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Rajarambapu Institute of Technology, Rajaramnagar
(An Autonomous Institute)
Teaching & Evaluation Scheme for
Second Year U.G. Program in Automobile Engineering
(To be implemented from Year 2014 - 15)

Semester-IV

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Total Credits: 24

Total Contact Hours/Week: 29 hrs


# Alternate turn for Foundry Practices and Electrical Technology Lab.

Practicing School - 1: Two Weeks Training in Garage (Evaluation will be carried out in Third Year – Vth semester)

(To be Implemented from Year 2014-15)
### Teaching Scheme

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### Rationale:

A student of Core Engineering Disciplines like Automobile has to take courses like Strength of Materials, Fluid Mechanics, Thermodynamics, Heat Transfer and Control Engineering. These Courses heavily rely on understanding functions of single and several variables, their derivatives, differential equations and their solution. Though, most of the practical problems involve nonlinear equations and the numerical treatment to them. The algorithms for them can be understood only if learner is acquainted very well with the analytical methods. Therefore, it is worthwhile to study ordinary and partial differential equations after having studied ordinary and partial differentiation. The control engineering also needs sound foundations of Laplace and inverse Laplace transforms. Thus, the present Course serves as backbone of these important engineering Courses.

### Course Learning Outcomes:

After the successful completion of this course, the student should be able to:

1. Identify the type of differential equations (ordinary/partial, order and degree, linear/nonlinear, homogeneous/non-homogeneous, with constant/variable coefficients etc.)
2. Apply appropriate method of solution to the given differential equation.
3. Apply the techniques of solution of higher order linear ordinary and partial differential equations to solve specific engineering problems.
4. Define and describe what Laplace transform and inverse Laplace transform of a function is and apply rules of Laplace and inverse Laplace transforms to find transform given expressions using transforms and inverse transform of standard functions.

### Pre-Requisites:

1. Functions of single variable, ordinary differential coefficients
2. Order and degree of differential equations; broad classification of differential equations
3. 1st order, 1st degree ordinary differential equations and their solution
4. Functions of two or more variables; partial differentiation and partial differential equations of first order

**1. Linear Differential Equations**

Introduction and definition, Complete Solution of Linear Differential Equations with Constant Coefficients, Complete Solution of Linear Differential Equations with Variable Coefficients

6 hrs
2. Applications of Linear Differential Equations to Mechanical and Electrical Engineering
Mechanical and Electrical Oscillatory Circuits, Free Oscillations, Damped Free Oscillations, Forced Oscillations (without damping), Forced Oscillations (with damping) 6 hrs

3. Higher Order Partial Differential Equations
Introduction and Definition, Linear Homogeneous Partial Differential Equations of nth Order with constant coefficients, Methods of Solutions of Linear Homogeneous Partial Differential Equations of nth Order with Constant Coefficients, Non-homogeneous Linear Equations 6 hrs

4. Laplace Transform I
Definition, Laplace transforms of Standard Functions, Properties of Laplace Transforms and Inverse Laplace Transforms. 6 hrs

5. Laplace Transform II
Laplace Transforms of Periodic Functions, Laplace Transform of Heaviside Unit-step Function, Laplace Transform of Dirac-delta Function, Applications of Laplace Transform to Solve Linear Differential Equations 6 hrs

6. Random Variable and Probability Distributions
Random Variable, Discrete and Continuous Probability Distributions, binomial, Poisson and Normal Distributions 6 hrs

RECOMMENDED BOOKS


(To be Implemented from Year 2014-15)
AE 2031 APPLIED THERMODYNAMICS

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RATIONALE:
This course is offered as a core course at the second year first semester of Automobile Engineering undergraduate programme. In this course students will be introduced to thermodynamics, its basic concepts, and its application. It contains theoretical, practical, and empirical material. Some may be familiar from other sources (e.g. physics), but the approach may be different. Students will relearn some old concepts, learn new concepts, encounter new terminology, and develop problem solving skills which will help in all engineering. This course is divided into six different modules like - review of laws of thermodynamics, entropy, properties of pure substances & availability, gas turbines, fundamentals of refrigeration, psychrometry and air conditioning systems. Major emphasis is given on understanding the basic concepts as well as solving various numerical problems in real situations.

COURSE LEARNING OUTCOMES:
At the end of the course, the students will be able to –
1. Illustrate the ideal gas, real gas, its deviation with compressibility chart.
2. Explain the use of Maxwell’s relations.
3. Analysis thermodynamic second law for various processes.
5. Analyze various methods of refrigeration and air conditioning.

PREREQUISITES: Basic Mechanical Engineering, Engineering Mathematics, Engineering Chemistry

CURRICULUM

Unit 1. Review of Laws of thermodynamics
Review of Zeroth, First, second and third law, Equation of state for ideal gas and real gases; p-V-T Surface of an Ideal Gas, Van der Waal’s Equation, behavior of real gases and its deviation from Ideal gas, compressibility factor, Law of corresponding states and use of generalized compressibility chart; Helmholtz and Gibbs functions- Definitions and importance; Simple Maxwell’s relations with its importance. (Numerical treatments restricted to First and Second law of Thermodynamics ONLY)

Unit 2. Entropy
Clausius inequality, entropy as a property of system, entropy of pure substance, T-s and h-s planes, entropy changes for closed and open systems, increase of entropy principle, calculation of entropy changes of gases and vapours, Entropy of generation, entropy change for various processes.

(To be implemented from Year 2014-15)
Unit 3. Properties of Pure substances and Availability
Phase change of pure substance, phase change terminology, property diagram, formation and properties of steam, use of steam table and Mollier chart, entropy change of steam (Numerical treatment). Availability of a closed and open system, availability of work and heat reservoirs, Anergy, energy and exergy. Simple numerical on availability.

