International Journal of Advanced Engineering and Management
ISSN: 2456-8066
Vol. 6 No. 2.
Paper ID 202109

A REVIEW STUDY ON THE SYLLABUSES OF THE MECHANICAL ENGINEERING COLLEGE ATBARA NEW DIPLOMA COURSE FOR PRELIMINARY YEAR

Osama Mohammed Elmardi Suleiman Khayal

Nile Valley University, Deptment of Mechanical Engineering, Atbara, Sudan
osamakhayal66@nilevalley.edu.sd

Abstract

Mechanical Engineering is an engineering branch that combines engineering physics and mathematics principles with materials science to design, analyze, manufacture, and maintain mechanical systems. It is one of the oldest and broadest of the engineering branches.

The course has been designed primarily to meet the growing needs for technician engineers in the Sudan. This need is recognized to be manifested currently in two areas; firstly in the development and provision of national infrastructure of power, transport, communications and other development schemes, and secondly in the growth of engineering service and general manufacturing industries.

The course is essentially practical in nature with some 40% of the curriculum being devoted to projects, workshop practice and integrative studies, and it is the intention to teach theory from an applications point of view.

It is believed that through this applications approach, the student technician will develop a practical working knowledge, which is a very necessary adjunct to the needs of industry within the country.

The choice of subjects reflects the national needs as they are seen at present, but attention is also paid to the future. Consequently, the student will be introduced to computational methods and made aware of advances in technology that results.

The main objective of the new course is to produce both mechanical and production technician engineers who are capable of working, typically in a supervisory capacity within all branches of the engineering service and manufacturing industry of Sudan.

The emphasis is on the broader aspects of engineering technician education, rather than on the highly specialized, in recognition of the diversification likely within future careers of the MECA graduates.

Keywords

Mechanical engineering, power option, production option, syllabuses, subject content, aims, first year diploma of MECA

I. Introduction

The diploma in mechanical engineering has beendeveloped as a cooperative venture between Leeds Polytechnic of the United Kingdom (U.K.) and the administration of Mechanical Engineering College Atbara of Sudan, under the auspices of the British Council.

The Mechanical Engineering College Atbara has offered a 3-years course in mechanical engineering since 1971. This current course is a logical development of the previous course, and maintains as its overall objective, the education of technician engineers to a level of practical and academic competence compatible with that of Western Europe and satisfying the particular needs of the Sudan.

The course is of three years duration and leads to the award of a diploma in mechanical engineering. It is designed for full time study inclusive of academic study, practical instruction and industrial training. The first two years are common and contain basic mechanical and production engineering subjects. In the final year, students select either the mechanical engineering (Power option) or production engineering (Technology and Systems option).

Admission to the course is by either selection from holders of the academic or technical Sudan school certificate with credit levels in mathematics, physics and an appropriate science subject; or mathematics, engineering drawing and workshop technology.

The institute was established in 1971 under the name " Institute of Mechanical Engineering Technicians" (IMET), with the main objective of supplying the country with high level engineering technicians, who can effectively contribute to the industrial development and to the increasing demand for mechanical engineering technicians. In 1976 the IMET was renamed as "Mechanical Engineering College Atbara "(MECA), and it continued to award Engineering Diploma of 3-years duration in mechanical engineering , in power and production options. In 1990 the Nilevalley University, (NVU), was established and (MECA) became one of the faculties of the university and it was renamed as " Faculty of Engineering & Technology (FET).

The following matter covers the subjects' content of the first year of the diploma course in mechanical engineering.

The course has been designed primarily to meet the growing needs for technician engineers in the Sudan. This need is recognized to be manifested currently in two areas; firstly in the development and provision of national infrastructure of power, transport, communications and other development schemes, and secondly in the growth of engineering service and general manufacturing industries.

In the former, particular attention is paid to the education of the student as a mechanical engineering technician seeking in a career typically within power generation, road and rail transport, irrigation schemes and the sugar industry. To this end subject matter essential to the general base of engineering knowledge has been combined with that more specifically related to mechanical engineering within the industries concerned.

Similarly, the student as a production engineer will build upon the foundation studies of years one and two, and will in the final year, study the elements of production engineering which make for a competitive and efficient manufacturing industry; namely, the technology of production and the organization of production systems.

In designing the curriculum, the subject material in the final year has been related directly to the detailed objectives of the graduate technician engineer and from these, specific aims for each subject have been produced.

Years 1 and 2 have been designed with these aims clearly in view.

The course is essentially practical in nature with some 40% of the curriculum being devoted to projects, workshop practice and integrative studies, and it is the intention to teach theory from an applications point of view.

It is believed that through this applications approach, the student technician will develop a practical working knowledge, which is a very necessary adjunct to the needs of industry within the country.

The choice of subjects reflects the national needs as they are seen at present, but attention is also paid to the future.

Consequently, the student will be introduced to computational methods and made aware of advances in technology that result.

The main objective of the new course is to produce both mechanical and production technician engineers who are capable of working, typically in a supervisory capacity within all branches of the engineering service and manufacturing industry of Sudan.

The emphasis is on the broader aspects of engineering technician education, rather than on the highly specialized, in recognition of the diversification likely within future careers of the MECA graduates [1] – [35].

Figure 1 below shows the main gate of the Faculty of Engineering and Technology – Atbara and Figure 2 below shows the logo of the festival of golden jubilee of mechanical engineering college Atbara (MECA).

Figure 1 a Photo Showing the Main Gate of the Faculty of Engineering and Technology - Atbara

Figure 2 the Logo of the Festival of Golden Jubilee of Mechanical Engineering College Atbara (MECA).

II. SUBJECT'S AIMS AND CONTENTS OF THE PRELIMINARY YEAR

A. Thermodynamics I (45 hours)

The overall aims of thermodynamics I are as follows:

To present both production and mechanical technician engineers with a practical understanding of the working principles of the types of plant they are most likely to be involved with in their future careers. The specific aim in year 1 is to introduce the student to the fundamental laws of thermodynamics as they relate to power plant and heat transfer.

A.1 Introduction to Thermodynamics (20 hours)

Subject Matter

Thermodynamics properties; pressure, temperature, volume, work, heat, internal energy, flow energy, units.

Principles of the heat engine; heat source, expansion work, heat sink, controls, thermal efficiency.

Properties of gases; equation of state, specific heats.

First law; systems, boundaries, energy balances and equations.

Non – flow energy equation; reversibility, P – V diagrams, constant volume, constant pressure, isothermal, adiabatic and polytropic processes.

Calculation of heat and work transfers in non – flow systems, cyclic operation.

Properties of liquids and vapors; phase changes, sensible/latent/super – heat, dryness fraction.

