys.	▪ Lectures, demonstration and practicals.	▪ Chalkboard
6 – 9	**General Objective 3.0: Know how to produce geo-metric design of a simple road.**		
	3.1 List the geometric elements of a highway. 3.2 Explain the factors that affect the design of each item listed above. 3.3 Produce design data for both arterial and rural roads. 3.4 Produce tentative designs of horizontal alignments, vertical alignments (sag and crest) etc for both rural and urban roads using the Nigeria Highway Manual I. 3.5 Define the different sight distances. 3.6 Explain its effects on geometric design. 3.7 Determine sight distances using various methods.	- do -	- do -

10 – 12	**General Objective: 4.0 Know all the various types of intersections and the application.**		
	4.1 State the possible types of intersections. 4.2 Explain the criteria that guide the location/existence of such in a road network. 4.3 Define Highway interchanges. 4.4 Describe the various types of interchanges and "round abouts". 4.5 Enumerate the advantages of interchanges and "round abouts". 4.6 Sketch typical interchanges and 'round abouts' 4.7 Visit existing "round abouts" and junctions.	- do -	- do -
13 - 15	**General Objective: 5.0 Understand the principles of bye-pass and ringroads.**		
	5.1 Draw typical Bye-pass. 5.2 Illustrate Bye-pass as provision to improve traffic situations in urban settings. 5.3 Study an existing bye-pass or ringroad. 5.4 List all existing ringroads in your state of operation.	- do -	- do -

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Transportation Engineering	**Course Code: 314**	**Contact Hours: 2 – 0 – 2**	
Course Specification: Practical Content			
WEEK	**General Objective: Conduct Practicals to improve the understanding of theoretical content**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	Carry out Traffic volume study	▪ Design traffic count survey, stations census and supervise collection and collation of traffic data	▪ Survey forms, Clip boards, Radar, Enoscope, Reflective or warning signs and Jackets ▪ Automatic Traffic counters.
3 - 5	Carry out origin – Destination surveys	▪ Plan O-D survey and choose. spots for interviews. ▪ Assign students to ▪ Collect, Collate and analyse data	▪ Paste cards, questionnaires, Clipboards, pens, Obtain police cooperation ▪ Reflective Jackets.
6 – 7	Conduct road parking survey	▪ Locate road parking slots, select existing parking slots. ▪ Explain procedure to students	▪ Parking layout design counters, Clip boards, Drawing materials, Rader, Enoscope simulators.
8 –9	Design, survey and make sketches for construction of various road junctions and traffic flow patterns for the immediate environment	▪ Supervise design. ▪ Plan survey.	▪ Drawing materials. ▪ Computer simulation and sketches.
10- 12	Study existing bye-pass or ring road or propose any.	▪ Explain the requirements for ring road and bye-pass. ▪ Explain features of ring road, by-pass. ▪ Guide students to produce their own bye-pass.	▪ Maps tracing , materials, traffic data, drawing materials.
13 – 14	Visit a road construction site in yard state of operation	▪ Choose road construction site. ▪ Explain all features and processes to students	▪ Road construction site.

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%

Competency: Students are exposed to the techniques of Transportation Engineering with special emphasis on data collection and Engineering design.

Reference: 1. M.J. Bruton, "Introduction to Transportation Planning. 2. Gichaga, F.J. "Essentials of Highway Engineering". McMillan Press, 1988.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Alternative Transportation System	**Course Code: CEC 412**	**Contact Hours: 2 – 1 - 0**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand airport classification.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Define airport. 1.2 Give the different classes of airport according to ICAO. 1.3 Classify aircraft size and runway length.	▪ Lectures	▪ Chalkboard
2	**General Objective 2.0: Know the different components of an airfield.**		
	List the components of an airport/aerodrome. 2.1 Draw an airport layout to clearly indicate the different runway arrangements (configurations). 2.2 State the factors that affect runway length design under the following headings: a. Environmental b. Aircraft. 2.4 Visit Airfields and study their construction processes.	▪ Lectures, supervise drawings, and guide field visits	▪ Drawing instruments ▪ Site visits ▪ ICAO Documents
3	**General Objective 3.0: Know the ICAO recommendations for airport and selection of site for an airport.**		
	3.1 Give the recommendations of ICAO on airport operation. 3.2 State the ten criteria for airport site location. 3.3 Explain in detail site survey for an airport.	▪ Lectures	▪ Teaching tools.
4	**General Objective 4.0: Understand the determination of runway orientation and number.**		
	Determination of Runway Orientation and Number 4.1 State the relevance of meteorological studies on runway design. 4.2 Learn the ICAO recommendations for runway design. 4.3 Use the Windrose method to determine the number and orientation of runway. 4.4 Design parallel runway, high speed and long speed runways.	Lectures, demonstrate and supervise.	Drawing tools.
	General Objective:5.0: Understand the design of airport pavements.		
5	5.1 Explain the various factors necessary for airport pavements. 5.2 Design a flexible pavement for different classes of airports. 5.3 Repeat 5.2 above for rigid pavement. 5.4 Differentiate between airport and heliport. 5.5 Explain the peculiarities in heliport layout and design. 5.6 Design a heliport.	Lectures, demonstrate supervise	Drawing tools.

	General Objective 6.0: Understand the basic consideration for harbour design.		
6 – 8	6.1 Define a harbour 6.2 Give the different types of harbour and ports. 6.3 Describe different types of harbour 6.4 Explain the ship characteristics that affect harbour design. 6.5 State the relationship between ship size and dimensions. 6.6 Draw a sketch to clearly indicate on a harbour, channel, and port. 6.7 Describe each of the following: Jetties, Dolphins, Wharves and Piers. 6.8 Describe how each of 6.6 and 6.7 could be designed.	▪ Lectures with sketches, drawing and supervise.	▪ Drawing tools.
	General Objective 7.0: Know the existence and significance of waves in Itig waters and ship prove protection.		
9 – 10	7.1 Define waves generally. 7.2 Explain the linear wave theory. 7.3 Show that tides are in waves form. 7.4 Describe the wave form and generation in high seas. 7.5 Explain both qualitatively and quantitatively the following properties of wave in absolute and mean high, length, etc. 7.6 State the significance of wave on ships and harbours. 7.7 Describe protection devices for ships. 7.8 Design a docked fender.	Lectures, supervise.	Teaching tools.
	General Objective 8.0: Understand general concept of railway transportation system.		
11	General Concept of Railway Transportation System. 8.1 Describe a rail transportation system. 8.2 Explain its significance in good transportation. 8.3 State the effect of the attractive forces resistances in train coach/car or track.	Lectures.	
	General Objective 9.0: Understand how to design a rail track geometrically.		
12	9.1 Sketch rail track sketches clearly indicating rail track components, gauges, wheel conings, rail joints welded. 9.2 Give geometric elements of a rail track with that of a highway. 9.3 Compare the geometric elements of a rail track with that of a highway. 9.4 State the effect of topographical and geological factors. 9.5 Design the following geometrical parameters of a rail track using any available international standard: - Cross sections, gradients, horizontal, vertical and transition curves, super elevation. 9.6 Define the following terms:	Lectures, sketches, drawing and supervise	Drawing tools

	- Turnouts, switches, processing track junctions, station yards. 9.7 List the equipment in a station yards. 9.8 State the uses of each. 9.9 Visit site and participate in rail track construction.		
	General Objective 10.0: Understand how to carry out track maintenance.		
13	10.1 Explain the advantages of maintaining a rail track. 10.2 List the functions of a track maintenance crew. 10.3 Enumerate the composition of a maintenance crew. 10.4 Propose a viable maintenance schedule for a rail track.	Lectures	
	General Objective 11.0: Know the principles of signaling in a station.		
14	11.1 Explain the purpose of signaling in a track. 11.2 Describe the importance of train schedules 11.3 Draw railway signaling post in your state of operation. 11.4 Carry out exercise on each topic above.	Lectures, drawings, sketches.	Drawing tools.
	General Objective 12.0: Understand the characteristics of rapid rail system.		
15	12.1 Explain the characteristics of a rapid rail system (magnetic/electro) 12.2 Explain the features of magnetic rail system. 12.3 Mention the advantages of RRS over the conventional rail system.	Lectures	

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%
Competency: Students should have indepth knowledge of the characteristics of both the Rolling stock and the facilities of the various modes of transport.
Reference: Gupta, B.L., Railway Engineering", Standard Publishers, Delhi, 1981.
Bar, J. "Transport Processes", Khwar Academics, Netherland, 1991.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Traffic Engineering	**Course Code: CEC 411**	**Contact Hours: 2 – 0 – 0**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the flow of traffic as both a discrete or continuous process**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Explain the inter-relationship between people movement, transport technology and modes. 1.2 Explain in quantitative terms (only) the flow of traffic as a continuous distribution. 1.3 Explain in qualitative terms (only) the flow of traffic as discrete distribution. 1.4 Compare the traffic stream and a fluid stream.	▪ Lectures.	
2 – 3	**General Objective 2.0: Know the characteristics of a traffic flow that can be identified**		
	2.1 Define traffic headway in terms of space. 2.2 Define traffic in terms of time. 2.3 State the earlier knowledge on delays. 2.4 Explain the meaning of gap lapse acceptance, etc. 2.5 Define traffic stream, average speed, operating speed, density. 2.6 Record traffic flow and store the data.	▪ Lectures, organize field surveys, or organize traffic data bank.	
4 – 5	**General Objective 3.0: Understand the inter-relationship between the various flow parameters.**		
	3.1 Give the mathematical relationship between: a. Headway, spacing and speed b. Density and spacing c. Volume, speed and spacing 3.2 Draw the fundamental traffic flow diagrams.	▪ Lectures, demonstrations	▪ Drawing instruments
	General Objective 4.0: Understand the necessity of provision of terminals for transportation and the design of parking facilities		
6 - 7	4.1 Explain the meaning of terminals as applicable to Urban and Rural transportation network, i.e bus stops, garages etc. 4.2 State the necessity of same. 4.3 List the terminal facilities for each transportation mode. 4.4 Differentiate between laybys, bus-stops and end of journey terminals. 4.5 Enumerate the parking design criteria. 4.6 Obtain the parking demand for a scheme. 4.7 Obtain the parking demand for parking space provision. 4.8 Explain how to select the best parking scheme for a transportation mode. 4.9 Design parking facilities using space standard.	▪ Lectures, supervise drawing	▪ Drawing tools.