Unit 4. Gas Turbines:
Working principle, applications, open, closed cycle and their comparison, Cycle modified to regeneration, reheat, inter cooling performance, Calculation of gas turbine work ratio, efficiency, Gas turbine irreversibility and losses.

Unit 5. Fundamentals of Refrigeration:
Introduction, elements of refrigeration systems, Methods of Refrigeration, applications of refrigeration, Basic refrigeration cycles- Reversed Carnot cycle, P-h Chart, Vapour Absorption Refrigeration System (VARS), Vapour Compression refrigeration system (VCRS), types and properties of refrigerant.

Unit 6. Psychrometry & Air-Conditioning:
Psychrometric terms, psychrometric relations, psychrometric chart, psychrometric processes, Human comfort and factors affecting comfort air conditioning, air conditioning systems, air conditioning equipment, components, and controls, air distribution, load estimation, duct design & layout for automobile. (Numerical Treatment is restricted to VCRS cycle ONLY)

**TEXT BOOKS**

2. R. K. Rajput, Thermal Engineering, S. Chand
9. Cengel, Thermodynamics: An Engineering Approach, 3/e, Tata McGraw-Hill,

(To be Implemented from Year 2014-15)
AE 2051 FLUID MECHANICS

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RATIONALE:

In essence, this course introduces the fundamentals of fluid mechanics for engineers. The emphasis is on the basics of fluid statics and fluid motion, with application in a variety of engineering fields. We are going to focus on properties of fluid, pressure measurement, Fluid Statics, fluid dynamics, Dimensional Analysis and Similitude as well as Laminar flow through circular pipes, laminar flow through parallel plates, Various types of energy losses during pipe flow, Boundary layer thickness, its characteristics, Forces on immersed bodies, Compressible flow- Propagation of elastic waves, Stagnation pressure and temperature.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to -
1. Classify various fluids on basis of properties.
2. Compare methods of flow measurement.
3. Calculate various types of losses through pipe.
4. Apply dimensional analysis technique for model analysis.

PRE-REQUISITES:

Must have Knowledge of Mathematics, physics and Basic Mechanical Engineering.

CURRICULUM

1 Properties of the Fluids:
Viscosity, compressibility, surface tension and capillarity, vapour pressure & cavitation, static pressure, pressure head, Insensitivity of pressure, Pascal's Law, Absolute gauge, Vacum, Atmospheric pressures, manometers.

Fluid Statics: Total pressure & C. P. for horizontal, vertical and inclined rectangular, Triangular & Circular plane surface, Buoyancy, centre of Buoyancy, Meta centre, Metacentric Height

2. Fluid Kinematics:
Methods of describing the motion of fluid. Flow visualization, types of flow, streamline, path line, streak line, stream tube, continuity equation, Velocity potential, Stream function. Acceleration of fluid particles.

(To be Implemented from Year 2014-15)
Fluid Dynamics: Equation of motion, Navier-Stokes equation, Euler's equation, Bernoulli's equation. Steady and unsteady flow through orifice. Orifice placed in a pipe, Venturimeter, flow over triangular and rectangular notches.

3. Momentum Equation:
Derivation of momentum equation, momentum correction factor, Applications of momentum equation. Dimensional Analysis and Similitude: Dimensionally homogeneous equations, Buckingham's theorem, calculation of dimensionless parameters. Similitude, complete similarity, model scales.

4. Laminar Flow:
Laminar flow through circular pipes, laminar flow through parallel plates. Flow in pipes: Energy losses in transition, expansion and contraction. Parallel pipe, siphon pipes, branching pipes and equivalent pipes. Hydraulic Gradient & Total energy line.

5. Boundary Layer Theory:
Boundary layer thickness, its characteristics, laminar and turbulent boundary layers, separation, boundary layer control (descriptive treatment)


6. Compressible flow:
Propagation of elastic waves, Mach number cone, Energy equation of compressible flows, Stagnation pressure and temperature, Adiabatic flow through pipes of varying cross section, Isentropic flow, Condition of maximum discharge.

RECOMMENDED BOOKS

2. K. L. Kumar, Fluid Mechanics, S. Chand Publication, New Delhi
AE 2071 MATERIAL SCIENCE AND METALLURGY

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RATIONALE:

Materials play an important role in the construction and manufacturing of equipment/tools. Right selection of materials adds to the economy, working and life of machinery. The students must be conversant with the properties, uses, availability and costs of materials used for construction/fabrication to enable him to perform his functions confidently. The subject of Materials and Metallurgy has been designed to cover the above aspects.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to -

1) Explain all phases, transformations, critical temperatures of Fe-Fe₃C equilibrium diagram.
2) Evaluate amount of different phases in a compound at any temperature.
3) Select appropriate material for a particular application.
4) Identify a place of external or internal defect present in a material.
5) Select a heat treatment process required for change in material properties.
6) Apply powder metallurgy method for production of metals with advance properties.

PRE-REQUISITES:

Must have undergone study of manufacturing processes, machine tool engg., different machining processes

CURRICULUM

1. Introduction to Engineering Materials: 5 hrs
   Classification of engineering material, Mechanical properties of engineering materials, Structure of materials, crystalline structure of solids: Concept of unit cell and space lattice, Miller indices, Crystal structure determination by X-ray diffraction.