Use of fluid data tables to determine enthalpy and specific volume.

A.2 Heat Transfer (12 hours)

Subject Matter

Descriptive treatment of the three modes of heat transfer.

One dimensional conduction; thermal conductivity, heat transfer coefficients, Fourier's law.

Boundary layers, insulating effects of fluid film, film coefficients, and overall heat transfer coefficient U.

Applications of Fourier's law to conduction through flat composite walls and to curved surfaces with fluid films.

Insulation of buildings, pipework and furnaces.

Descriptive treatment of heat exchangers, evaporators, condensers, coolers, boilers, and of convective and radiant heat transfer in furnaces and ovens.

A.3 Fuels and Combustion (13 hours)

Subject Matter

The world energy situation, predictions for the future.

Revision of Dalton's law, Avogadro's law, and molar quantities as applied to gas mixtures.

Fuels: classifications, analyses, higher and lower calorific values. Principles relating to efficient combustion; fuel and air mixing, optimization of excess air, relationship between combustion, time and temperature.

Stoichiometry; determination of stoichiometric air to fuel ratios for solid liquid and gaseous fuels. Excess air. Calculation of excess air from dry products analysis. Determination of heat loss in exhaust products.

B. Fluid Mechanic I (45 hours)

The overall aims of fluid mechanics I are as follows:

To givethe students a practical appreciation of the fundamentals of fluid statics and dynamics. To enable the student to understand and analyze, the equations governing the action of various pressure and flow measuring devices, and to gain a working knowledge of the concept of dimensional analysis. To present the student to the types of flow and factors which affect them. To introduce the student to the field of lubrication.

B.1 Fluid Statics (8 hours)

Subject Matter

Definition of a fluid; properties of fluids: density. Relative density, specific weight, surface tension. Units.

Pressure at a point; absolute and gauge pressure, variation of pressure with depth, pressure head.

Hydraulic pressure applications, hydraulic cylinders and jacks.

Measurement of pressure; barometer, piezometer, U – tube manometers, Bourdon gauge.

B.2 Fluid Dynamics and Flow Measurement (10 hours)

Subject Matter

Equation of continuity of flow, energy of fluids, Bernoulli's energy equation, applications, syphons.

Flow measurement; sharp edged orifice, Pitot tube, venturimeters, notches, anemometers, and industrial meters.

B.3 Dimensional Analysis and Dynamical Similarity (6 hours)

Subject Matter

Dimensional homogeneity, Rayleigh method of analysis, application to resistance of totally and partially submerged bodies, Stoke's law, testing of models.

B.4 Fluid Friction and Flow (9 hours)

Subject Matter

Definition and units of viscosity.

Reynold's experiments; laminar and turbulent flow.

Significance of Reynold's number, transitional flow.

Laminar flow; Poiseuille equation, estimation of viscous loss in journal and collar bearings.

Turbulent flow; Darcy equation.

Effect of surface roughness, friction coefficients, and variation with Reynold's number.

B.5 Fundamentals of Lubrication (Tribology) (12 hours)

Subject Matter

Friction; resistance to motion, sliding and rolling friction, generation of heat, loss of energy, effects of temperature.

Wear; destruction and loss of surface material, effects of speed and temperature on wear effects of dirt.

Lubrication; function of lubricants, reduction of wear and friction, cooling, general description of hydrodynamics, thin film and boundary layer lubrication.

Power losses in bearing; journal and collar types.

Selection of lubricants; properties of greases and oils, oxidation stability, acidity, emulsification, pour point, viscosity, thermal conductivity and specific heat.

Factors governing selection; application to journal and slider, gears and roller bearings; operating conditions, economic considerations.

C. Electrical Technology I (60 hours)

The overall aims of electrical technology I are as follows:

To introduce the technician to basic electrical principles. He should be able to understand simple ac/dc circuit theory and perform simple calculations relating to current, voltage, resistance and power in dc circuits.

C.1 DC Circuit Theory (8 hours)

Subject Matter

Definition of emf and potential difference;

Ohm's law applied to a circuit with pure resistance, e.g. potential divider circuit and Wheatstone bridge.

Elementary treatment of Kirchhoff laws.

Applications in circuits with more than one source of emf.

Applications in Wheatstone bridge circuits.

C.2 Magnetic Circuit Theory (12 hours)

Subject Matter

Description and definition of the terms mmf, reluctance, flux density, magnetic induction.

Constant and relative permeability.

Composite circuits neglecting leakage/fringing.

Prediction of mmf required to set up given flux/flux density in air gap of a composite circuit.

Magnetic pull between two surfaces.

Lifting magnets.

C.3 Time Response of Circuits (6 hours)

Subject Matter

Relationship between charge, voltage and capacitance ($V = {}^{Q}/_{C}$).

Constant and relative permittivity.

Self and mutual inductance of coils.

Time constant of capacitive/resistive circuits, and their application in timing devices.

C.4 AC Circuit Theory (12 hours)

Subject Matter

Mean, peak rms values of sinusoidal voltages/currents and their relationship. AC voltage and current in pure ohmic resistance, capacitance, inductance. Phasor diagrams applied to LC, LR and LCR series and parallel circuits.

Power factor, definition in terms of:

I) Power consumed = apparent power $\times$ power factor

II) Phase difference between voltage and current, i.e. cos$\emptyset$.

Correction of power factor using parallel capacitor.

Definition of resonance.

Voltage magnification at resonance.

J operator for addition and subtraction of voltage/current phasors, and impedance.

C.5 Transformer (8 hours)

Subject Matter

Transformer construction and emf equation.

Energy losses associated with heating, hysteresis, eddy currents.VA rating. Calculations based on efficiency, load currents.

International Journal of Advanced Engineering and Management
ISSN: 2456-8066
Vol. 6 No. 2.
Paper ID 202109

Use with bridge rectifier to provide dc supply.

Open and short circuit tests for calculating efficiency.

C.6 Electrical Measuring Instruments (14 hours)

Subject Matter

Moving coil voltmeter, ammeter, ohmmeter, wattmeter.

Range and accuracy. Time base recorders; chart recorders; cathode ray oscilloscope.

Use of CRO as instrument to measure frequency, voltage and phase.

Use of CRO as X/Y recorder.

D. Properties of Materials I (46 hours)

The overall aims of properties of materials I are as follows:

To give to both mechanical and production engineers an understanding of the structure and properties of materials to enable them to contribute to the design and manufacture of a variety of components.

D.1 Structure of Materials (10 hours)

Subject Matter

A brief descriptive treatment of atomic bonding, ionic, covalent and metallic bonding as well as secondary bonding.