	4.10 Apply the design to parking facilities.		
	General Objective 5.0: Understand the working of traffic signals		
8 - 9	5.1 Define different types of traffic signals. 5.2 Describe the 8 warrants of traffic signals. 5.3 Explain the placing scheme of a traffic signal. 5.4 Give the different components of a cycle. 5.5 Use Websters formula to determine the cycle. 5.6 Design traffic signals.	▪ Lectures, drawing and supervise	▪ Drawing
	General Objective 6.0: Know the capacity of a transportation facility at different levels of service and the factors that affect capacity and service Volumes		
10 – 12	6.1 Define the capacities of highways, railways, airports and harbours. 6.2 Illustrate the application of spacing as a measure of capacity. 6.3 Give the mathematical expressions for each of the above in terms of headways and schedules. 6.4 Explain the meaning of level of service for a transportation flow stream in terms of operating conditions. 6.5 Draw the speed-flow graphs. 6.6 Indicate different levels of service (A.E) on above graph. 6.7 Explain the same and its application in traffic steam studies. 6.8 State the procedure for practical determination of levels of service. 6.9 Explain the relationship between capacity and service volumes. 6.10State the roadway factors affecting capacity and service volumes. 6.11Illustrate the roadway for traffic factors.	▪ Lectures, supervise drawing.	
	General Objective 7.0: Understand the improvement of operation of a transportation scheme.		
13 - 15	7.1 Show how traffic flow can be improved with traffic signals at intersections. 7.2 Study road markings and sketch them. 7.3 Apply adequate terminal facility provision. 7.4 Design operational controls. 7.5 Carry out practical exercises on each of the topic above.	▪ Lectures, supervise drawings. Field exercises.	

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%
Competency: Students are exposed to the nature of vehicle traffic and their relationship with terminal facilities.
Reference: Salter, R.J. "Traffic Engineering I", Basingstoke – McMillan.
Salter, R.J. "Traffic Engineering II", Basingstoke – McMillan.
Wergelt, A.R. "City Traffic: A systems digest", Van Nostrand, N.Y. 1973.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Highway Engineering	**Course Code: CEC 413**	**Contact Hours: 2 – 0 – 2**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know how to locate highway routes.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Define: a. reconaissance survey b. location survey c. preliminary survey 1.2 Explain setting out of roads 1.3 Describe final location survey 1.4 Use these surveys in Highway Engineering Works.	▪ Lectures.	▪ Teaching tools
2 - 4	**General Objective 2.0: Know how to design visible elements of a highway.**		
	2.1 Design various components of a highway (horizontal curves, vertical curves, compound curves, tangents, intersections and interchanges). 2.2 Design typical highway components. 2.3 Undertake the design of a model Highway.	▪ Supervise drawing, guide designs	▪ Drawing tools.
	General Objective 3.0: Know various pavement design data and methods.		
5 - 7	3.1 Explain CBR, its determination and applications (subgrades and burrow pits). 3.2 Illustrate bearing capacity, its determination and application. 3.3 Explain various properties of bitumen. 3.4 Explain preparation and uses of asphalt. 3.5 Explain the design of flexible pavements. 3.6 Explain the design of rigid pavements. 3.7 Explain design of full asphalt pavements. 3.8 Design typical examples of 3.5, 3.6, and 3.7. 3.9 State the relative advantages and disadvantages of 3.5, 3.6, and 3.7 above. 3.10 Trace stages of construction with reference to examples in 3.5, 3.6, and 3.7 above. 3.11 Determine results of each stage of construction.	▪ Lectures, Demonstrations, Supervise drawings and designs.	▪ Drawing tools.
	General Objective 4.0: Know alternative construction techniques in tackling complex situations.		
8	4.1 Explain the stabilization methods. 4.2 Describe the methods of construction on non-suitable sub-grades. 4.3 Undertake construction exercise on each topic above under the supervision of lecturer.	▪ Demonstration ▪ Supervise construction exercise.	▪ Studies, Construction materials

	General Objective 5.0: Know various parts of different cross-sections of roads.		
9 – 11	5.1 Illustrate different possible types of cross sections of highways (tangents, superelevation, embarkment, excavation, culverts, bridges and tunnels). 5.2 Draw typical examples of 5.1 above. 5.3 State the drainage requirements of the various types of sections stressing their importance. 5.4 Explain different forms of drainages (longitudinal and cross sectional). 5.5 Explain the process of carrying out the construction of Road Cross sections.	▪ Illustrations, Supervise drawing and construction exercises.	
	General Objective 6.0: Know the different types of culverts.		
12 - 13	6.1 Describe culverts as special types of drainages. 6.2 Distinguish the difference between culverts and bridges. 6.3 List the different types of culverts (box, ring etc). 6.4 Draw typical sections of culverts. 6.5 Explain the conditions under which the different types of culverts are used. 6.6 Carry out simple designs of typical culverts	- do -	
	General Objective 7.0: Know the different types of construction equipment.		
14 - 15	7.1 Name different types of road construction equipment (grader, bulldozer, scraper, excavator, payloader, compactors/rollers, asphalt plant, bitumensprayer, etc). 7.2 Describe different types of road construction equipment. 7.3 Sketch different types of road construction equipment. 7.4 Explain the use of the different types of equipment for road construction. 7.5 State the basic methods of maintaining the above named equipment. 7.6 Manipulate/operate heavy building machines of bulldozer scrapper etc. 7.7 Explain the process of carrying out routine maintenance in machines.	▪ Lecture, sketches, ▪ Supervise drawings.	

Assessment: Coursework 20%; Course test 20; Practical 20%; Examination 40%.

Competency: Students would be able to obtain design data, design visible elements of a highway, using construction equipment and carry out simple construction exercises of highway infrastructure.

References: Salter, R.J. "Highway Traffic Analysis and Deisgn", McMillan 1996.
Oglesby, "Highway Designers Manual".

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Highway Engineering	**Course Code: CEC 413**	**Contact Hours: 2 – 0-2**	
Course Specification **Practical Content**			
WEEK	**General Objective: Acquire design knowledge and construction techniques in Highway Engineering**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	Carry out the location of possible routes of a roadway from contour maps	▪ Explain the procedure for the location of possible routes from contour maps, and supervise the students selection and location of the possible routes from maps	▪ Contour maps pencils, eraser.
2	Review CBR tests on subgrade and embankment /fill materials	▪ Explain to the students what CBR test is and guide the students on how to collect subgrade and embankment/fill materials samples and carry out the tests in the laboratory.	▪ Soil sampling tools and CBR testing equipment CBR laboratory forms.
4 - 5	Design of flexible pavements for different design parameters	▪ Explain what a flexible pavement is (its components or layers). ▪ Explain the design procedure for a flexible pavement, using CBR values and traffic loads and guide the students on how to carry out the design, using different design parameters.	▪ CBR testing equipment to carry out the CBR tests on subgrade materials; Traffic data loads. (Number and axle load) on the traffic that will use the pavement. ▪ Design charts that will be used to determine the thicknesses of the various pavement layers of flexible pavement from FMW & H Highway design manual.
6 - 8	Design rigid pavements for different design parameters	▪ Explain what a rigid pavement is (its components or layers). ▪ Explain the design procedure for a rigid pavement using CBR values and traffic loads	▪ Complete CBR testing equipment. ▪ Traffic data cumulative (Number and axle loading), appropriate design charts .

		and guide the students on how to carry out the design using different design parameters	
9 – 11	Design various forms of intersections and interchanges.	▪ Explain to the students the various forms of intersections and interchanges used in Highway Engineering. Demonstrate and guide the students on the design of the various forms of intersections and interchanges.	▪ FMW & H Highway design manual. ▪ Survey data of intersection. ▪ Drawing boards, Papers, Pencils and Eraser.
12	Draw typical examples of highway cross-sections and longitudinal sections.	▪ Explain to the students what cross-sections and longitudinal section of a road or highway are; demonstrate and guide the students on how to draw them.	▪ Surveys (levelling) instruments; Drawing instruments. ▪ FMW & H Highway ▪ Design manual
13 - 15	Design typical culverts from hydrology to structural considerations and details.	▪ Explain to the students the various types of culverts, their uses, ▪ Limitations of each type. ▪ Demonstrate and guide the students on the design procedure of the culverts from hydrology to structural considerations and details	▪ Contour maps/graphical maps to determine catchment area of the culvert. ▪ Design data. ▪ Catchment area characteristics data. ▪ FMW & H Highway design manual; Structural design codes, axle, loads.