2. Engineering Ferrous Alloys: 8 hrs
   Study of Fe-Fe₃C equilibrium diagram with all phases and critical temperatures
   - Steels
   - Alloy Steels
   - Cast Irons
   - Fe-Fe₃C-ferrous alloys

(To be implemented from Year 2014-15)
3. **Engineering Non Ferrous Alloys:**
   - Al –based alloys
   - Cu –based alloys- Different types of Brass and bronze.
   - Tin based alloys
   - Introduction to light metal alloys- Mg based and Titanium based alloys

4. **Metals and Alloy Systems:**
   - Alloy formation by crystallization, solidification, cooling curves, Solid solutions and intermediate, phases, Phases and phase rule, Construction of equilibrium diagrams from cooling curves, components of different solubility in liquid and solid state. Eutectic, Eutectoid, Peritectic, transformations. Lever arm principles, Long and short-range freezing, dendritic structure and coring.

5. **Composite Materials and Rubbers:**
   - Introduction, Types of composite materials, properties, advantages, orthotropic and anisotropic behavior, Micromechanical and macromechanical analysis of composite material, Applications of composite materials. Natural rubber- production and properties. Compounding and Vulcanization of Rubber- Synthetic Rubbers - Buna Rubbers, Butyle Rubbers, Neoprene Thiokols, Polyurethane and a Silicons Rubbers.

6. **Heat Treatments and Metallurgical Testing:**
   - Annealing and its types, Normalizing, Hardening by quenching and Surface hardening, Tempering, Precipitation hardening, Destructive and Non- Destructive Testing methods.

**TEXT BOOKS**

1. V D Kodgire, Material science and metallurgy, Everest Publishers, Pune
5. P. C. Sharma, Production technology, S. Chand and Company Ltd.,
8. Lawrence H. Vanlack, “Elements of Material Science and Engineering”, Addison-Wesley
12. R. Jones, Mechanics of composite material,
13. K Caw, Mechanics of composite material,
17. ASTM Volumes on Welding, casting, forming and material selection Perry’s Chemical Engineers handbook

(To be Implemented from Year 2014-15)
AE 2091 MANUFACTURING PROCESSES

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RATIONALE:

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are shaped using various manufacturing processes to produce the required product. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the materials. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to -
1) Explain different melting furnaces and casting process.
2) Identify the casting process used for various Automotive applications
3) Explain various machines and machining operations
4) Illustrate grinding wheel specifications.
5) Apply the theoretical knowledge of the subject during field application.

PRE-REQUISITES:
Knowledge of materials and manufacturing related preliminary information

CURRICULUM

Unit 1. Pattern making and Moulding Processes:

Introduction to manufacturing processes and casting, casting advantages, limitations, pattern materials, types, allowances, pattern color code, Gates, runners and risers, types of core and core making, Moulding sand, types and properties of moulding sand, types of moulding processes, Investment casting, Gravity and pressure die-casting, Centrifugal casting, Continuous casting.

Unit 2. Melting, Pouring and Fettling of Casting:

Types of melting furnaces, Metal pouring equipments, Casting defects, remedies, Safety pollution, control and mechanization in foundries, applications of Ferrous and non ferrous casting in automobiles.

(To be implemented from Year 2014-15)
Unit 3. Metal forming and Powder Metallurgy:

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

Unit 4. Lathe, Drilling & Boring Machine:

Working principles, types, specifications, principal parts, accessories and attachments, various operations, boring tools and bars, boring heads.

Unit 5. Milling Machine and Grinding Machine:

Types, various operations, accessories and attachments, grinding wheels- Abrasives, bonds and bonding processes, grit, grade and structure of wheel, wheel shapes, wheel specifications.

Unit 6. Shaping, Slotting, Planning and Broaching Machine:

Types, various operations, feed mechanism, advantages and limitations.

Industrial visit of students to ferrous and non-ferrous foundry.

TEXT BOOKS

5. P. C. Sharma, Production Technology, S. Chand and Company Ltd.

REFERENCE BOOKS

4. ASTM Volumes on Welding, Casting, Forming and Material Selection.
SH 2011 ENVIRONMENTAL SCIENCE

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**COURSE DESCRIPTION:**

The syllabus of Environmental Science provides an integrated, quantitative and interdisciplinary approach to the study of environmental systems. The students of Engineering undergoing this course would develop a better understanding of human relationships, perceptions and policies towards the environment and focus on design and technology for improving environmental quality. Their exposure to subjects like understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation, natural resource management and the effects of global climate change, will help the students to bring a systems approach to the analysis of environmental problems.

**CURRICULUM**

1. **Natural Resources:**
   Renewable and Non-renewable resources, Forest resources, water resources, Mineral resources, food resources, Energy resources, alternative energy resources, Land resources (Use & overexploitation, Problems), Role of individual in conservation of natural resources, Equitable use of resources for sustainable life styles.

2. **Ecology and Environment:**
   Definition, Principles and Scope of ecology, Ecosystem: Structure and Functions, biotic and abiotic components, energy flows, food chains, food web, ecological pyramids, Biodiversity, types of biodiversity, conservation of biodiversity.

3. **Environmental Pollution and Control Measures**
   Environmental Pollution, types of pollution, Air pollution, Water Pollution, Noise Pollution, Soil Pollution, Marine Pollution, Radioactive Pollution, Thermal Pollution (Causes, sources and effects, abatement methods), Pollution Case studies-Bhopal Gas Tragedy, Chernobyl Accident: A nuclear Disaster, Ganga Water Pollution.

4. **Solid Waste, Hazardous waste and Disaster Management**

(To be Implemented from Year 2014-15)
5. Environmental Management

Environmental impact assessment, Impact Assessment Methodologies, Environmental impact statement and environmental management plan, Environmental audit, Cost-benefit analysis, Role of Central Pollution Control Board (CPCB), State Pollution Control Board, Role of NGO’s, Role of Information technology in environment & human health, Environmental Ethics: Issues & possible solutions, Awareness of Environmental Legislation.