To consider briefly the structures of metals, polymers and ceramics and to show how they affect the material's properties.

D.2 Mechanical Testing (6 hours)

Subject Matter

A descriptive treatment of the tensile, impact and hardness tests, wherever possible using practical demonstrations.

Interpreting the test results and showing how they can be used in engineering design.

D.3 Solidification of Metals and Alloying (12 hours)

Subject Matter

Formation of equilibrium diagrams using simple cooling curves for different alloy systems. Show how the cooling curves are analyzed using the lever rule and how they are used to predict the phases that exist for a particular alloy at different temperatures. Consider how precipitation and super saturation occur and how they can lead to hardening processes.

D.4 Defects in Crystal Structure (12 hours)

Subject Matter

A descriptive approach to consider the different types of defects present in a metal crystal, concentrating on the edge dislocation when considering line defects.

D.5 Deformation (6 hours)

Subject Matter

A brief consideration of the movement of ions under stress and how dislocation movement leads to plastic deformation.

E. Strength of Materials I (40 hours)

The overall aims of strength of materials I are as follows:

To develop an analytical approach to the solution of problems associated with deformation of materials.

E.1 Stress and Strain (20 hours)

Subject Matter

Direct stress, direct strain, tensile loads, compressive loads, sign convention, Hook's law, modulus of elasticity, load extension graph, stress – strain graph, complete load – extension diagram for mild steel, tensile test results, brittle and ductile materials. Strain energy in simple tension or compression, compound bars, temperature stresses, shear stress, shear strain, modulus of rigidity, complementary shear stress, and strain energy in simple shear, riveted joints.

E.2 Shearing Force and Bending Moment (12 hours)

Subject Matter

Definition of beams, types of support, types of loads, definition of shearing force, calculation of shearing force, sign convention, shearing force diagram, definition of bending moment, sign convention, bending moment diagram, relationship between load shearing force and bending moment, points of inflection.

E.3 Properties of Area (8 hours)

Subject Matter

Definition of centroid of a lamina, first moment of area and second moment of area, parallel axes theorem, perpendicular axes theorem.

F. Applied Mechanics I (40 hours)

International Journal of Advanced Engineering and Management
ISSN: 2456-8066
Vol. 6 No. 2.
Paper ID 202109

The overall aims of applied mechanics I are as follows:

To give the student a basic understanding of the fundamental principles of mechanics and to develop an analytical approach to the solution of problems associated with dynamics.

F.1 Statics (12 hours)

Subject Matter

Definition of vector quantities, addition and subtraction of vectors, resolution of vectors. The concept of force, the moment of a force, conditions of equilibrium for coplanar forces. Free body diagrams. The polygon of forces. The center of gravity of a body, the center of area of a lamina. Simple frameworks, forces acting on a pin – joint, forces acting on a member, the graphical solution, the analytical solution.

F.2 Friction (8 hours)

Subject Matter

Definition of friction, laws of friction, angle of friction, coefficient of friction, kinetic friction, static friction, friction on an inclined plane, application to screw threads.

F.3 Kinematics of Rigid Bodies (5 hours)

Subject Matter

Linear displacement, velocity and acceleration.

Angular displacement, velocity and acceleration.

Formulae for constant acceleration with linear and angular motion, relation between linear and angular motion.

F.4 Kinetics of Rigid Bodies (Translatory Motion) (15 hours)

Subject Matter

Linear momentum, Newton's laws of motion, equation of motion, gravitational force on a body, work done by a constant force, work done by a variable force, energy and power, kinetic energy of translation, linear impulse, conservation of linear, momentum, impact, loss of energy due to impact, translation in a circular path.

G. Mathematics and Computing I (90 hours)

The overall aims of fluid mathematics and computing I are as follows:

To give the student a fundamental understanding of the mathematics and statistics necessary in order to develop a mathematical approach to problems in engineering, and to form a basis for the more advanced mathematical topics in year 2.

G.1 Calculus (40 hours)

Subject Matter

Review of differentiation, interpretation and the derivatives of simple algebraic, trigonometric, exponential and logarithmic expressions. Differentiation of sums, products, quotients, and functions of functions. Implicit and parametric differentiation. Second and higher derivatives. Maxima and minima.

Review of integration, indefinite and definite integrals. Integration of algebraic, trigonometric and exponential functions. Integration by substitution, by partial fractions, and by parts. Numerical method of integration. Calculation of areas, volume of revolution, first and second moments.

Parallel and perpendicular axes theorems.

G.2 Algebra (35 hours)

Subject Matter

Introduction to complex numbers, addition and subtraction, Argand diagram representation. Multiplication and division, modulus/argument form, exponential form, DeMoivre's theorem and applications.

Iterative methods of solving algebraic equations, convergence and divergence, Newton – Raphson method, application to solution of equations derived from engineering problems.

Introduction to matrices in two dimensions, addition, multiplication and inverse. Solution to simultaneous equations in two variables, extension to three dimensions, determinants.

Binomial and exponential series expansions, partial fractions.

Cartesian coordinates equations of straight lines, circles, ellipse, hyperbola and parabola. Polar coordinates.

G.3 Probability and Statistics (15 hours)

Subject Matter

Introduction to probability, events and their Boolean algebras. Mutually exclusive and independent events and their probabilities. Conditional probability, Baye's theorem. Uniform, binomial and Poisson probability laws and their areas of application.

Descriptive statistics, discrete and continuous data, grouping of data, representation as bar charts and ogives.

Measures of location and spread, calculation of sample mean and sample standard deviation for grouped and ungrouped data.

H. Manufacturing Processes I (90 hours)

The overall aims of manufacturing processes I are as follows:

To familiarize the students with the principles and uses of elementary primary processes, machining techniques and measurement.

H.1 Primary Processes (51 hours)

Subject Matter

H.1.1 Casting (14 hours)

Fundamentals involved in the manufacture of metallic components from the liquid state by sand casting, die-casting, investment casting and shell molding.

Materials suitable for each casting process.

Mold construction for these processes.

Compare the types of materials, soundness of casting, complexity of design, manufacturing quality, quantities required and overall manufacturing costs.

H.1.2 Hot and Cold Forming (Thick Section) (8 hours)

Fundamentals involved in rolling, forging, extrusion and wire drawing of metallic components.

Effect on physical properties, defect.

H.1.3 Plastics (5 hours)

Difference between thermoplastics and thermosets.

Form of supply of plastic materials. Injection molding, compression molding, transfer molding.

Mold configuration. Presses used in plastic molding.

H.1.4 Sintering (4 hours)

Fundamentals involved in the manufacture of components from metallic and non – metallic powders.

Compare properties of sintered and more conventional components. Pressing principles used. Volume ratio.