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Transportation Planning	**Course Code: CEC 416**	**Contact Hours: 2 – 0 – 1**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand transport and urban system analysis.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	Analyse an existing urban area in terms of activities, activity systems and land use elements and interactions.	▪ Lectures.	
3 - 5	**General Objective 2.0: Understand the preparation and use of regional, district and local plans.**		
	2.1 Prepare plans with emphasis on the following subjects: a. The analysis of physical and aesthetic characteristics of areas for planning. b. Implication of user's choice, culture, and future developments and demands. c. Social and economic consideration of labour opportunity and its stability, investment parameters. d. Efficiency considerations with respect to infrastructure analysis and investments, population growth (or decline), population density. e. Existing transport facilities, existing traffic situation, existing demand for transport, future demand for transport. 2.2 Carry out complex urban proposals for a particular town/city with emphasis on individual and public transport.	▪ Demonstrations, sketches and supervise plans.	▪ Drawing tools
6	**General Objective 3.0: Understand the performance of a transportation system**.		
	3.1 Define an urban transportation system. 3.2 Describe the different forms of transport technology available in Nigeria. 3.3 List the criteria employed in the choice of transport technology. 3.4 State the advantages/disadvantages of the different transportation systems. 3.5 Differentiate between transportation system and facility.	▪ Lectures.	
7 - 8	**General Objective 4.0: Know the units normally employed for measuring economic values of urban transportation.**		
	4.1 Define the following terms in relation to urban journey, veh-hos veh-KM, etc. 4.2 Explain both the qualitative and quantitative costs of urban journey. 4.3 Explain socio-economic aspect of urban transport schemes. 4.4 Produce a comprehensive list of benefits and costs of an urban	▪ Lectures and demonstrations	

	transport scheme.		
	General Objective 5.0: Understand how to evaluate a transportation scheme economically.		
9 – 10	5.1 Differentiate between cost, and cost-effectiveness of an urban scheme. 5.2 Carry out the cost analysis of a transportation scheme. 5.3 Repeat 3.2 above for cost-effectiveness analysis.	▪ Lectures and demonstrations.	
	General Objective 6.0: Know how to advise on the adoption of a plan.		
11 – 13	6.1 Present in tabular forms or graphs the results of performed activities under three. 6.2 Explain the adoption of the tested plan using the Critical Path Method (CPM). 6.3 Describe the essence of programming in transportation scheme. 6.4 Carry out practical exercise of Urban transportation planning in your state of operation using these concepts.	▪ Guide practicals and supervise exercises.	
	General Objective 7.0: Understand the use of transportation planning models.		
14 - 15	7.1 Describe the relationships between transport and land use. 7.2 Apply regression and category analyses to establish trip-making 7.3 Describe trip distribution model using growth factor. 7.4 Apply assignment models 7.5 Use model split 7.6 Carry out cost – benefit analysis (CBA) of transportation plans.	▪ Lectures and demonstrations	

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%.
Competency: Students should understand the transportation planning process and carry out both urban and rural transport planning schemes.
References: 1. Bruton, M.J. "Introduction to Transportation Planning".
2. Hobbs, "Traffic Engineering".

WATER

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Water and Waste-water Engineering I		**Course Code: CEC 304**	**Contact Hours: 2 – 0 –3**
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the procurement of water methods of yield estimation.**		
	Specific Learning Outcome	**Teacher Activities**	**Resources**
1 – 2	1.1 Define: a. Historic yield or yield from experience b. Probability yield c. Net yield d. Gross yield. 1.2 Explain methods of yield estimation. 1.3 Explain methods of reservoir sizing a. Sequent peak algorithm b. graphical method,	▪ Use questions/answer techniques	▪ Graphs ▪ Charts ▪ Drawings
	General Objective 2.0: Understand the basic principles of water treatment.		
3 – 4	2.1 Explain: a. impurities in water (physical, chemical and bacteriological) b. water born diseases c. examination of water (physical, chemical and bacteriological). 2.2 Explain the concept of water quality guideline (standards) 2.2 Explain the basic principles of water chemistry 2.3 Describe the unit processes of classification: a. Coagulation and the use of coagulant aids b. Flocculation c. Sedimentation 2.4 Describe the unit processes of filtration: a. Slow and rapid sand filters 2.5 State: a. Methods of dis-infection b. types of chemical disinfectant. 2.6 Carry out experiments of water treatment using the processes on 2.5 above.	▪ Use questions/answer techniques	▪ Graphs ▪ Charts ▪ Drawings
5 – 7	3.1 Identify the various types of pipes and fittings used in water distribution. 3.2 Describe the procedures involved in the distribution		

	line. 3.3 Analyse water distribution network using the Hardy Cross Method of: a. Head balancing (looped network) b. Flow balancing (non-looped network) 3.4 Draw water distribution network.	- do -	- do -
	General Objective 4.0: Understand the basic principles, design and operations of alternative (or low cost methods of excreta disposal)		
8 - 9	4.1 Describe various methods of excreta collection and transportation. 4.1 State the various methods of excreta disposal system/ 4.2 State the performance and health criteria of excreta disposal systems. 4.3 Describe the unit processes of: a. Pit latrine b. equa privies c. composters d. septic tanks and soakaways. 4.5 Design each item for construction purposes.	▪ Show examples ▪ Give assignments	▪ Video ▪ OHP ▪ Charts ▪ Drawings ▪ Pictures.
	General Objective 5.0: Understand the principles of waste-water treatment and disposal.		
10-12	5.1 Identify the characteristics of waste-water 5.2 Analyse the basic parameters of waste-water (BOD, DO, COD, PH, temperature etc). 5.3 Explain the effect of each parameter on the ecological balance of water bodies. 5.4 Outline adequate treatment procedure. 5.5 Plan for safe disposal. 5.6 State recycling methods of waste-water treatment and disposal. 5.7 Carry out recycling operations of waste -water treatment and disposal.	- do -	- do -
	General Objective 6.0: Understand the basic Chemistry and Microbiology of water and waste-water		
13-14	6.1 Determine basic water quality testing apparatus. 6.2 Describe various types of micro-organisms 6.3 Use indicator organising and methods of determination	- do -	- do -

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%.

Competency: The student on completing this course should be able to test water and waste water, produce water and distribution network.

Reference: Patterson, J.W. "Waste-Water Treatment Technology", Ann Arbor Science Inc. Chicago, 1975
Tebbutt, T.H.Y. "Principles of Water Quality Control", Pergammon Press, 1992

PROGRAMME:Civil Engineering Technology			
Course: Water and Waste Water Engineering I		**Course Code: CEC 304**	**Contact Hours: 2 – 0 -0**
Course Specification : Practical Content			
WEEK	**General Objective: Conduct Practicals to improve the understanding of theoretical content**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1. Carry out the standard total coliform MPN test 2. Determine the total solid in water:- Volatile, suspended and dissolved solids.	▪ Technologist to supply the equipment under the supervision of the lecturer.	▪ Bacteriological apparatus, water samples ▪ Computerised digital atomic absorption spectrophotometer (AAS), ▪ UV spectrophotometer dreal – 2000 ▪ Conductivity meter, ▪ Flame photometer, water samples ▪ Filterability index apparatus ▪ Flocculation test apparatus ▪ Ion – exchange apparatus ▪ Sedimentation study apparatus ▪ Drawing sheet, drawing board T-square ▪ pencil set square, scale rule ▪ Aggregate of different sizes ▪ Team site to distribution and restrain sites ▪ Water closet, pit latrine ▪ Standard water regulation (WHO) water ▪ analysis result.
3 – 4	3. Carry out test on water for chlorine, acidity, alkalinity, turbidity, residual chlorine and chlorine demand, dissolved oxygen, hardness in water, iron, manganese, aluminum , silica, phosphate, nitrogen, carbon-dioxide, ozone, colour, odour, taste, phenot, COD BOD.	▪ Technologist to demonstrate the processes of analysis and students to follow. Ditto	
5 – 7	4. Carry out filterability index of water for treatment. 5. Carry out flocculation test on water. 6. Carry out fluidization, iron-exchange and sedimentation studies.	▪ Teacher to arrange site visit ▪ Teacher/technologist to supervise the construction	
8 - 12	7. Draw storage and distribution of treatment water plan 8. Construct (a) Slow sand filter, rapid sand filter, (c) compare to a pressure filter 9. Visit water supply site	▪ Teacher to arrange site visit ▪ Teacher to allow students to visit these types of latrine	
13 – 15	10. Design and produce odour pit latrine and a compost latrine close to the department of civil engineering. 11. Asses the water quality with results obtained from the test carried out	▪ Teacher to guide students in comparing result with standard regulation.	

PROGRAMME: Civil Engineering Technology			
Course: Water and Waste Water Engineering II	**Course Code: CEC 426**	**Contact Hours: 2 – 0 -2**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Know the basic principles of unit processes and methods of network analysis**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 3	1.1 Discuss the principles of preliminary treatment 1.2 Explain the principles of coagulation, flocculation, sedimentation, filtration, disinfection and sludge disposal. 1.3 Describe the procedure of analysing water distribution network using: a. Newton Raphson method b. Method of equivalent pipe. 1.4 Describe how to Carry out construction works of water supply lines.	▪ Use question and answer techniques ▪ Give assignments	▪ Charts ▪ Drawings ▪ OHP ▪ Video ▪ Pictures
	General Objective 2.0: Understand the general principle of sewer design		
4 – 6	2.1 Explain the general principles of sewer hydraulics 2.2 Describe the systems of sewer layout: a. combined system b. separate system 2.3 Explain the hydraulic design of sewer systems: a. Sanitary sewers b. Storm sewers 2.4 Explain the general principles of channel hydraulics and design: a. Lined and unlined channels b. Culvert hydraulics c. Design of gutter inlets d. Special culvert problems. 2.2 Explain the construction of gutters and culvert,	▪ Give design , assignments	- do -
	General Objective 3.0: Understand the basic principles governing the design of waste water treatment unit.		
7 – 11	3.1 Explain the general principles of system hydraulics. 3.2 explain the procedure for the design of primary treatment units. a. Screen chamber b. Grit removal tank c. Sedimentation tank. 3.3 Explain the procedure for the design of biological treatment units a. Activated sludge b. Tricking filter (Biofilter)	▪ Use question and answer techniques ▪ Provide examples ▪ Give assignments	▪ Charts drawing pictures ▪ Audio visual aids.

	c. Rotating Biological contractors. d. Aerated lagoons e. Waste stabilization ponds 3.4 Explain the advantages of waste stabilization ponds and aerated lagoons in hot climates 3.5 Describe the designs for sewage treatments.		
	General Objective 4.0: Know the principles of industrial waste-water treatment and disposal.		
12 – 14	4.1 Identify the types of industrial waste-water 4.1 State the characteristics of industrial waste water outflows. 4.2 Describe the treatment processes for different types of industrial waste-water. 4.3 Explain acceptable effluent standard 4.4 Explain the effect of industrial waste-water on the environment. 4.5 Discuss the effectiveness of industrial waste-water pollution.	- do -	- do -
One week for revision, week 15 for revision.			