6. Social Issues and Environment
From unsustainable to sustainable development, Urban problems related to energy, Water conservation: Rainwater harvesting, Watershed management, Resettlement & rehabilitation of people: Problems & concerns, Climate change, Global Warming, Ozone layer depletion, Acid Rain, Consumerism & waste Products, Concepts of Eco-labeled products, Eco-mark, Public Environmental education & awareness regarding environmental issues.

TEXT BOOKS

1. ‘Ecology and Environment’ P. D. Sharma
2. ‘Environmental Studies’ by Dr. J. S. Samant, Shivaji University, Kolhapur
3. ‘Environmental Science & Engineering’ by Decksha Dave and S. S. Katewa
4. ‘Environmental Science’ by V. K. Ahluwalia and Sunita Malhotra, Narosa Publication
5. ‘Environmental Science & Engineering’ by P. Anandan & R. Kamaravelan

(To be Implemented from Year 2014-15)
The load of Part – I will be allotted to the Workshop Staff.

The load of workshop practice will be assisted by workshop staff for completing the jobs.

1) One job of plain turning, taper fuming, external threading and knurling operation with its process sheet.

2) Description on thread manufacturing processes and gear train calculations.

3) Journal Consists of Following:
   - Process sheet and tool layout on Capstan /Turret lathe.
   - Setting of milling machine for gear cutting.
   - Study and demonstration of grinding machine (Surface, cylindrical and centerless).
   - Study and demonstration of shaper/planer (mechanisms and stroke).

4) Industrial visit to study gear manufacturing processes and finishing processes.

Assessment of journal based on above term work and industrial visit report is to be done by students.
AE 2531 MATERIAL SCIENCE AND METALLURGY LAB.

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RATIONALE:

Students can use different types of destructive and non-destructive methods of testing of material. Only knowledge about some engineering materials like steel, C.I., brass, bronze are prerequisite for this course which students are learning in course on Engineering Material and Metallurgy. This course intends to build the competency in the students to select a proper heat treatment process which is required depending on the final properties required in the product.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to -
1. Select a heat treatment process required for change in material properties.
2. Apply powder metallurgy method for production of metals with advance properties.
3. Select appropriate material for a particular application.
4. Identify a place of external or internal defect present in a material.
5. Select a heat treatment process required for change in material properties.
6. Apply powder metallurgy method for production of materials with advance properties.

PRE-REQUISITES:

Must have undergone study of manufacturing processes, machine tool engg., different machining processes

DETAILED PRACTICAL LIST

1. Introduction and laboratory
2. Tensile test on Mild Steel
3. Hardness testing – Rockwell and Brinell of steel, CI, Brass and Alloy steel
4. Impact testing – Mild steel, Brass and Aluminium
5. Demonstration of NDT
6. Macroscopic examinations – Spark Test and Sulphur Printing
7. Examination of microstructure of Steel
8. Examination of microstructure of C.I.
9. Examination of microstructure of Non Ferrous Alloys
10. Jominy End Quench Test for Hardenability
11. Industrial visit for observing various heat treatment processes

(To be Implemented from Year 2014-15)
PART – I FLUID MECHANICS

RATIONALE

This course is introduced in syllabus in order to get hands on experience of theoretical concepts of fluid mechanics. Course covers flow visualization, flow measurement and pipe losses.

COURSE LEARNING OBJECTIVES

After completion of course student will able to
1. Determine fluid flow with different apparatus.
2. Design piping system.

PREREQUISITE

Student must have knowledge of basic mechanics, physics and mathematics and theoretical concepts in fluid mechanics.

List of Experiments (Any Ten Experiments)

1. Flow visualization by Heshaw apparatus
2. Reynolds experiment
3. Verification of Bernoulli’s equation.
4. Calibration of Notch
5. Calibration of Venturimeter
6. Calibration of Orifice-meter
7. Orifice under steady and unsteady flow condition
8. Determination of major losses in pipes-fittings
9. Determination of minor losses in pipes-fittings
10. Determination of loss head and discharge in parallel pipes.
11. Determination of loss head and discharge in series pipes.
RATIONALE:
This laboratory course is designed to perform testing of lubricants properties like grease penetration, drop point, aniline point, carbon residue etc. This course also covers the demonstration of fire-tube and water-tube boilers, mountings and accessories, methods of refrigeration and air conditioning along with its equipments and controls. Trials on refrigeration bench, ice plant and air conditioning bench have also been included for more clarification.

COURSE LEARNING OUTCOMES:
At the end of the course, the students will be able to –
1. Conduct lubricant test like grease penetrometer, drop point, aniline point, carbon residue.
2. Demonstrate the constructional and working of various fire-tube and water-tube boilers, mountings and accessories.
3. Demonstrate working of various refrigeration and air-conditioning methods/systems along with equipments and controls therein.
4. Conduct trial on refrigeration test bench, ice plant and air conditioning test bench to evaluate the performance.

PREREQUISITE: Basic Mechanical Engineering, Engineering Mathematics, Engineering Chemistry

TERM WORK (Any Ten Experiments)
1. Test on Grease Penetrometer and Dropping Point apparatus.
2. Test on Aniline Point apparatus and carbon residue apparatus.
3. Demonstration of constructional details and working of any one water tube boiler and one fire tube boiler.
4. Demonstration of constructional details and working of any four boiler mountings and three boiler accessories.
5. Demonstration of various methods of refrigeration and its applications.
6. Demonstration of various air conditioning systems.
7. Demonstration of controls in air conditioning and refrigeration.
8. Trial on refrigeration bench.
9. Trial on ice plant.
10. Trial on air conditioning bench.
11. Report on visit to refrigeration and air conditioning plant.