Sintering processes, post-sintering processes.

H.1.5 Shearing and Forming (8 hours)

Principles of piercing, blanking, cropping and bending of sheet metal. Construction of a press tool.

Types of presses. Mechanical, hydraulic; single, double and triple action. Closed and open frame. Force calculation. Use of shear.

Principles of metal spinning and flow turning.

Typical applications.

H.1.6 Welding Processes (12 hours)

Oxy – acetylene gas welding characteristics of welding gases, welding equipment, applications and welding procedures.

Manual metal (shielded metal), arc welding: fundamentals of the process, equipment, materials, applications, joint design and preparation, welding procedure and weld quality.

H.2 Machining (25 hours)

Subject Matter

H.2.1 Generation of Flat Surfaces (6 hours)

Principles of generating flat surfaces.

Construction of machine tools for milling, surface grinding, shaping.

H.2.2 Generation of Cylindrical Surfaces (6 hours)

Principles of generating cylindrical surfaces.

Construction of machine tools for turning, drilling, boring.

H.2.3 Metal Cutting (4 hours)

Basic principles of metal cutting. Effect of rake and clearance.

Single point cutting tools, orthogonal and oblique cutting.

Drill geometry, milling cutters.

H.2.4 Cutting Tool Materials (2 hours)

Development of materials up to modern coated carbides.

Form of supply of tool materials.
Method of supporting and clamping cutting tips.

H.2.5 Cutting Fluids (1 hour)

Types of cutting fluids, synthetic fluids, chemical solutions, lubricants, application of cutting fluids.

H.2.6 Tool and Cutter Grinding (2 hours)

Construction of tool and cutter grinding machines.
Work support, tooth rest, offset calculations.
Applications to plain milling cutters, form relieved milling cutters, inserted tooth face milling cutters.

H.2.7 Process Planning and Costing (4 hours)

Exercises in planning machining sequences for milled, turned, bored, etc. components and estimation of the manufacturing cost.

H.3 Metrology (14 hours)

Subject Matter

H.3.1 Linear Measurement (6 hours)

Standards of length; line and end standards.
Use of slip gauges. Principle of micrometer and Vernier scales and instruments.

H.3.2 Angular Measurement (4 hours)

Vernier protractor, angle slip gauges, angle dekkor, sign bar. Use of balls and rollers.

H.3.3 Measurement of Flatness (4 hours)

Precision level, application for measuring a surface table.

I. Engineering Drawing and Design I (180 hours)

The overall aims of engineering drawing and design I are as follows:
To provide the student with the understanding and techniques of engineering drawing, projections and dimensioning which enable him to read or produce an engineering drawing from existing drawings or sketches.

I.1 Line, Lettering and Scale (20 hours)

Subject Matter

Lines: various line symbols, centerline, visible line, hidden line, dimension lines, section lines.
Lettering: various styles of lettering, legible lettering numbers.
Scale: full size, reduced or enlarged proportion, standard metric scaling system.

I.2 Projections (30 hours)

Subject Matter

Orthographic projection: examples of first and third angle projections, position of views.
Pictorial projection: examples of isometric projections, isometric scale, example of oblique parallel projection.
Sections: full sections, half sections, offset sections, hidden and visible lines in sectional views, broken out sections, revolved sections, sections through shafts, bolt, rivets, etc.
Examples of sections of isometric and oblique projections.

I.3 Cams and Linkage (25 hours)

Subject Matter

Cams: kinds of cams, types of followers, common types of motion produced by cams, uniform motion, S.H.M., constant acceleration, displacement diagrams, cam curve.
Linkage: examples of simple mechanisms, 4 – link mechanism, quick return mechanism, loci of point.

I.4 Interpenetration (Intersection) of Surfaces (25 hours)

Subject Matter

Examples of intersecting prisms, cylinders, intersecting cylinders and prisms, cylinders and cones, intersection of planes and curved surfaces.

I.5 Development (25 hours)

Subject Matter

Pattern layout for fold up packages, development of prisms, oblique prisms, development of cylinders, oblique cylinders, four-piece elbow. Pyramids and cones, true length of an edge of a pyramid or an element of a cone, method of triangulation, development of a transition piece, development of shapes intersecting with each other.

I.6 Technical Drawing (25 hours)

Subject Matter

Screws, screw thread, screw thread profiles, bolts, studs; various bolt heads, nuts (thread series for unified and American National screw thread).

Examples of locking devices for nuts, keys cottered joints.

Rivets fittings and joints, valves, elbows, union plugs, tee, cap.

I.7 Dimensioning (30 hours)

Subject Matter

Dimensioning: functional dimensioning, projection lines, dimension lines, leaders.

Linear dimensioning, angular dimensioning, arrangement of dimensions.

Tolerance dimensions: general tolerance block, tolerancing of angular dimensions, cumulative effects of tolerance.

Geometrical tolerancing; importance of maximum metal condition, interpretation of straightness, flatness, parallelism, squareness, angularity, concentricity, symmetry and position.

Virtual size, datum faces.

Surface finish.

Limits and fits: terminology and definitions, determination of fit, selection of holes and shafts using ISO tables. Significance of maximum and minimum metal conditions.

I.8 References

1. Engineering Drawing with Worked Examples (Parts 1 and 2), Pickup and Parker (Hutchinson Education).

2. Technical Drawing, D.F. Morris, (Thomas Nelson and Sons ltd).

3. Basic Engineering Drawing, R.S. Rhodes and L.B. Cook (Pitman).

4. Graphics for Engineers, R.P. Hoelscher (John Wiley and Sons Inc.).

5. Machine Drawing and Design, W. Abbott (Blackie).

6. Manual of British Standards in Engineering Drawing (B.S.I.).

J. Technical English I (90 hours)

The overall aims of technical English I are as follows:

To teach the language and skills necessary for the efficient reading of engineering textbooks, and writing of essays and reports; to enable the graduate engineering technician to handle the English he will meet in the work place, in particular catalogues, instruction manuals and reports; to give a firm command of a selection of linguistic features taught at secondary level, and to develop them as features of technical English.

Subject Matter

J.1 Skills

J.1.1 Reading:

Study of different techniques in reading.

Definition of purpose in reading and the speeds and techniques suited to different purposes.

Speed-reading.

Skimming to find the subject of a passage.

Definition of the subject of a passage.

Scanning to find the relevant part of a passage or for specific information.

Levels of generality.

Relations between generalizations and examples.

Information transfer to tables and diagrams.

Deduction of information from the passage.

Deduction of word meaning from the passage.

Prediction of what will come next in a passage.

Recognition of the functions of a passage, e.g. definition, classification.

Cohension – what words such as the words e.g. they, the former, refer to.