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%.
Competency: The student should be able to develop higher skills in design and testing Water – Waste Water Engineering.
References: 1. Gray, W.F., "Activated Sludge Theory and Practice", Oxford Univ. Press 1990
2. Qasin, S.R. "Waste Water Treatment Plants", Holt, Reinhart and Wiston, N.Y. 1985

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Hydraulic Structures	**Course Code: CEC 421**	**Contact Hours: 2 – 1 - 0**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the principles of design and operation of Hydraulic Structures.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 – 2	1.1 Define Hydraulic Structures. 1.2 Identify the necessary design parameters, e.g. flood frequency, rainfall frequency, empirical formulae. 1.3 Explain sluices, flumes, stilling basins, culverts, aqueducts, siphons and hydraulic drops.	▪ Use question and answer techniques Provide examples	▪ Drawings ▪ Pictures ▪ OHP ▪ Charts
	General Objective 2.0: Understand the design principles of water intake structures.		
3 – 5	2.1 Define water intake 2.3 Describe the criteria for selection of an intake 2.4 Describe the principles of the followings: a. Direct intake b. Land intake c. Reservoir intake. 2.5 Design of a simple intake structure 2.6 Apply the design to describe the construction of a simple intake structure	▪ Give assignments	- do -
	General Objective 3.0: Understand water control works.		
6	3.1 Illustrate with drawings the followings: barrages, regulators, outlets, outfalls etc.	- do -	- do -
	General Objective 4.0: Understand the principles of Navigation Works		
7	4.6 Describe Navigation locks and Navigation channels. 4.7 Carry out practical exercises on each of the topic above.	- do -	- do -
	General Objective 5.0: Know various types of Dam and Reservoirs.		
8 – 9	5.1 Explain the design criteria of different types of dams: a. earth dams b. rock fill dams c. concrete dams d. masonry. 5.3 Design: a. earth fill dams b. concrete dams 5.2 Describe various types of reservoirs 5.3 Carry out investigations for the location of dams and reservoirs.	▪ Give assignments	▪ Drawings ▪ Pictures ▪ OHP ▪ Charts

	General Objective 6.0: Understand the design principles of harbours, ports, jetties and wharf		
10	6.1 Explain the procedure for the design of harbours, ports jetties and wharfs 6.2 Draw a typical harbours, port, jetty and wharfs.	- do -	- do -
	General Objective 7.0: Know the principles of Retaining Walls and its application to water retaining structures		
11 – 13	7.1 Describe the various types of retaining walls 7.2 Design simple retaining walls 7.3 Apply the design to describe the construction of retaining walls 7.4 Explain the codes of practice for design of water retaining structures 7.5 Design various types of simple water retaining structures, e.g. a. Rectangular tanks b. Circular tanks c. Pyramoidal tanks 7.6 Describe the construction of concrete and steel tanks	▪ Give designing examples ▪ Give assignments	- do -
	General Objective 8.0: Know river training works.		
14	8.1 Explain the principles of groynes, spurs, bunds cut-offs, and revetments. 8.2 Explain the benefits of river training	- do -	- do -

Assessment: Coursework 20%; Course test 20%; Practical 0%; Examination 60%.
Competency: The student shall be exposed to the design of Hydraulic Structures.
References: 1. Ven te Chow., "Open Channel Hydraulics".
2. French, R.H. "Open Channel Hydraulics" McGraw Hill, 1994.

PROGRAMME: Civil Engineering Technology			
Course: Environmental Engineering and Pollution Control	**Course Code: CEC 417**	**Contact Hours: 2 – 0 – 3**	
Course Specification: Theoretical Content			
WEEK	**General Objective 1.0: Understand the concept of environment and environmental health**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Explain the concept of Environment 1.2 Explain the concept of Health 1.3 Explain the concept of Environment health	▪ Use questions and answers techniques	▪ Chalkboard ▪ Charts ▪ OHP ▪ Pictures
	General Objective 2.0: Understand the concepts of pollution and contamination		
2	2.1 Define pollution with examples 2.2 Define contamination with examples	▪ Give assignments	- do -
	General Objective 3.0: Know the different types of environment		
2	3.1 Give examples of different types of environment air, water, soil, social, work etc.	- do -	- do -
	General Objective 4.0: Know the different types of pollution and their effects		
2	4.1 Define air pollution, water pollution, land pollution, thermal pollution and noise pollution. Illustrate with appropriate examples 4.2 Identify the composition of the atmosphere 4.3 Explain: a. Particulate matters b. Sulphur dioxide c. Oxides of nitrogen d. Carbon monoxide e. Hydrocarbons f. Fluorine compounds 4.4 Explain particulate fall-out 4.5 Describe air pollution indoors. 4.6 Describe the units of measurement of air pollutants. 4.7 Test for air pollution.	▪ Give assignments	- do -
	General Objective 5.0: Understand the classification of water-related diseases		
3	5.1 Explain water-borne, water-based, water-washed and water Related diseases 5.2 Explain faecal-oral transmitted diseases. 5.3 Explain the effects of water quantity and water quality on water related diseases. 5.4 Differentiate between epidemics and endemic diseases.	▪ Give assignments	▪ Charts drawings pictures/video

	5.5 Explain the motive of WHO drinking water and sanitation laws. 5.6 Describe the life cycle and methods of control of the following diseases a. Schistosommiasis b. Filariasis c. Malaria d. Common out numatodes e. Diarrhoea diseases. 5.7 Propose measures to curb the diseases in your area of operation.		
	General Objective 6.0: Understand the basic principles of pollutants emission and disposal		
4	6.1 Explain the physical characteristics of the atmosphere 6.2 Describe methods of pollution dispersion in the atmosphere. 6.3 Explain how predicate the ground level concentration of pollution.	- do -	- do -
	General Objective 7.0: Know the effects of specific environmental pollution and self-purification in water bodies		
5 – 6	7.1 Describe the effects of air pollution on: a. Material b. Plants c. Animals d. Human beings 7.2 Propose measure to curb air pollution in the environment, 7.3 Describe the various methods of air pollution control on: a. Source emission b. Point emission 7.4 Define water pollution 7.5 State the source of different type of water pollution (surface and groundwater) 7.6 State the mechanism of self purification of stream 7.7 Test for water pollution. 7.8 Produce results making future projections. 7.9 List the effects of pollutants on receiving steam. 7.10 List various control measures 7.11 Apply these control measures in your state of operation. 7.12 Define noise pollution 7.13 List the sources of noise pollution. 7.14 Determine (Measure) noise pollution in your area of operation. 7.15 Describe the effects of pollution on human health. 7.16 Propose legal measures to check noise pollutions in your area of operation	▪ Give assignments	▪ Charts drawings pictures/video

	7.17 List various noise control measures. 7.18 Apply these control measures in your area of operation.		
	General Objective 8.0: Understand the various methods of pollution control including vector control		
7 – 8	8.1 Define the vector control chemicals. 8.2 Name the aquatic growth control 8.3 Explain the effects of ventilation, lighting artificial illumination on human health. 8.4 Describe the industrial hazards of working environment. 8.5 State the control of occupational health hazards. 8.6 Identify the sources of hazardous chemicals. 8.7 State the characteristics of hazardous chemicals from industries and agriculture. 8.8 Explain the effects of hazardous chemicals on water bodies. 8.9 Carry out test for hazardous chemicals. 8.10 Outline control measures. 8.11 Carry out practical exercise on each of the topic above.	▪ Give assignments	▪ Charts drawings pictures/video
	General Objective: 9.0 Understand the management of solid wastes and their effects on the environment.		
9 – 10	9.1 Explain the environmental effects of solid waste management. 9.2 Identify the different methods of solid waste, waste collection treatment and disposal e.g., sanitary landfill, incineration. 9.3 Explain the general principles of sanitary land fill. 9.4 Explain the general principles of: a. High temperature incineration. b. Pulverization and bailing. 9.5 Describe the general principles of material recovery and conversion from solid wastes 9.6 Appreciate the effects of solid wastes management on the environment. 9.7 Design refuse disposal unit at your state of operation. 9.8 Undertake the construction of refuse disposal unit using the principles on 9.4 above.	- do -	- do -
	General Objective 10.0: Understand the health effects of basic utilities and work environments.		
11 - 12	10.1 Explain the effects of ventilation, lighting artificial illumination on human health. 10.2 Describe the industrial hazards of working environment. 10.3 State the control of occupational health hazards.	- do -	- do -

	General Objective 11.0: Understand the basic principles of environmental impact assessment (EIA)		
13- 14	11.1 Define EIA and state the basic principles 11.2 Outline the basic steps in EIA 11.3 Explain environmental impact statements. 11.4 Explain environmental audits. 11.5 Discuss specific development projects vis-à-vis. 11.6 Prepare EIA, EIS for two different projects (e.g. oil and textile industries).	- do -	- do -
One week is reserved for revision.			

Assessment Coursework 20%; Course test 20%; Practical 20%; Examination 40%.
Competency: The student should be able to know pollution problems controls and environmental health aspect of the environment.
Reference:
1. Hardman, D.J., McEldowney, S. and White, S. "Pullution: Ecology and Biotreatment", Longman 1993.
2. Nelson, P. "Transportation Noise Reference Book". Butterworths 1987.
3. Sterritt, R.M., laster J. N. and Spoon, F.N. Microbiology for Environmental and Public Health Engineers", 1988.