(To be Implemented from Year 2014-15)
AE 2571 MACHINE DRAWING LAB.

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RATIONALE

This subject is introduced as a laboratory course with an objective to complete exercises on details and assembly drawings, conventional representation, production drawing and interpenetration of solids using AutoCAD or suitable drafting software. Free hand sketching is also included in the syllabus in order to make the students aware about the concept to be used during initial stages of product development cycle.

COURSE LEARNING OUTCOMES:

After completion of the course, the students will be able to;

1. Represent the automotive and mechanical components and materials with their conventions
2. Develop an ability to prepare free hand sketches with proportionate dimensions.
3. Apply AutoCAD or similar software for drawing machine components and assemblies
4. Develop an ability to prepare details and assembly drawings as per standard procedure
5. Prepare the production drawing of the given system before it is given to manufacturing

PRE-REQUISITES:

The students are supposed to be well familiar with the basic concepts of engineering drawing as well as they must have studied AutoCAD as a tool for engineering drawing. Before they prepare drawings of mechanical and automotive components and assemblies, students are also expected to have learned their functions and applications. Apart from above, background theoretical concepts of Machine Drawing are supposed to be covered during theory sessions in the class rooms.

CURRICULUM

Sheet No.1 and 2: Conventional Representation

Conventional representation of engineering materials, all types of gears and assemblies, springs, types of threads, square head, splined shaft, diamond knurling, types of sections, symbolic representation of welds, geometrical tolerance symbols, machining symbols etc.

Sheet No.3 and 4: Free Hand Sketching

Various types of nuts, bolts, rivets and riveted joints, keys, couplings, bearings, pulleys, belts, pipe joints, studs and washers etc.
Sheet No.5 and 6: Details an Assembly Drawing

Drawing details and assembly containing maximum ten parts by taking actual measurements on parts (different automotive assemblies should be given to a group of four students.)

Sheet No.7: Production Drawing

Redrawing of assembly of components and entering limits, fits, tolerances, surface finish symbols, geometrical tolerances etc.

Sheet No. 8: Interpenetration of Solids

Interpenetration of prism with prism, prism with cylinder, prism with cone, prism with pyramids, cylinder with cylinder, cone with cylinder etc.
AE 259 MINI PROJECT (ENVIRONMENTAL SCIENCE)

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**COURSE DESCRIPTION:**
Mini project has been incorporated to enhance high potential in the student and built research and positive attitude towards environment related issues, which will help them in their social and technical life ahead. The mini project is designed to make them apply practical knowledge with relevant tools and techniques to solve real life problems related to the environment & industry. It will help students in developing eco-friendly approach to achieve sustainable development.

**Guidelines for Mini Project:**
1. Subject teacher will be project coordinator.
2. The distribution of project group will be done by project coordinator and respective Head of the department to the faculty.
3. Mini project will be a team work, consisting min. 3 to max. 5 students
4. The faculty can guide to student more than one batch (3 to 5 students-one batch) with consideration to load specification. (2 hrs. per week)
5. Project topic should be application oriented and with consideration to Environmental Science problems in their respective stream. Selection and finalization will be through project guide.
6. Prepare project report as per guidelines.
7. Project group must provide complete solution to the selected problem with conceptual clarity.
8. The project will be evaluated by respective branch HOD and project guide and senior faculty.
9. The mini projects should be presented before the committee, which shall evaluate for 100 marks.

**Project report guidelines & evaluation method will be circulated later.**

(To be implemented from Year 2014-15)
AE 2021 NUMERICAL METHODS

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**RATIONALE:**

Basically numerical method is subject is aimed at better understanding of computational methods. This course uses classroom as to enable the students to understand the content. The term work for this subject is aimed at understanding the computational methods to solve problems like linear, non linear, ordinary and partial differential equations, etc. The classroom learning is well supported by tutorial sessions where they to for solve problems using the computational methods.

**COURSE LEARNING OUTCOMES:**

By the end of this course, students will be able to –

1. Formulate and solve the engineering problems using LPP.
2. Solve engineering problems using regression analysis.
3. Apply the basic theory of probability to engineering problems
4. Apply various methods for numerical integration.
5. Solve Differential Equations using computational methods.

**PRE-REQUISITES:**

Student should have basic knowledge of matrix operations and determinant. Students also know basic of linear and nonlinear equations, probability, integration, differential equations, and partial differential equations

**CURRICULUM**

**Unit 1: Algebraic equations:**
Linear Algebraic equations, transcendental equations, System of non-linear Equations, Roots of polynomials-Muller’s Method

**Unit 2: Optimization:**
One-dimensional & Multidimensional unconstrained optimization, Constrained optimization.

**Unit 3: Regression Analysis:**
Least Square Regression, Interpolation
Statistics: Mean and standard deviation, Addition and multiplication laws of probabilities, Binomial, Poisson and normal distribution.
Unit 4: Numerical Integration:

Newton's Cote's Integration of Equation - Trapezoidal rule, Simpson's rules, Integration with Unequal Segments. Romberg's Integration & Gauss quadrature

Unit 5: Ordinary and Partial Differential Equation:

Boundary Value & Eigen Value Problem, Finite Difference Method
Finite difference - Elliptical Equations, Laplace's equation, Parabolic Equations

Unit 6: Finite Element Method:

Finite Element Method - Solutions to boundary value problems, Integral formulation, Applications of FEM

TUTORIALS

Problems based on above numerical methods

TEXT BOOKS

1) Numerical Methods – Dr. B.S. Grewal (Khanna Publications)

REFERENCE BOOKS

3) Manish Goyal “Computer based numerical and statistical techniques”, Laxmi Publication.
5) Larry J. Segerlind, Applied Finite Element Analysis, John Wiley & Sons
6) S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall Publication

(To be Implemented from Year 2014-15)
AE 2041 KINEMATICS OF MACHINES

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RATIONAL

Basically, Theory of Machines deals with study of machines and mechanisms with and without consideration of forces causing motions in them (i.e. kinetics & kinematics). The subject under consideration, i.e. Kinematics of Machines is concerned with kinematics part i.e. study of machines and mechanisms without considering the forces causing motions in them. The major focus is on determination of displacement, velocity and acceleration of different links of the mechanisms using Graphical method. This is required further for kinetic analysis of the mechanisms. Apart from above, generation of cam profile, study of friction and its applications, lower pair mechanisms and governors are the major contents of the syllabus.