Note taking.

J.1.2 Writing:

Long – term goal – training report (to be submitted during training).

Instructions.

Definitions of properties.

Definitions of objects, processes and materials.

Paragraphs describing a) structure, b) processes, c) cause and effect.

Paragraphs classifying objects, materials and processes.

Each function should have an appropriate paragraph writing exercise.

J.1.3 Reference:

Use of the Latin alphabet as an ordering device so that students can spot words that are out of order in a list and use dictionaries and indexes at speed.

Use of English – English dictionaries.
Use of English – Arabic dictionaries.
Use of book indexes and contents pages.
Use of the library and the library index and catalogue.

J.1.4 Listening:

Dictation – paragraphs for which the student has a incomplete written version.
Completing tables and diagrams for oral description.
Recognition of the subject of an oral text.
Completing notes from oral sources.

J.2 Functions

J.2.1 Static Description:

Properties
Location
Structure
Classification
Definition of properties of objects
Measurement
Quantification of properties of materials
Function and ability
Cause and effect.

J.2.2 Description of processes:

Cause and effect.
Instructions.

J.3 Linguistic Features

1. Verbs be and have
2. Number
3. The present simple tense active (with number negative and question forms).
4. The present simple passive (with number negative and question forms).
5. Article systems.
6. Adverbials.
7. Paragraph structure, including cohesion and logical connectors such as therefore, because, etc.
8. Relative clauses with which, where, from which, through which, etc.
9. Preposition of location and direction.
10. Verb infinitive forms; pre + verb ing e.g. by/for igniting …
11. Verbs with clausal complements such as cause, enable, prevent.

J.4 Tasks

Writing a report on training.
Library reference work.
Keeping a vocabulary notebook.

K. Workshop Practice I and II (720 hours)

The overall aims are to enable thetechnicians to develop the necessary hand and operational skills, which will enable him to become competent in specific hand skills for the successful maintenance of workshop equipment and to develop expertise in the operation of machine tools and associated plant. The aims of the laboratory work are to allow the student to gain confidence in the use of equipment with due regard to scientific method and associated measuring techniques.

Subject Matter

K.1 Electrical Installation I and II (124 hours)

1. Correct standards on wiring/installation, e.g. covering on wire PTFE or PVC.
2. Correct number of conductors for current capacity with a safety factor.
3. Specification on terminations wiring of single phase plugs.
4. Earthing arrangements, for single-phase supplies.
5. Wiring in trench, under floor or ceilings, labelled, labelling, used of detailed drawings.
6. Use of PYRO (trade name) cable or similar in more hazardous situations, e.g. water, heat, etc.
7. Color codes of resistors and capacitors.
8. Standards and specifications of other electronic components such as transistors and diodes.
9. Limitations of electrical instruments and multimeters.
10. Wire gauge (SWG) and wire sizes.
11. Specification on the termination of 3ph plugs/sockets.
12. STAR and DELTA connections for three phase motors.
13. Earthing arrangements for three-phase supply.
14. Neutral line in a three-phase supply (STAR); non – earthing for unbalanced loads.
15. Operation and care of electrical machines.

16. The connection of and the problems associated with relays and magnetic switches.
17. Methods of repair of electronic circuits, especially simple power circuits.

K.1.1 Practical Work I and II

1. Use of multimeters to test for the continuity in equipment and for the verification of Ohm and Kirchhoff's laws.
2. Connection of one lamb to a power supply.
3. Construction of series and parallel circuits.
4. Series/parallel circuits.
5. Switches; two way and intermediate switches.
6. Connection of fluorescent lamps, single, double in parallel and double in series.
7. Connection of office bells including bell indicator sets.
8. House wiring.
9. Inspection of short and open circuit faults.
10. Winding of single-phase transformers and coils.
11. Joints; tee, married and Britannia.
12. Soldering; cable soldering, electronic components soldering.
13. Measurement of voltage, current and power.
14. Installation of simple electronic circuits, e.g. power supply circuits, voltage regulators, etc.

K.1.2 Safety

A) Correct fusing, installation, use of NEON indicators to show when live is applied.
B) Switches always be placed in live lines.
C) Treatment of electric shock.
D) Euro standard.
E) High voltage precautions.

K.1.3 Practical Experience

Additionally the student must have a practical experience in the testing, installation and repair of the following electrical and electronic components and systems:

1. Power Distribution Systems.
2. Electric Machines:

Generators: AC, DC and synchronous.
Motors:
DC motors (including shunt, series and compound).
AC motors: split phase, shaded pool, repulsion and capacitor types, rotary magnetic field induction motors, and synchronous motors.

3. Controls:

Relays; manual, current and voltage.
Magnetic switches; drum, reversing switch.

4. Solid State:

Power circuits using metal rectifiers and Zenner diodes.
Operational amplifiers.
Assembly of circuits on electronic circuit boards.

K.2 Machining I and II (124 hours)

Safety aspects of center lathe operation. The principles of the center lathe and its method of operation. Preparation of work for turning between centers, use of three – point steady to ensure accurate centering. Turning multi – diameter work to close limits. Truing of headstock center. Use of three and four jaw chucks for work requiring external turning and internal boring and reaming operations.
Screw cutting, single and multi – start screw threads, internal and external and assembly of internally and externally threaded components. Use of chasing dial. Taper turning, the turning of tapers using tailstock, compound slide and taper turning attachment.
Use of taps and dies for screw threads manufacture and the assembly of externally and internally threaded components.

K.2.1 Shaping

Setting of the shaping machine for the manufacture of flat surfaces which may be parallel, inclined or perpendicular to each other. The machining of grooves and tee – slots.

K.2.2Milling

Setting of the milling machine and cutter selection for the machinery of flat surface which are either parallel inclined or perpendicular to each other. The machining of grooves and Tee – slots.

K.2.3 Grinding

Use of the tool and cutter grinder for grinding work pieces such as lathe mandrels and other work which requires grinding between centers.

The use of the hand or cutter grinder for the sharpening of all types of lathe and shaper tools.

K.3 Foundry Work I and II (124 hours)

Safety aspects of foundry work, foundry equipment and machines.

Sand preparation, mold casting and fettling operations.

Study of the design of different types of pattern; allowances (machining and shrinkage) for the preparation of molds.

The effect of gates, runner and riser positions and shapes.

Cupola and Crucible furnaces for melting cast iron, Aluminium and copper alloys (or any nonferrous metals available).

Gravity die-casting molds.

K.4 Forging I and II (45 hours)

Safety aspects of the forging shop. Forging equipment and tools, forging hearths. Heating of work piece. Hot and cold cutting of work pieces using chisels.