PROGRAMME:CIVIL ENGINEERING TECHNOLOGY			
Course: Environmental Engineering and Pollution Control		**Course Code: CEC 417**	**Contact Hours: 2 – 0 - 3**
Course Specification : Practical Content			
WEEK	**General Objective: Conduct Practicals to improve the understanding of theoretical content**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
2 - 14	1. Visual observation in the local environment to identify problem in the environment brought about by development projects. 2. Carry out visit to specific industrial development sites at different stages of completion to assess probable and possible environmental impacts of the developments, both positive and negative. 3. Carry out visit to specific industrial development sites at different stages of completion to assess probable and possible environmental impacts of the developments, both positive and negative. 4. Visit already commissioned and operating development sites to evaluate/audit the project vis-à-vis their impact (positive and negative), on the lives and health of the adjacent population. 5. Investigate sound produced by a generator classroom in progress airport music shops etc. 6. Test water, air and land for pollution. 7. Test effluents from industries in the state for hazardous chemicals. 8. design and construct a refuse disposal unit. 9. Prepare EIA, EIS for two projects	▪ Lecturer should carefully relocate the sites to visit to cover a fairly broad and different types of projects and industrial activity. ▪ Technologist and technician should go in the site visits ▪ On site discussion are encouraged. ▪ Provide instruments and materials for testing	▪ Vehicles to facilitate transportation lunch packages etc. ▪ Spectrophotometer sound detectors equipment in Micro and macro decibels.

PROGRAMME: HND II: Civil Engineering Technology			
Course: Irrigation and Drainage	**Course Code: CEC 424**	**Contact Hours: 2 – 0 – 2**	
Course Specification : Theoretical Content			
WEEK	**General Objective 1.0: Understand the interrelation of soil, water and plants.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 - 2	1.1 Define crop water requirements. 1.2 Determine irrigation requirements. 1.1 Determine adequacy of water sources. 1.2 Test the soil-plant-water level for an irrigation. 1.3 Describe soil salinity ratios	▪ Use questions and answers techniques ▪ Give assignments	▪ Chalkboard ▪ Charts ▪ OHP ▪ Video
	General Objective 2.0: Know the planning procedure and irrigation methods.		
3 - 6	2.1 Establish the need for irrigation programme. 2.2 Determine the characteristics of the area to be irrigated. 2.3 Propose uses of an irrigated area. 2.4 Plan a layout programme for irrigation. 2.5 Analyse each of their economic importance. 2.6 Identify the criteria that affect choice of irrigation method. 2.7 Choose an appropriate irrigation method for specific programme. 2.8 Define appropriate method for specific conditions. 2.9 Carry out case studies of a given area for irrigation project.	- do -	- do -
	General Objective 3.0: Understand Drainage and Land reclamation as integral part of Irrigation programmes		
7 - 10	3.1 State the functions of drainage. 3.2 Distinguish among the various types of drainage. 3.3 Choose appropriate type of drainage. 3.4 Plan reclamation programme. 3.5 Design efficient drainage work for specific condition. 3.6 Determine how effective the land reclamation is. 3.7 Carry out case studies of a given area.	- do -	- do -
	General Objective 4.0: Know Management Techniques in Irrigation.		
11-14	4.1 State the factors affecting efficiencies in operation of irrigation schemes. 4.1 State the importance of irrigation maintenance services. 4.2 Explain the engineering measures necessary for the control of health hazards in irrigation programmes. 4.3 Apply management techniques on irrigation works.	- do -	- do -

Assessment: Coursework 20%; Course test 20%; Practical 10%; Examination 50%.
Competency: The student should be able to develop skills in the use, production, planning and management of irrigation and drainage works.
Reference: Michael "Irrigation Engineering", Swaffield, J.A. "Pressure Surge in Pipe and duct System", Avebury Tech., Sydney, 1993.

PROGRAMME:CIVIL ENGINEERING TECHNOLOGY			
Course: Irrigation and Drainage		**Course Code: CEC 424**	**Contact Hours: 2 – 0- 2**
Course Specification : Practical Content			
WEEK	**General Objective: Conduct Practicals to improve the understanding of theoretical content**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
2-3 4-5 6-10 11-12 13- 14 15	1. Measure Irrigation flow at head works 2. Measure lateral canal flow value 3. Determine volume of irrigation water 4. Estimate drainage channel discharge 5. Draw field layout and grading of land for irrigation project 6. Carry out tests on soil plant water level. 7. Sketch drainage layout for land readmission programme including cross-section of channels 8. Carry our case studies of irrigation and land reclamation projects 9. carry out site visits	▪ Arrange site visit for measurement “ “ “ ▪ Give elevation points for a layout ▪ Introduce the methods ▪ Explain project	▪ Floats ▪ Stop watch ▪ Measuring tope ▪ Current meter ▪ Drawing board and sets ▪ Vehicles to transport student and staff ▪ Engineering project reports or irrigation and drainage. ▪ Specimens

PROJECTS

PROGRAMME: CIVIL ENGINEERING TECHNOLOGY			
Course: Research Methodology	**Course Code: CEC 401**	**Contact Hours: 1 – 0 – 5**	
Course Specification : Theoretical Content			
WEEK	**General Objective 1.0: Select a research topic.**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Explain the criteria for choosing a Research topic 1.2 Choose a project or research topic relevant to the area of specialization.	▪ Advise students on choice of project.	▪ Reference Books ▪ Project layout ▪ Examples ▪ Library books
	General Objective 2.0: Formulate a Research Problem.		
2	2.1 Define a Research Problem. 2.2 Explain aspects of Research Problem 2.3 Formulate study objectives 2.4 Define study area.	- do -	- do -
	General Objective 3.0: Know theoretical/conceptual basis of Research.		
3	3.1 Situate research within the framework of theories, models and concepts. 3.2 Discuss importance of literature review. 3.3 Visit library to obtain literature materials.	- do -	- do -
	General Objective 4.0: Know how to Analyse data.		
4	4.1 Mention main sources of data. 4.2 Discuss techniques of data collection: a. Laboratory. b. Field survey/measurement c. Questionnaire d. Oral interviews.	▪ Guide student on project ▪ Presentations	
	General Objective 5.0: Know how to present information/data		
5 - 8	5.1 Explain how to present data in a manner suitable for research in the following form: Tables, Graphs, Charts, bars 5.2 Input information into computer. 5.3 Print out results.	- do -	▪ Computers ▪ Software
	General Objective 6.0: Know how to analyse data		
9 – 11	6.1 Use mathematical tools to find means, averages, peak. 6.2 Draw inferences and make projections. 6.3 Analyse some specific data as examples.	- do -	- do -

	General Objective 7.0: Know how to write a research work or project.		
12 – 15	7.1 Explain contents of preliminary page Title, Approval page Dedication, Acknowledgement, Abstract, Table of Contents, List Figures, List of plates, List of Tables. 7.2 Explain how to write Introduction. 7.3 Explain how to write the literature review. 7.4 Explain how to write the methodology. 7.5 Explain how to write the main body of the work. 7.6 List findings, recommendation and conclusions. 7.7 List references. 7.8 Present a summary paper. 7.9 Appendices 7.10 Defend the project.	- do -	- do -

Assessment: Coursework 20%; Course test 20%; Practical 20%; Examination 40%
Competency: The student should be able to write an acceptable final year diploma project in Civil Engineering.
Reference: J.Bingham, "Mastering Data Processing", McMillan Edc. Lt. 1986.

GUIDELINES FOR ASSESSMENT OF PROJECT

PART A: SUPERVISOR ASSESSMENT

TITLE OF PROJECT	
NAME OF STUDENT	
REGISTRATION NUMBER	
COURSE	

GENERAL ASSESSEMENT

			MAXIMUM SCORE	**ACTUAL SCORE**
1	Has the student understood the problem and pursued it?	(Fully) (Partly) (Not at all)	4	
2	To what extent has the student shown self reliance in determining the outcome of work?	(Greatly) (Slightly) (Not at all)	3	
3	What original work has the student contributed to the problem? e.g. experimental technique, mathematical derivation, an ingenious design.	(A considerable amount) (A little) (Nothing)	3	
4	Do you consider that the student has done more than just about or less than what is required by the objectives	(A reasonable) (Just amount of work) (Not much)	4	
5	Is the summary (a) concise	**REPORT ASSESSMENT** (Absolutely clear?) (Moderately clear?) (Not clear?)	3	
6	Is the summary (b) complete	(Adequately complete?) (Not complete?)	3	
7	Is the presentation of the report good and in conformity with the standard format in: building quality, typing quality, minimal errors and corrections, topics layout numbering system, acceptable number of words?		3	
8	Is the quality of English (sentence		2	

	construction, grammar, spelling?) satisfactory			
9	How is the survey of literature. (Has relevant references being omitted? Is the appraisal critical enough?).		2	
10	Were results discussed? (in the case of literature survey, results may be replaced by contents of literature such as assumptions, leading statement, supporting experiments).		3	
11	How are diagrams presented and cross-referencing carried out? Are references made correctly?		3	
12	Does the report read as an integrated whole? (e.g details of work should be put in appendices, padding should be penalised).		2	
13	Has the problem been presented to the reader.		2	
14	How is the conclusion?		3	
	TOTAL		**40**	

Brief Remarks:_____
_____
_____
_____

Name of Supervisor: _____ Date: _____

PART B: PANEL ASSESSMENT (ORAL DEFENCE)

TITLE OF PROJECT	
NAME OF STUDENT	
REGISTRATION NUMBER	
COURSE	

		MAXIMUM SCORE	ACTUAL SCORE
1	Abstract (summary)	2	
2	Clear Presentation of Problem	2	
3	Literature Survey (Adequacy of)	2	
4	Results Discussion (Thorough or Not)	2	
5	Diagrams, Referencing and Cross-Referencing)	2	
6	Overall flow and Coherency of the Report	2	
7	Conclusions	2	
8	Quality of English	2	
9	Overall Presentation and Quality of Report	2	
10	Amount of Work done by the Student	2	
11	Overall Presentation		
	a) Confidence in Presentation	4	
	b) Understand one of Subject Matter	4	
	c) Response to Technical Question	4	
	d) Command of English Language	4	
	e) Overall Performance	4	
	TOTAL	**40**	

Remarks:_____

_____

PANEL MEMBERS:

S/N	NAME	SIGNATURE	DATE
1.			
2.			
3.			
4.			
5.			
6.			