COURSE LEARNING OBJECTIVES

By the end of this course, students will be able to –

1. Select appropriate mechanism to design and develop a machine for an application
2. Analyze the mechanisms to determine velocity and acceleration of various links of the mechanism
3. Design and draw profile of the cam to obtain specified follower motion for an application
4. Analyze the governor to determine its height for the corresponding change in speed and sleeve displacement
5. Explain lower pair mechanisms and select them to meet the need where they are suitable
6. Explain and apply friction concepts in automotive and mechanical applications.

PRE-REQUISITES

The students before learning to the Kinematics of Machines are expected to have studied the subjects like Applied Mechanics and Engineering Graphics. This will ensure that the students are aware about the concepts such as vector diagrams and all the basics of engineering drawing. They are supposed to be good at analytical skills which can be enhanced further.

CURRICULUM

1. Basic Concepts of Mechanism

Kinematic links, kinematic pairs - types, kinematic chain, mechanism, constrained motion, mobility of mechanisms, Grubbler’s and Kutzbach criterion, types of kinematic chains and their inversions.

(To be implemented from Year 2014-15)
2. Kinematic analysis of the mechanisms

Velocity and acceleration diagrams for different mechanisms using Relative velocity and acceleration method, Coriolis component of acceleration.

3. Lower Pair Mechanisms

Classification, Pantograph, Exact and approximate straight line mechanisms, steering gear mechanisms, Hooke’s joint

4. Kinematics of CAM

Terminology, types of cams, types of followers, displacement, velocity and acceleration diagrams for various follower motions, generation of cam profile for specified motion of different followers.

5. Friction:

Sliding and Rolling friction, Friction in screw threads, Friction in pivot and collar bearings, Friction clutches, Belt and rope drives, Friction aspects in Brakes

6. Governors:

Types of governors, Porter and Hartnell governor, controlling force and stability of governor, hunting, sensitivity, isochronisms, governor effort and power, insensitiveness of governors.

TUTORIALS

Problems based on above numerical methods

TEXT BOOKS

1. Phakatkar, Theory of Machines I and II, Nirali Publication, Pune

REFERENCE BOOKS

2. V.P. Singh, Theory of Machines, Dhanpat Rai and Sons.
7. Shah and Jadhawani, Theory of Machines, Dhanpat Rai & Sons

(To be implemented from Year 2014-15)
AE 2061 HEAT TRANSFER

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RATIONALE:

In essence, this course is to introduce the Concept of Heat Transfer for engineers. The emphasis is on the basics of modes of heat transfer, Steady state and unsteady state one dimensional conduction, convection over plate and cylinder with natural and forced fluid flow, rate of heat transfer by radiation, radiation shape factor and finally the application of these concept i.e. design of heat exchangers.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to -

1. Apply laws of conduction, convection, radiation and combined modes of heat transfer for simple heat transfer applications.
2. Perform problem formulation and solve 1-D steady and unsteady heat conduction problems.
3. Apply empirical correlations for fully-developed laminar, turbulent internal flows and external boundary layer convective flow problems.
5. Analyze and design of heat exchanger

PRE-REQUISITES:

Student must have knowledge of Engineering Mathematics, physics and Basic Mechanical Engineering.

CURRICULUM

1. Basics and Laws:
   Basics and Laws, Modes of heat transfer, Thermal resistance, Applications of heat transfer.

2. Steady State Heat Conduction with & without heat generation:
   Heat Conduction equation in Cartesian, polar and spherical co-ordinate systems, 1-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, Extended surfaces (fins): Straight fin of uniform rectangular and circular cross section, Fin effectiveness and efficiency, 2-D heat conduction.
3. Transient Heat Conduction:
Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Unsteady state system with negligible internal thermal resistance in comparison to surface resistance, Unsteady state conduction in semi-infinite solid.

4. Convection:
Flow over a flat plate, Laminar forced convection flow over a flat plate, Dimensionless numbers, Forced convection heat transfer in internal flows, Natural convection heat transfer, Dimensional analysis applied to convection heat transfer.

5. Thermal Radiation:
The Stephen-Boltzmann law, The black body radiation, Shape factors and their relationships, Spectral emissive power of black body, Radiation shields.

6. Heat Exchangers:
Principle of working, Classification, Performance variables, Heat exchanger effectiveness, Analysis of a parallel and counter flow heat exchanger, Condensation and boiling boiling modes,

RECOMMENDED BOOKS

2. Heat transfer– C. Gururaja Rao, The Hi tech publishers,
AE 2081 STRENGTH OF MATERIALS

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RATIONALE

Strength of material is offered as the core course at the fourth semester of Automobile Engineering undergraduate program. This is basic and very important subject for structural design of machine components it is divided in three parts i.e. strength and stiffness, third part is related to torsion. Strength criteria consist of elementary theory of simple stresses and strains and combined bending and shear stresses. A stiffness criterion is related to deflection and buckling of beam and columns. Torsion of circular shaft is included in third part.