Heat treatment of carbon and alloy steels. Quenching media. Surface hardening using carbonizing powders.

The practical exercises in this shop should be directed towards manufacturing a range of hand tools.

K.5 Elementary Carpentry and Pattern Making I and II (45 hours)

Planing of wood: types of plane; jackplane, smoothing plane, form planes, machine planes.

Saws: types – rough, cross cut, tenon, fretsaw, circular saw.

Chisels: types – flat, beveled, form.

Sharpening of planes, chisels and saws.

Wood joints: types of joint used in pattern making.

Manufacture of simple patterns; removing angle, shrinkage and machining allowance.

Tool sharpening.

K.6 Bench Work I and II (45 hours)

Safety aspects of bench work and fitting.

The types of files available and their applications; marking out tools, taps, dies and drills.

The use of different fitting tools to enable the student to gain skills in bench work.

Filing, drilling, tapping, riveting and assembly.

Use of surface plate, squares, scribers, rules and other measuring equipment; marking out operations.

Note: it is suggested that this section of the course be used to manufacture a range of hand tools.

K.7 Elementary Welding Practice I and II (45 hours)

K.7.1 Gas welding:

Safety aspects; setting gas welding apparatus, leakage testing, flame adjustment. Creating and controlling a molten pool, introduction of filler rod to molten pool.

Running short and long stringer beads in flat position.

Use of weaving techniques.

K.7.2 Arc Welding:

Techniques of arc welding. Correct connection of welding circuit, setting of welding machine variables. Arc striking and arc length control. Running of short and long stringer beads in flat position.

Use of weaving techniques.

Welding of mild steel gauge plates by both oxy – acetylene and manual arc methods. Joints; closed corner and open corner, confined to flat position and leftward welding techniques.

K.8 Welding and Joining of Metals I and II (82 hours)

Preparation of work pieces.

Correct setting and adjusting of welding plant to obtain optimum welding conditions.

Welding of components by both oxy – acetylene and electric arc methods involving all basic joints (confined to down hand-welding techniques).

Welding of various metals, steels, cast iron, Aluminium and Aluminium alloys, building up fillet welds.

Repair work.

Flame cutting, flame adjustment, preheating, cutting.

Arc cutting, stock arc, carbon arc.

Visual inspection and workshop testing of welds

K.9 Engine Components and Analysis I and II (86 hours)

Identification of petrol and diesel engine types.

Identification of major components; block, piston, conrod, crankshaft, camshaft, lubrication and water pumps, cooling system, dynamo/alternator, diesel pump and injector, petrol spark plugs and ignition systems and carburation, exhaust systems.

Dismantling and assembly of main engine block and the removal, testing and replacement of ancillary equipment.

Testing the rebuilt components and the engine.

At the end of each subject material there are enough references, but for further reading it is recommended to refer to references [36] – [73].

III. CONCLUSIONS

The first year of the mechanical and production engineering diploma course consists of eleven core subjects that includes Thermodynamics I, Fluid Mechanic I, Electrical Technology I, Properties of Materials I, Strength of Materials I, Applied Mechanics I, Mathematics and Computing I, Manufacturing Processes I, Engineering Drawing and Design I, Technical English I and Workshop Practice I and Laboratory Work I.

The overall objectives of the above-mentioned subjects are as briefly described below:

Thermodynamics I: To establish a firm base of knowledge and understanding of physical laws and concepts in so far as these are needed for underpinning the subject; to introduce the principles underlying the transfer of heat and to deal specifically with one dimensional conduction; and to present briefly the current energy situation and to give a working insight into the efficient use of fuel.

Fluid Mechanic I: To examine and understand the nature and effects of forces exerted by a fluid at rest; to examine the concepts required for the study of fluids in motion; to present the method of dimensions as a means of producing empirical equations for the solution of engineering problems; to examine the basic equations controlling flow in pipes and energy requirements; and to teach the basic elements of the theory of lubrication with particular reference to selection of lubricants.

Electrical Technology I: To give the student a basic understanding of direct current related to practical engineering and applications; to give the student a knowledge and understanding of how to apply magnetic circuit theory to common electrical and mechanical devices; the student should be able to understand the concept of capacitance, inductance and circuit time constant, with reference to common applications in engineering; to enable the student to understand the concepts of AC voltage and current in pure resistance, and reactive components; to give the student an understanding of transformer action with energy losses, applications in power supplies and impedance matching; and to allow the student to become familiar with the use of modern electrical instrumentation for measuring analogue and digital quantities.

Properties of Materials I: To know the differences in structure between metals, ceramics and polymers; to instruct the student how to interpret the results of tensile, impact and hardness testing, to know the purpose and usefulness of simple binary equilibrium diagrams; to know that crystals contain certain defects and that these defects impart certain properties to a metal; and to know how the deformation processes of a metal are influenced by the crystal structure and the defects within that structure.

Strength of Materials I: To use stress, strain, and elasticity in problems; to prepare shearing force and bending moment diagrams; to become familiar with the properties of area.

Applied Mechanics I: To study vector quantities and to understand and apply the equilibrium conditions to find unknown forces; to state the laws of friction and to describe and solve problems involving friction; to state the equations of uniformly accelerated motion and solve problems in relation to linear and angular motion; to understand the principles of linear momentum and to state the laws of and solve problems associated with translatory motion.

Mathematics and Computing I: To strengthen the student's knowledge of differentiation and integration, to provide techniques and applications and to form a firm base for the study of advanced calculus in year 2; to extend the student's knowledge of algebra to include areas of importance; namely – complex numbers, iterative methods of solution, matrices, and series and partial fractions and to show how these are used to obtain solutions to engineering problems. To consolidate basic ideas of geometry; to introduce the basic concepts of probability and statistics in order to form a basis for the study of statistics in year 2.

Manufacturing Processes I: The expected learning outcome is that the student will be able to understand the principles and appreciate the advantages of a range of primary processes, explain the principles of the equipment requirement to undertake the primary processes, justify the selection of a viable production process in relation to quality, quantity and cost; understand the principles and appreciate the advantages of a range of basic machining processes and their ancillary equipment, explain the principle of the equipment necessary to efficiently perform the machining operation, appreciate the significance of planning machining operations for milled and turned components, understands the elements of manufacturing costs and be able to estimate the cost of milled and turned components; understand the principles of basic measuring concepts for (lengths, angles, flatness and small holes), and select and apply the most appropriate measuring technique for a particular situation.