PART C: READER ASSESSMENT

TITLE OF PROJECT	
NAME OF STUDENT	
REGISTRATION NUMBER	
COURSE	
NAME OF SUPERVISOR	

			MAXIMUM SCORE	**ACTUAL SCORE**
1.	Abstract (summary)	(Absolutely clear?) (Moderately clear?) (Not clear)	1	
		(Adequate?) (Moderately?) (Comprehensive?) (Inadequate?)	1	
2.	Has the problem been presented.	(Clearly?)	2	
3.	Is the survey of Literature.	(Satisfactory?) (Moderately Good?) (Unsatisfactory?)	2	
4.	Were results discussed?	(Thoroughly) (A little?) (Not at all?)	2	
5.	How are diagrams presented and cross-referencing carried out? Are references made correctly?	(Well) (Moderately Well?) (Not at all?)	2	
6.	Does report read as an integrated whole?	(Yes) ((Partly) (No)	2	
7.	Are conclusion in body of report	(Precise) (Moderately clear)	2	
8.	Is the quality of English (Sentence construction, grammar, spelling.	(Good) (Moderate) (Bad)	2	
9.	Is the presentation of the report good in conformity with the standard format in: binding		2	

	quality, typing quality, errors and corrections, topic layout, numbering system etc.			
10.	Do you consider the student has done more than, just about or less than.	(A reasonable amount of work)?	2	
TOTAL			**20**	

Remarks: _____

_____

Name of Reader: _____

Signature: _____ Date: _____

Guidelines for textbook writers

The following guidelines are suggestions from the Engineering Committees to the writers of the textbooks for the new curricula. They are intended to supplement the detailed syllabuses which have been produced, and which define the content and level of the courses.

Authors should bear in mind that the curriculum has been designed to give the students a broad understanding of applications in industry and commerce, and this is reflected in the curriculum objectives.

- One book should be produced for each syllabus
- Page size should be A4
- The front size should be 12 point for normal text and 14 point where emphasis is needed
- Line spacing should be set to 1.5 lines
- Headings and subheadings should be emboldened
- Photographs, diagrams and charts should be used extensively throughout the book, and these items must be up-to-date
- In all cases, the material must be related to industry and commerce, using real life examples wherever possible so that the book is not just a theory book. It must help the students to see the subject in the context of the 'real word'
- The philosophy of the courses is one of an integrated approach to theory and practice, and as such, the books should reflect this by not making an artificial divide between theory and practice.
- Illustrations should be labeled and numbered.
- Examples should be drawn from Nigeria wherever possible, so that the information is set in a country context.
- Each chapter should end with student self-assessment questions (SAG) so that students can check their own master of the subject
- Accurate instructions should be given for any practical work having first conducted the practical to check that the instructions do indeed work
- The books must have a proper index or table of contents, a list of references and an introduction based on the overall course philosophy and aims of the syllabus.
- Symbols and units must be listed and a unified approach used throughout the book
- In case of queries regarding the contents of the books and the depth of information, the author must contact the relevant curriculum committee via the National Board for Technical Education
- The final draft version of the books should be submitted to Nigerian members of the curriculum working groups for their comments regarding the content in relation to the desired syllabus.

LIST OF BOOKS (ND & HND)

Recommended List of Books for Electronics:

1. Operational Amplifiers – G.B. Clayton
2. Advance Industrial Electronics – Morris
3. Digital Integrated Electronics – Taub & Schilling
4. Integrated Electronics – Millman – Halkias
5. Introduction to Switching Theory and Logical Design – F.J. Hill, G.R. Peterson
6. Introduction to Digital Computer Technology – Mashelsky
7. Systematic Analogue Computer Programme – Charleswor Fletcher.

Radar and Wave

1. Radar Detection and Tracking System – S. A. Hovanessian
2. Introduction to Radar System – Skoluik
3. Foundation of Microwave Engineering – Collin
4. Microwave Transmission – J. A. Staniforth

Communication Engineering

1. Transmission Systems – M. T. Hills, B.G. Evans
2. Telecommunication – Brown & Glazier
3. Electronics & Radio Engineering – Terman
4. Electronics Communication System – Kennedy
5. Principles of Communication System – Taub & Schilling
6. Radio & Line TX A & B – D. C. Green
7. Principles of Digital Communication G. J. – Marshall
8. Signal Processing, Modulation and Noise – Betts.
9. Electrical Communication – Meadow
10. Signals, Antena, Wave Transmission, Noise, Modulation – F. R. Connors.

Recommended List of Books for Circuit Theory

1. Circuit Devices and Systems – Smith
2. Telecommunication Principles for final students 1 & 2 – Knight
3. Advanced Electrical Engineering – Morton
4. Problems in Electrical Circuit Theory – R. G. Meadows
5. Network Analysis and Synthesis – KUO
6. Higher Electrical Engineering – Shepherd, Morton, Spence.
7. Networks – By F.R. Connor
8. Circuit Theory – Vol. 1 & 2
9. Electrical Technology – E. Hughes.

Electrical Machines

1. Electrical Machinery – Fritzgerald and Kuo
2. Electrical Machines – Drapper
3. Alternating Current Machine – M. G. Say
4. Direct Current Machine – M.G. Say and E. O. Taylor
5. Introduction to Electrical Machines – Daniel
6. Electrical Technology (ND only) – Hughes
7. Higher Electrical Engineering by Shepherd, Morton, Spence

Electrical Power Engineering

1. Electric Power Systems (Third Ed.) – B. M. Weedy
2. Electrical Power Systems, Vols. I & II – A. E. Guile & W. Paterson
3. Electric Power Transmission and Distribution – P. J. Freeman
4. Generation, Transmission and Utilization of Electrical Energy – A. T. Starr
5. Transmission and Distribution of Electrical Power – H. T. Cotton
6. Elements of Power System Analysis (4th Ed) – William T. Stephenson
7. Electric Power System: Design and Analysis – Mohammed El-Hawary
8. Electrical Power System: Wadhwa CL
9. Electric Energy Systems Theory: an introduction – Elgend O. I.
10. Elements of Power Systems – O. I. Elgend

Electric Field Theory (HND)

1. The electromagnetic Field in its Engineering Aspects – Carter. G. W. (Longman s)
2. Introductory Engineering Electromagnetic – Popovic
3. Applied Electromagnetics

Control Engineering (HND)

1. Control System Engineering – Magrath, L. J. & Copal, M., Viley Eastern Ltd., New Delhi, 1st Ed. 1975.
2. Control Engineering – Morris, N. M., Mc-Graw Hill, 3rd Ed., U. K.
3. Feedback Control Theory for Engineers – Atkinson, P., Heinemann, 2nd Ed., 1972
4. Theory and Problems of Feedback Control System – (Schaum's Outline Series), Di Stefeno J.J., Stubberud, A.R., William, L. J., McGraw-Hill, 1st Ed., 1967.
5. Control System for Technicians p Eryan, G.F. ELBS & Holder & Stoughton, 2nd Ed. 1970.
6. Control, System engineering (with notes and worked examples – C. O. Oroge , UPL Ibadan 1986.

Electrical/Electronic Drafting and Design

1. Basic Electronic and Electrical Drafting – Bethuma, J. D., Prentice-Hall, 1980 Ed.
2. Electrical and Electronics Drawing – Baer, C. J. McGraw-Hill, 2nd Ed. 1966.

List of Books for Computer Technology Courses

1. Title: Advanced Microprocessors Architecture
   Author: L. Gminiera & A. Valenzane
   Publisher: Addison Wesley

2. Title: Digital Signal Processing
   Author: R. A. Roberts & C. T. Muuis
   Publisher: Addison Wesley

3. Title: Microprocessor Systems 16-bit Approach
   Author: W. J. Eccles
   Publisher: Addison Wesley

4. Title: Microprocessor Systems 16-bit Approach
   Author: H. S. Stone
   Publisher: Addison Wesley

5. Title: Introduction to Robotics
   Author: H. S. Stone
   Publisher: Addison Wesley

6. Title: Pulse Digital and Switching Waveforms
   Author: Millman and Taub
   Publisher: Addison Wesley
7. Title: FORTRAN 77
   Author: Donald M. Munno
   Publisher: Harnold

8. Title: Digital Integrated Electronics
   Author: Taub
   Publisher: TAB Books

9. Title: Computer Technicians Handbook
   Author: Margolis A.
   Publisher: TAB Books

10. Title: Interfacing Techniques
    Author: Joseph Carr
    Publisher: TAB Books

11. Title: Computer Peripherals
Author: Barry Wilkinson/David Horrocks
Publisher: Edward Arnold

12. Title: Computing with Fortran IV
Author: Practical Course, Donald M. Monro
Publisher: Edward Arnold

13. Title: Digital Control
Author: A.M. Zikil; Ellis Harwood
Publisher: Edward Arnold

14. Title: Computer Interfacing: Connection to the Real World
Author: M. D. Cripps
Publisher: Edward Arnold

15. Title: Basic Control System Technology
Author: C. J. Chesmond
Publisher: Edward Arnold

16. Title: Control Applications of Microcomputers
Author: P.M. Mitchel
Publisher: Edward Arnold

17. Title: Microprocessor and their Manufacturing Applications
Author: A. K. Kochlan/N.D. Burns
Publisher: Edward Arnold

18. Title: Digital Techniques: From problem specification to realization
Author: Thijssen A.P./Vink, H.A. et al
Publisher: Edward Arnold

19. Title: Checking Experiments in Sequential Machines
Author: A. Bhattacharyya
Publisher: Wiley

20. Title: Security for Computer Networks
Author: D. W. Davies/W.L. Price
Publisher: Wiley

21. Title: Microprocessor System Design Techniques
Author: R. Barnett
Publisher: Wiley

22. Title: The Fifth Generation: The Future of Computer Technology
Author: H.S. U.
Publisher: Wiley

23. Title: Control Applications of Microcomputers
Author: P. Mitchel
Publisher: Hodder Stoughton.

24. Title: Computer Peripherals
Author: Barry Wilkinson/David Horrocks
Publisher: Hodder Stoughton.

25. Title: Basic Principles and Practices of Microprocessors
Author: D. E. Heffer/G.A. King/D.C. Keith
Publisher: Hodder Stoughton.