This course intends to build the competency in the students to apply the strength and stiffness approach to suggest optimum structural design of machine components.

COURSE LEARNING OBJECTIVES

At the end of the course the student will be able to:
1. Apply elementary knowledge of stresses and strains for static analysis.
2. Select appropriate beam section for structural applications.
3. Apply the stiffness criteria for the beam analysis.
4. Compare different columns on the basis of end conditions.
5. Analyze the circular shaft subjected to pure torsion.
6. Apply energy method for structural analysis of solid body.

PREREQUISITE: NIL

CURRICULUM

Unit 1: Stresses and Strain:
Normal and shear stresses and strains, stresses in composite materials, Elastic constants, Thermal stresses.

Unit 2: Bending of beams:
Shear Force and Bending Moment Diagram for cantilever, simply supported beams and overhanging beams.

Unit 3: Stresses in beams:
Bending Stresses in Beams, Distribution of shear stresses in beams of various commonly used sections, combined effect of bending and shear.

(To be implemented from Year 2014-15)
Unit 4: Deflection of Beams & Columns:
Deflection of beams by double integration method and area moment method.
Columns - Euler's formula for different end connections, equivalent length, Rankine formula

Unit 5: Compound Stresses & Strains:
Stresses on inclined planes, principal stresses & strains, Mohr circle of stress & strain, strain rosettes.

Unit 6: Torsion & Energy Methods:
Pure torsion, combined bending and torsion. Strain energy for axial stress, pure bending and shear stresses, use of energy theorem to determine deflections and twists of shafts

TUTORIALS
Problems based on above topics.

RECOMMENDED BOOKS
4. Rajput, Strength of Materials, Laxmi Publication
6. S.B. Junnerkar, Mechanics of structure Vol I, Publication House,
7. Bansal, Charotor Strength of Materials, Laxmi Publication
10. Singer, Strength of Materials, Horper and Bow Publication. New York,

(To be Implemented from Year 2014-15)
AE 2101 FLUID MACHINES

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RATIONALE:

Fluid Machines is one of the basic courses offered in undergraduate Automobile Engineering. The course introduces the students to various Fluid Machines like hydraulic turbines, pumps, compressors, gas turbines, etc. The students learn the constructional features, operational principles, types and performance characteristics of these Fluid Machines.

COURSE LEARNING OUTCOMES:

At the end of the course the student will be able to:

1. Explain construction and working of various fluid machines.
2. Select & justify appropriate fluid machine for given requirement.
3. Compute discharge, heads, power and efficiency for various fluid machines.
4. Interpret effect of various major & minor losses on performance parameters for fluid machines.
5. Plot performance characteristics curves for various fluid machines.

PRE-REQUISITES:

The pre-requisite for study of this subject from students end is that, they must have undergone Basic Mechanical Engineering, Fluid Mechanics. The students must have adequate knowledge about graphical skills and analytical skills.

CURRICULUM

Unit 1: Hydraulic Turbines 6 hrs
Pelton wheel turbine, Francis Turbine, Kaplan Turbine, Performance curves, Governing

Unit 2: Hydraulic Pumps 7 hrs
Centrifugal Pump - Principle, construction, multistage pumps, velocity triangles, minimum starting speed, cavitations, NPSH, priming, heads, efficiencies, power required, performance characteristic.

Reciprocating pumps - Principle, construction, working, indicator diagrams, air vessels, performance characteristic, discharge, power and efficiencies

Unit 3: Reciprocating Air Compressor. 5 hrs
Construction, working, work input, efficiencies, heat rejected, effect of clearance volume, multistage, Optimum intermediate pressure, after cooler, free air delivered.

(To be Implemented from Year 2014-15)
Unit 4: Rotodynamic Air Compressor  
Centrifugal compressor, velocity diagram, efficiencies, effect of compressibility, diffuser, pre-whirl, pressure coefficient, slip factor, performance, Axial flow compressors, construction, working, velocity diagram, degree of reaction, efficiencies, surging, choking, stalling, performance, comparison with centrifugal

TEXT BOOKS

1. Dr. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi publications, New Delhi

REFERENCE BOOKS

AE 2121 ELECTRICAL TECHNOLOGY

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RATIONALE:

DC and AC machines are used in Automobile Industry for electric supply, starting mechanism. Hence, it is very much essential that students should know the performance of DC and AC machines in relevance with automotive applications. Students should become capable of analyzing the characteristics of the machines as well as to test these machines.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to
1. Explain the constructional features of DC and AC machines.
2. Test DC and AC machines used for automobiles.
3. Analyze the AC and DC machine
4. Interpret the characteristics curves of AC and DC machines.

PRE-REQUISITES:

Basic Electrical Engineering

CURRICULUM

1. DC & AC Generators: 6 hrs
   Principal of working, Constructional features, EMF equation, armature reaction, Commutation, Type of DC generators, Voltage regulation, Condition for self excitation, Single phase and three phase alternator, Construction, Armature winding, Voltage regulation, Applications AC Generators in automobiles.

2. DC & AC Machines:
   DC Machines: Torque equation, Characteristics, Speed control methods, Electric braking, Applications, AC Machines: Three phase induction motor - Working principal, Torque equations during starting and running condition, Torque speed characteristics, Speed control methods,

3. Testing and characteristics of DC and AC Machines
   Speed control test of DC motors, Open circuit characteristics test for self excited DC generator, Brake Load test on DC motor, Hamkinson test on DC motor, Swinburnes Test on DC motors, Electrical characteristics such as current v/s speed, current v/s torque, Voltage regulation test on alternator.