Engineering Drawing and Design I: To provide an understanding of the various line symbols, lettering styles and scales and their application in engineering drawing; to provide an understanding of different methods of projection with more emphasis on orthographic projection; to provide an understanding of various types of cams and linkages, supplemented by methods of producing cam curves and loci of a point; to provide an understanding of the concept of intersection curves and their importance, also how to generate these curves for different shapes intersecting with each other; to provide techniques of producing patterns on flat sheets of materials which can be folded, rolled or otherwise formed to provide the required shape; to provide an understanding of the main features and uses of various types of fastenings; to provide the principles of dimensioning and the methods of applying tolerances of size on engineering drawings.

Technical English I: To teach the language and skills necessary for the efficient reading of engineering textbooks, and writing of essays and reports; to enable the graduate engineering technician to handle the English he will meet in the work place, in particular catalogues, instruction manuals and reports; to give a firm command of a selection of linguistic features taught at secondary level, and to develop them as features of technical English.

Workshop Practice I and Laboratory Work I: The overall aims are to enable the technicians to develop the necessary hand and operational skills, which will enable him to become competent in specific hand skills for the successful maintenance of workshop equipment and to develop expertise in the operation of machine tools and associated plant. The aims of the laboratory work are to allow the student to gain confidence in the use of equipment with due regard to scientific method and associated measuring techniques.

ACKNOWLEDGEMENTS

The author would like to acknowledge with deep thanks and profound gratitude Mr. Osama Mahmoud Mohammed Ali of Dania Center for Computer and Printing Services, Atbara, who spent many hours in editing, re – editing of the manuscript in compliance with the standard format of International Journal of Advanced Engineering and Management (IJOAEM) Journal. Also, my appreciation is extended to Professor Mahmoud Yassin Osman for revising and correcting the manuscript several times.

REFERENCES

[1] Syllabus for Mechanical Engineering (ME). Gate 2012, Graduate Aptitude Test in Engineering, Organizing Institute: Indian Institute of Technology – Delhi, New Delhi – 110016.

[2] The Summer Institute for Engineering and Technology Education, University of Arkansas 1995.

[3] D. T. Potts (2012). A Companion to the Archaeology of the Ancient near East. p. 285.

[4] Selin, Helaine (2013). Encyclopedia of the History of Science, Technology, and Medicine in Non-Western Cultures. Springer Science & Business Media. p. 282. ISBN 9789401714167.

[5] ABET searchable database of accredited engineering programs, Accessed 11 March 2014.

[6] Minors Archived 4 August 2012 at archive. Today. Department of Mechanical Engineering, University of Tulsa, 2010. Accessed: 17 December 2010.

[7] Dugas, Rene. A History of Classical Mechanics. New York, NY: Dover Publications Inc., 1988, pg. 19.

[8] William Thomson, LL.D. D.C.L., F.R.S. (1882). Mathematical and Physical Papers. 1. London, Cambridge: C.J. Clay, M.A. & Son, Cambridge University Press. p. 232.

[9] Guggenheim, E.A. (1933). Modern Thermodynamics by the Methods of J.W. Gibbs, Methuen, London.

[10] Clark, John, O.E. (2004). The Essential Dictionary of Science. Barnes & Noble Books. ISBN 978-0-7607-4616-5. OCLC 58732844.

[11] "Military Applications". Archived from the original on 31 January 2019. Retrieved 15 December 2009.

[12] Mechanical Characterization of Aluminium Nano films, Microelectronic Engineering, Volume 88, Issue 5, May 2011, pp. 844–847.

[13] R. C. Hibbler, Engineering Mechanics, Vols. II and Pearson, I Press, 2002.

[14] F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol. I - Statics, Vol. II – 1. H. Choudhury, Elements of Workshop Technology, Vol. I, Asia Publishing House, 1986.

[15] N D Bhatt and V M Panchal, Engineering Drawing, 43rd Ed., Charator Publishing House, 2001.

[16] J. Hannah, R. Stephens, Mechanics of Machines, Fourth Edition: Elementary Theory and Examples, Butterworth-Heinemann; (July 15, 1984).

[17] G. H. Ryder, strength of materials, Macmillan Publishers India Limited, 2002, ISBN9780333935361 .

[18] Maurice Arthur Parker, F. Pickup, Engineering drawing with worked

examples 1 - Third Edition, Oxford University Press; 3rd edition (November 1, 2014).

[19] Maurice Arthur Parker, F. Pickup, Engineering drawing with worked Examples 2 - Third Edition, Oxford University Press; 3rd edition (November 1, 2014).

[20] T.D. Eastop, A. McConkey, Applied Thermodynamics for Engineering Technologists, Publisher : Pearson; Fifth edition (March 15, 1993).

[21] Douglas, Solving Problems in Fluid Mechanics Volume 2, Paperback – January 1, 1989.

[22] Douglas, Solving Problems in Fluid Mechanics: v. 1: 001 Paperback – 22 Jan. 1996.

[23] Osama Mohammed Elmardi Suleiman Khayal, A REVIEW STUDY OF TECHNICAL EDUCATION IN THE DEMOCRATIC REPUBLIC OF SUDAN, International Journal of Advanced Engineering and Management Vol. 5, No. 2, pp. 9-23, 2020.

[24] Osama Mohammed Elmardi Suleiman Khayal, (2020). Solid Mechanics, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-2-67920-6.

[25] Osama Mohammed Elmardi Suleiman Khayal, (2020). Solar Energy Applications, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-2-91917-3.

[26] Osama Mohammed Elmardi Suleiman Khayal, (2021). Mechanical Engineering, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-3-86405-2.

[27] Salaheldin Hassabelgabo Ibrahim, and Osama Mohammed Elmardi Suleiman Khayal, (2020). Design and Analysis of Photovoltaic Diesel Hybrid Power System, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-3-02873-7.

[28] Osama Mohammed Elmardi Suleiman Khayal, (2021). Corrosion and Biofouling, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-3-85737-5.

[29] Osama Mohammed Elmardi Suleiman Khayal, (2021). Air Conditioning Systems, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-3-86404-5.

[30] Osama Mohammed Elmardi Suleiman Khayal, (2020). TECHNICAL EDUCATION IN SUDAN, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-2-67934-3.

[31] Osama Mohammed Elmardi Suleiman, (2020). Fundamentals of Economics in Engineering Projects, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-2-673982-3.

[32] Osama Mohammed Elmardi Suleiman, (2021). Engineering Psychology and Ergonomics, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group,

Germany, and ISBN: 978-620-3-86394-9.

[33] Osama Mohammed Elmardi Suleiman, (2020). BIOGAS PLANTS TECHNOLOGY, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-620-2-67292-4.

[34] Osama Mohammed Elmardi Suleiman, April (2017). Solution of Problems in Heat Transfer Transient Conduction or Unsteady Conduction, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, and ISBN: 978-3-659-66822-7.