LIST OF MINIMUM RESOURCES

LIST OF PHYSICAL FACILITIES

Programme	**Laboratory**	**Workshop**	**Studio/Drawing** Room and Other
Civil Engineering Technology (ND)	1. Structures/Strength of Materials 2. Soil Mechanics and Concrete. 3. Hydraulics 4. Engineering Geology	1. Carpentry 2. Concrete/Building 3. Plumbing 4. Electro Mechanical	1. Drawing Room 2. Surveying & Geo-informatics Equipment Store 3. Computer Facilities/Laboratory 4. Photocopiers
	5. Structures	Ditto	Ditto
	6. Transportation	Ditto	Ditto
	7. Environmental Engineering	Ditto	Ditto
	8. Irrigation Water Management	Outdoor drainage and irrigation facilities	Ditto

LIST OF EQUIPMENT

CIVIL ENGINEERING TECHNOLOGY

LIST OF LABORATORY EQUIPMENT

S/No	Structures/Strength of Materials – ND	No. Required
1.	Torsion testing machine	1
2	Plastic bending of Portal frames	1
3.	Two-hinged arches apparatus	1
4.	Continuous beam apparatus	1
5.	Deflection of beams apparatus	1
6.	Bending moment and shearing force apparatus	1
7.	Elastic beam apparatus	1
8.	Elastic deflection of frames	1
9	Strut buckling apparatus	1
2.	**A. Soil Mechanics and Laboratory (ND)**	
1.	C.B.R. Apparatus	1
2.	Consistency limits test apparatus	6
3.	Compacting factor machine	1
4.	Compacting core machine	1
5.	Particle size distribution test apparatus (manual and electrical –sieve shaker)	2 set
6.	Compaction test apparatus	3 standards
7.	Core penetrometer	1
8.	Moisture content text apparatus	2
9.	Specific gravity test apparatus	3
10	Density test apparatus	3
11.	Le Chatelier test apparatus	2
12.	Augers and rings with sampling & extruding devices	5
13.	V-b consistometer text apparatus	1
14.	Drying ovens	3
15.	Sampling collecting trays and sample containers	20
16.	150mm cube moulds	18
17.	150mm cylindrical moulds	18
18.	Balances e.g analytical balance triple beam Balance, top pan-balance, semi-automatic Balance, spring balance, chemical balance, electrical balance	2 of each
19.	Vicat apparatus	2
20.	Thermometers	5 of each

21.	Measuring cylinders	5
22.	Cement fineness test apparatus	2
23.	Soil hydrometers	3
24.	Crucibles, spatulas, funnels	5
25.	Dessicators	6
26.	Curing tank	1
27.	Stop watches	10
28.	Beam moulds	4
29.	Crushing machine	1
30	Vernier calipers	2
31	Glass wares	Assorted
32	Schudt rebounce harmers	2
S/No	**2. Additional Equipment Required for HND**	**No. Required**
1.	Consolidation text apparatus	1
2	Triaxial compression apparatus	1
3.	Unconfined compression text apparatus	1
4.	Extensometer (universal-shear compression)	1
5.	Direct shear box text apparatus	1
6.	Laboratory vane text apparatus	1
7.	Permeability text apparatus	1
8.	Constant and falling head permeability cell	1
9	Soil pulverizer	1
2.	**3A Hydraulics and Hydrology (HND)**	
1.	Hydraulic benches	Assorted
2.	Stability of floating bodies apparatus	1
3.	Discharge through the orifices	1
4.	Flow through venturimeter	1
5.	Discharge over a notch	1
6.	Friction loss along a pipe	1
7.	Impact of jets	1
8.	Centre of pressure apparatus	1
9.	Flow visualization	1
10	Losses in piping systems	1
11.	Windage counter	1
12.	Evaporation gauge	1
13.	Hydrology apparatus	1
14.	Hydrostatic and properties of fluids	1
15.	Laminar/turbulent flow pipe	1
16.	Current meters	1
17.	Point and hook gauge	2

18.	Rain gauges	1
19.	Water tank	1
20.	Barometer piezometer	1
21.	Falling head permeameter constant head permeameter	1
22.	Hydrometer	1
23.	Surge tank demonstration set	1
24.	Simple weather equipment e.g wind vane infiltrometer	2 each
25.	Pitot tube	2
26.	Float	Assorted
27.	Stop waters	5
28.	Measuring tapes	5
29.	Meteorological station	1
30	Rain fall simulator	1
31	Water Hammer apparatus	2
S/No	**3 B. Additional Equipment Required for HND**	**No. Required**
1.	More hydraulic benches	Assorted
2.	Flow channel	1
3.	Flow measuring apparatus	1
4.	Reynolds number 8 transitional flow	1
5.	Centrifugal pump test rig	1
6.	Model sedimentation tank	1
7.	Liquid semidentation	1
8.	Permeability tank	1
9.	Bernoll's theorem demonstration apparatus	1
10.	Hydraulic ram	1
11.	Series/Parallel pump test	1
12.	Pump characteristics text accessories	1
13.	Osborne Reynolds apparatus	1
14.	Air flow rig	1
15	Drag coefficients of particles apparatus	1
16	Flow meter demonstration apparatus	1
17.	Pipe surge and water Hammer apparatus	1
18.	Drainage seepage tank	1
19.	Standard 300mm wide tilting flow channels and models	1
20	Ground water flow	1
21.	Raingall hydrographs.	1
22.	Hydraulic models	
	4 Structures Laboratory for HND	
1.	Universal testing machine (100) and complete accessories	1
2.	Stand magnus apparatus	1

3.	Three-hinged arch apparatus	1
4.	Deflection of curved bars	1
5.	Model frame work apparatus	1
6.	Deformation of rings, squares and rectangle apparatus	1
7.	Plastic bending apparatus	1
8.	Universal testing frame apparatus and accessories	1
9.	Suspension bridge apparatus	1
10	Unsymetrical cantilever testing apparatus	1
11.	Shear center apparatus	1
12.	Audio-Visual aids	Assorted.
13.	Deflection of an Eccentric tie	1
14.	Strength of Timber beams.	1
	Transportation Laboratory (For HND) **A. Traffic engineering equipment**	
1	Rader and enoscope for 5 speed studies	4
2	Measuring tapes and stop watches	6
3	Warning flares and cones	6
4	Ranging rods.	6
S/No	**B Asphalt Laboratory**	**No. Required**
1.	Standard penetration text apparatus	1
2	Kinematic capillary viscosity text apparatus	1
3.	Saybelt fuel viscosity test apparatus	1
4.	Cleveland open cup flash point text apparatus	1
5.	Ductility text apparatus	1
6.	Distillation text apparatus	1
7.	Float text apparatus	1
8.	Loss angeles abrasion text apparatus	1
9.	Marchall stability and flow text apparatus	1
10.	Hveen stabilometer test apparatus	1
11.	Hveencohesiometer text apparatus	1
12.	Hubbard field apparatus	1
13.	Swell test apparatus	1
14.	Softening point apparatus (ring and ball)	1
15.	Penetration text apparatus	1
16.	Tally counter	6
17.	Aggregates impact and crushing values apparatus	1
18.	Binder extraction apparatus	2
19.	Hot plate	2
20.	Benkelman beam	1
21.	Temperature bath	2

22.	Dessicators	5
23.	Water tank	1
24.	Thermometer	Assorted
25.	Oven	Various ranges
	6. A. Water & Waste Water Treatment laboratory (For HND)	
1.	Chlorine determination apparatus e.g Lovibond 1000 comparator	1
2.	Acidity and alkalinity apparatus	1
3.	Aluminium apparatus	1
4.	Iron determination apparatus e.g Hack kit IR 18B Merck text strips	1
5.	Silica determination apparatus	1
6.	Dissolved oxygen apparatus	1
7.	Oxygen demand apparatus	1
8.	Phosphate apparatus	1
9.	Nitrogen apparatus	1
10.	Turbidity apparatus	1
11.	Manganese apparatus	1
12	Hardness apparatus	1
13	Carbon-dioxide apparatus	1
14	Colour apparatus	1
15	Ozone apparatus	1
16	PH determination apparatus	1
17	Phenol apparatus	1
18	Odour and taste apparatus	1
19	Bachteriological analysis apparatus	15
20	Bottle with stoppers	15
21	Weight bottles with stoppers	15
	Robber tubes	15
S/No	**Water & Waste Water Treatment laboratory (For HND)**	**No. Required**
23.	Automatic sampler e.g peristallic pump diaghragm pump	Assorted
24.	Filtrability index apparatus	1
25.	Deep-bed filter column	1
26.	Permeability/Fluidisation apparatus	1
27.	Ion-exchange apparatus	1
28.	Aeration apparatus	1
29.	Flocculation text apparatus	1
30.	Sedimention study apparatus.	1
31	Flame photo meter	1
32.	Otomet Absorphus spectrophontometer	1
33.	Spectrophoto meter	1
34.	Electronic Balances	2

35.	Microscopes	5
36	Oven	3
37.	Refrigerator	2
38.	Inembatory	2
39.	Petri-dishes	various
40.	Glass wares	various
41.	Pi-pumps	10
	6. B Irrigation Water Management Laboratory (For HND)	
1	Open channels, distributors and measuring devices	1
2	Sprinkler infiltrometer	1
3	Sprincler testing rig	1
4	Surface drainage field demonstration	1
5	Demonstration sand table	1
6	Rainfall simulator’	1
7	Surface Irrigation model	1
8	Gauging weirs and flumes	1
9	Gauging and control structures	1
10	Test channel section	1
11	Demonstration Iysimeter	1
12	Irrigation equipment displays	1
13	Demonstration inflitration apparatus	1
14	Field drain filter test apparatus	1
15.	Outdoor Irrigation and drainage field	1
	6 C Engineering Geology Laboratory	
1	First aid box	1
2	Shower	1
3	Fire extinguisher	2
4	Fire buckets	2
5	Safety charts and drawings	Assorted
6	Safety codes and standards	Assorted
7	Goggles	30
8	Protective clothing	30
9	Fire hydrains	
	Geological maps	Assorted
	Specific gravity test apparatus	5
	Balances	5 various
	Microscopes	2
	Microscopes with camera	1

LIST OF WORKSHOP EQUIPMENT

1. CARPENTRY WORKSHOP

S/No	Planes and Saws	No. Required
1	Jack planes	3
2	Smoothing planes	3
3	Block planes	3
4	Shoulder planes'	3
5	Multi-Plough plane	3
6	Rebate plane	3
7	Grooving/Plough plane	3
8	Bull nose plane	3
9	Compass plane	3
10	Jointing plane	3
11	Side rabbet plane	3
12	Rip saw	3
13	Cross cut/hand saw	3
14	Tenon saw	3
15	Panel saw	3
16	Coping saw	3
17	Nest of saws/compass saw	3
18	Key-hole saw	3
19	Bracket or Fret saw	3
20	Band saw	3
	Chisels	
21	Ordinary firmer (set) 3mm, 6mm, 12mm, 18mm and 25mm.	2
22	Bevel-edge firmer (set)	2 each of 6mm
23	Pairing bevel-edge (set)	2 each 6-9mm, 12mm
24	Mortice (set)	3
25	Firmer gauge (set)	3
26	Pairing firmer (set)	3
27	Turning chisels (set)	3
	Bits	
28	Centre (set)	2
29	Auger (set)	2
30	Twist (set)	2
31	Counter-sink (set)	2
32	Rose (set)	2
33	Gimlet	2

	Driving/striking Tools	
34	Screw driver (set of 6)	2
35	Mallet	2
36	Claw hammer	2
37	Pane hammer	2
38	Warington hammer	2
39	Bradawl	2
	Cramps	
40	Sash (set)	2
41	Gee ('G') cramp	2
41	Corner	2
43	Bench hold fast	2
44	Circular saw bench	1
45	Surtacer	1
46	Wood lathe with accessories	1
47	Band saw	1
48	Spindle moulder	1
49	Radial circular saw	1
50	Compressor and spraying unit	1
51	Thicknessing machine	1
52	Tenoning machine	1
53	Mortiser (chisel and chain)	1
54	Sanders (drum, disc and belt)	1
55	Dimension saw	1
56	Drilling machine	1
57	Jig saw	1
58	Press (school size)	1
	Utilities	
59	Work benches	15
60	Tool trolleys	4
61	Hangers for dresses	35
	A/V	
62	Magnetic board	1
63	Flannel board	1
64	Display board	1
65	Overhead projector and transparencies	1
66	Slide projector	1
67	Film strips projector	1
68	Opaque projector	1
69	Projector screen	1

	Dressing	
70	Overalls (aprons-brown)	35
71	Goggles	35
	Chalkboard	
72	T. Square	2
73	Set square 60/75	2
74	Compasses	2
75	Protractors	2
76	Duster	2
77	Ruler (metre rule)	2
	Powered Hand Tools	
78	Blower	2
79	Sprayer	5
80	Grinding machines	2
81	Sharpening machines	1
82	Grinding stone	1
83	Oil cans	2
84	Grinder for long blades e.g surface planer	1
85	Paint brushes (sets)	5
86	Putty knives	5
87	Paint containers	5
88	Glue pot-2 jackets (for animal glue)	2
89	Glue spreader	1
90	Glue brushes – various sizes	2 each
91	Marking gauge	3
92	Mortice gauge	3
93	Cobine gauge	3
94	Cutting gauge	3
95	Marking knives	3
96	Verneer knives	3
97	Try square	3
98	Mitre square	5
99	Four fold wooden ruler metric	5
100	Measuring tapes metric	10
	2. Concrete/Block-laying Workshop	
1	Portable compressor and accessories	1
2	Bar bending machine	1
3	Steel cutter	1
4	Mesh/BRC cutter	1
5	Concrete vibrator: poker and table vibrators	1

6	Hand rammers	4
7	Concrete portable mixer (at least 2 cu. Ft. capacity)	1
8	Brick/block making machine	1
9	Wheel barrow	5
10	Watering can	5
11	Shovels	15
12	Head pan	10
13	Brick saw	1
14	Concrete nail gun	1
15	Hand tools, e.g spirit levels, trowels, hammers, rules, squares, mallet, tapes, floats etc.	Assorted
16	Multiflow mixer	1
17	Cement box	5
18	Aggregates and sand box	5
19	Slump cones	5
20	Concrete crushing machine	1
	3. Plumbing/Mechanical Workshop	
1	Guillotine (three feet)	1
2	Fittings	Assorted
3	Pumps various types (e.g centrifugal, reciprocating pump, series and parallel	
4	pumps, submeersives etc)	1 each
5	Valves, surge tanks, water hose	
6	Pipe bending machine	Assorted
7	Light duty drilling machine	1
8	Table drilling machine	1
9	Sheet metal folding machine	1
10	Tapping machine forge	1
11	Arc welding machine	1
12	Oxy-acetylene equipment	5
13	Acetylene generator	1
14	Electric soldering tool	1
15	Refix hydraulic pipe bender	1
16	Grinding machine	10
17	Jack pump	10
18	Pipe standing vices	1
19	Table vices	1
20	Copper tube bender	1
21	Copper bit	1
22	Hacksaw	10
23	Boxwood bending dresser	6

24	Share hooks	6
25	Tin snips	6
26	Hacking knife	6
27	Gimlet for lead pipe and wood screws	1
28	Wrenches	Assorted
29	Dies	Assorted
30	Pipe and bolt threading machine	1
31	Files	Assorted
32	Rules	Assorted
33	Tapes	5
34	Wheel cutter	5
35	Compound and combination type water meters	5 each
	4. Electrical Workshop	
1	Bending vices/machine	10
2	Accumulators	2
3	Electrical tool kits	4
4	Battery charging equipment	1
5	Soldering iron and equipment	10
6	Generators	1
7	Avo meters	2
8	Ammeters	2
9	Volt-meters	2
10	Writing boards	Assorted
11	Consumer units:	
	a. Circuit breakers	Assorted
	b. Distribution box	2
	c. Outlets and plugs and switches	Assorted
	d. Meters	3 types
	e. Mains switchs	Assorted
	II Studio/Drawing Room	
1	Drawing table	35
2	T-Square	3
3	Set square	3
4	Drawing pen	3
5	Chalkboard set square	2 sets
6	Chalkboard protractors	2
7	Chalkboard divider	2
8	Chalkboard pair of compasses	2
9	Chalkboard wooden straight edges	2
10	Chalkboard lettering set	2 sets

11	Drafting machine for standard drawing table	4
12	Templates	2 sets
13	Plastic curves	2 sets
14	Railway curves (metric) set	2 sets
15	Projector	1
16	Electronic calculators	20
17	Standard drawing boards (imperial size)	30
18	Engineering scale rules	Assorted 10 eacg
S/No	**Duplicating and Printing Room**	**No. Required**
1	Photostating machine	1
2	Plan printing machine	1
3	Duplicating machine	1
4	Trimming machine	1
5	Scanning machine	1
	Safety Equipment (for each Workshop)	
1	First aid box	1
2	Safety goggles	32
3	Safety caps	32
4	Rubber boots	32 pairs
5	Leather apron	32
6	Leather palm gloves	32 pairs
7	Fire extinguisher	2
8	Fire buckets	2
9	Safety charts and drawings	Assorted
10	Shower	1
S/NO	**COMPUTER & GIS LABORATORY**	**QUANTITY**
	hard wares	5
1	Pentium Base Computers	2
2	9 second Total Station Accessories	1
3	3 Seconds Total Station & Accessories(HND)	1 pair
4	Handheld GPS(HND)	1
5	EDM(HND)	1
6	Digital Theodolite	1
7	Printers	3
8	Digitizers A3 (HND)	1
	Softwares	
1	DBMS	
2	SURFERS	
3	MAPMAKERS	

4	LOTUS/EXCEL	
5	Wordprocessing	
5	AUTOICAD	
6	ILWIS	
7	ARCVIEW/ARCINFOR	
	SURVEYING EQUIPMENT STORE	
1	Levelling Instruments	1 each
2	Theodolite	2
3	Compasses with tripods	3
4	Mirror Stereoscope (HND)	3
5	Pantograph	2
6	Staves	5
7	Ranging Poles	20
8	Surveying Umbrella	6
9	Chains	5
10	Steel arrows	15
11	Planimeters	3
12	Tapes(30m, 50m, 100m)	4 each
13	Optical square	3
14	Pocket altimeter	2
15	Steel band	3

UNESCO-NIGERIA PROJECT IN SUPPORT OF REVITILISATION OF TECHNICAL AND VOCATIONAL EDUCATION IN NIGERIA

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