[35] Osama Mohammed Elmardi Suleiman, (2015). Further Experimental Research Work on Water Current Turbines, LAP LAMBERT Academic Publishing, Member of Omni Scriptum Publishing Group, Germany, ISBN: 978-3-659-58160-1.

[36] David G. Ullman, the Mechanical Design Process (Schaum's Outline Series in Mechanical Engineering Series), Publisher : McGraw-Hill College (March 1, 1992).

[37] Alfred Hall, A. Holowenko, H. Laughlin, Schaum's Outline of Machine Design 1st Edition, Publisher : McGraw-Hill; 1st edition (June 1, 1967).

[38] Authors: Joseph Edminister, Mahmood Nahvi, Schaum's Outline of Electrical Circuits, Sixth Edition (EBook), Published October 18 2013, ISBN: 9780071830447.

[39] T E French, C J Vierck and R J Foster, Graphic Science and Design, Fourth Ed., McGraw Hill, 1984.

[40] Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill).

[41] Solid State Physics - by S.O. Pillai, 5th edition (New Age International).

[42] Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi).

[43] Thermodynamics by Burghardt.

[44] Simeon Oka, Fluidized Bed Combustion, First Edition, and September 27, 2019.

[45] Peter Lynwander, Gear Drive Systems: Design and Application, First Edition, June 08, 1983.

[46] Harold Josephs, Ronald L. Huston, Blake's Design of Mechanical Joints, Second Edition, October 05, 2018.

[47] Francis S. Tse, Ivan E. Morse, Measurement and Instrumentation in Engineering: Principles and Basic Laboratory Experiments, First Edition, July 28, 1989.

[48] Kuppan Thulukkanam, Heat Exchanger Design Handbook, Second Edition, April 10, 2017.

[49] Ronald F. Gibson, Principles of Composite Material Mechanics, 4th Edition, February 05, 2016.

[50] Dale Ensminger, Leonard J. Bond, Ultrasonic: Fundamentals, Technologies, and Applications, Third Edition, September 19, 2011.

[51] Marcio L. de Souza-Santos, Solid Fuels Combustion and Gasification: Modeling, Simulation, and Equipment Operations, Second Edition, March 25, 2010.

[52] John H. Bickford, Introduction to the Design and Behavior of Bolted Joints: Non-Gasketed Joints, Fourth Edition, August 24, 2007.

[53] Edgar Rapoport, Yulia Pleshivtseva, Optimal Control of Induction Heating Processes, First Edition, July 07, 2006.

[54] Agnieszka Muszynska, Rotordynamics, First Edition, May 20, 2005.
[55] Werner Soedel, Vibrations of Shells and Plates, 3rd Edition, August 11, 2004.
[56] William C. Orthwein, Clutches and Brakes: Design and Selection, Second Edition, Clutches and Brakes: Design and Selection, Second Edition, February 18, 2004.
[57] Vijay Srinivasan, Theory of Dimensioning: An Introduction to Parameterizing Geometric Models, First Edition, and September 30, 2003.
[58] George A. Antaki, Piping and Pipeline Engineering: Design, Construction, Maintenance, Integrity, and Repair, First Edition, May 28, 2003.
[59] V. Ganapathy, Industrial Boilers and Heat Recovery Steam Generators: Design, Applications, and Calculations, First Edition, October 16, 2002.
[60] Mahendra Hundal, Mechanical Life Cycle Handbook: Good Environmental Design and Manufacturing, First Edition, September 11, 2001.
[61] Ulrich Heubner, Nickel Alloys, First Edition, September 01, 2000.
[62] Yuri Melnikov, Influence Functions and Matrices, First Edition, November 05, 1998.
[63] John Bickford, Gaskets and Gasketed Joints, First Edition, November 19, 1997.
[64] James D. Meadows, Geometric Dimensioning and Tolerancing: Workbook and Answer book, First Edition, March 21, 1997.
[65] Shirley Seireg, Optimizing the Shape of Mechanical Elements and Structures, First Edition, January 02, 1997.
[66] Hoa, Computer-Aided Design of Polymer-Matrix Composite Structures, First Edition, August 03, 1995.
[67] Charles Schacht, Refractory Linings: Thermomechanical Design and Applications, First Edition, January 25, 1995.
[68] Earl Logan, Jr., Turbomachinery: Basic Theory and Applications, Second Edition, Second Edition, June 29, 1993.
[69] Meyers, Shock Wave and High-Strain-Rate Phenomena in Materials, First Edition, May 12, 1992.
[70] Duane Tandeske, Pressure Sensors: Selection and Application, First Edition, November 19, 1990.
[71] David Ardayfio, Fundamentals of Robotics, 1st Edition, May 29, 1987.
[72] D. G. Ullman, Mechanical Design Failure Analysis: With Analysis System Software for the IBM PC, First Edition, and September 29, 1986.
[73] Jerome Lange, Solving Mechanical Design Problems with Computer Graphics, First Edition, March 31, 1986.

AUTHOR BRIEF AUTOBIOGRAPHY

Osama Mohammed Elmardi Suleiman Khayal was born in Atbara, Sudan in 1966. He received his diploma degree in mechanical engineering from Mechanical

Engineering College, Atbara, Sudan in 1990. He also received a bachelor degree in mechanical engineering from Sudan University of science and technology – Faculty of engineering in 1998, and a master degree in solid mechanics from Nile valley university (Atbara, Sudan) in 2003, and a PhD in structural engineering in 2017. He contributed in teaching some subjects in other universities such as Red Sea University (Port Sudan, Sudan), Kordofan University (Obayed, Sudan), Sudan University of Science and Technology (Khartoum, Sudan), Blue Nile University (Damazin, Sudan) and Kassala University (Kassala, Sudan). In addition, he supervised more than three hundred under graduate studies in diploma and B.Sc. levels and about fifteen master theses. The author wrote about hundred engineering books written in Arabic language, and seventy books written in English language and more than hundred research papers in fluid mechanics, thermodynamics, internal combustion engines and analysis of composite structures. He authored more than three hundred lectures notes in the fields of mechanical, production and civil engineering He is currently an associated professor in the Department of Mechanical Engineering, Faculty of Engineering and Technology, Nile Valley University Atbara, Sudan and now he is the faculty dean. His research interest and favorite subjects include structural mechanics, applied mechanics, control engineering and instrumentation, computer aided design, design of mechanical elements, fluid mechanics and dynamics, heat and mass transfer and hydraulic machinery. The author also works as a technical manager and superintendent of Al – Kamali mechanical and production workshops group which specializes in small, medium and large automotive overhaul maintenance and which situated in Atbara city in the north part of Sudan, River Nile State.