(To be Implemented from Year 2014-15)
TEXT BOOKS

1. Mehta and Mehta, Electrical Technology.
2. B.L. Therja, Electrical Technology.

REFERENCE BOOK

1. Clayton, Performance and Design of DC machines
2. M. G. Say, Performance and Design of AC Machines
3. H. Partap, Utilisation of electrical energy,
4. A. K. Sawhney, A Course in Electrical and Electronics measurement and Instrumentation, 11/e, Dhanpat Rai & Sons
5. Fundamentals of the electrical drives: Gopal K Dubey, Narosa publication
AE 2521 FOUNDRY PRACTICES AND ELECTRICAL TECHNOLOGY LAB.

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PART- I: FOUNDRY PRACTICES

RATIONALE:
Automotive Engineering students should be familiar with foundry practices like sand preparation and testing parameters, since many components would be manufactured in the form of castings.

COURSE LEARNING OUTCOMES:
By the end of this course, students will be able to
1. Conduct test on sand for size analysis, grain fineness number, hardness, permeability, moisture percentage, clay content etc.
2. Characterize the sand based on various properties.

PRE-REQUISITES: Casting Techniques

LIST OF EXPERIMENTS (Any five)
Sand testing for given sand and core sand -
1. Size analysis, Grain fineness Number
2. Hardness (mould/core)
3. Permeability
4. Moisture percentage
5. Clay content
6. Given compressive strength

PART – II: ELECTRICAL TECHNOLOGY

RATIONALE:
DC and AC machines are used in Automobile Industry for electric supply, starting mechanism. Hence it is very much essential that students should know the performance of DC and Ac machines in relevance with automotive applications. Students should become capable of analyzing the characteristics of the machines as well as to test this machines.

COURSE LEARNING OUTCOMES:
By the end of this course, students will be able to
1. Test DC and AC machines used for automobiles.
2. Analyze the AC and DC machine
3. Interpret the characteristics curves of AC and DC machines.

PRE-REQUISITES: Basic electrical Engg.

LIST OF EXPERIMENTS
1. O.C.C .of DC generator
2. Load test on D.C. Shunt Generator
5. Determination of Voltage Regulation of alternator.

RECOMMENDED BOOKS
1. B. L. Thereja, Electrical Technology, Volume,
2. H. Partap, Utilisation of electrical energy,
3. A. K. Sawhney, A Course in Electrical and Electronics measurement and Instrumentation, 11/e, Dhanpat Rai & Sons
4. Fundamentals of the electrical drives: Gopal K Dubey, Narosa publication


(To be implemented from Year 2014-15)


AE 2541 FLUID AND THERMAL ENGINEERING LAB.- II

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RATIONALE:

The students conduct trial, observe, sketch, measure and compare the performance of various types of pumps and turbines in first part and estimate the efficiencies of various types of heat exchangers and thermal conductivities of materials in second part of this course.

COURSE LEARNING OUTCOMES:

By the end of this course, students will be able to

1. Determine efficiencies of various fluid machines.
2. Select suitable pump or turbine on basis of performance characteristic curves.
3. Compute thermal conductivities of various materials.
4. Apply free and forced convection concepts.
5. Analyse heat exchangers.

PART - I : FLUID MACHINES

List of Experiments (Any Ten)

1. Trial on reciprocating pump
2. Trial on gear and vane pump
3. Trial on centrifugal pump
4. Trial on Pelton wheel
5. Trial on Francis turbine
6. Trial on Kaplan turbine
7. Trial on reciprocating air compressor
8. Trial on centrifugal blower
9. Trial on axial compressor
10. Trial on gas turbine
11. Industrial Visit to hydraulic device mfg plant/ gas power plant

(To be Implemented from Year 2014-15)
PART - II: HEAT TRANSFER

List of Experiments (Any Ten)

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. To determine natural convection coefficient of vertical cylinder.
4. To find heat transfer coefficient and effectiveness of finned tube heat exchanger.
5. To find heat transfer coefficient and effectiveness of flat plate type heat exchanger.
6. To find heat transfer coefficient and effectiveness of shell and coil type heat exchanger.
7. To find heat transfer coefficient and effectiveness of shell and tube type heat exchanger.
8. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.
9. To measure the emissivity of the gray body (plate) at different temperature and plot the variation of emissivity with surface temperature.
10. To verify the Stefan-Boltzmann constant for thermal radiation.
11. Design of Heat exchanger using CAD and verification using thermal analysis package e.g. I-Deas etc.
12. Prepare C programming for any two experiments.
AE 2561 CAD LABORATORY

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RATIONAL

Modeling software is need of production and design department of industry. Mechanical & Automobile students (Degree/Diploma) have maximum opportunities in the core industries because of modeling software. For meeting ever increasing demands of industry student should have knowledge modeling software.

This course aims to create awareness in the students and give the desired practice of CAD modeling software like CATIA, Solid edge, Unigraphics. This covers part modeling, assembly modeling and drafting.

PREREQUISITE:

Prerequisite for this course is engineering graphics and machine drawing. Also it requires knowledge of manufacturing processes.

COURSE LEARNING OUTCOMES

After completion of this course student will be able to-
1. Develop base feature for modeling of parts.
2. Apply tools for 3D modeling.
4. Develop shop floor drawing in drafting environment.

LIST OF EXPERIMENTS

Term work should consist of minimum six exercises based on modeling using any of the software given below (CATIA/UNIGRAPHICS/Pro-E/Solid works), which covers -

- 2D modeling.
- 3D modeling.
- Assembly.
- Drafting.

(To be implemented from Year 2014-15)
SH 2511 PROFESSIONAL SKILLS DEVELOPMENT - I

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RATIONALITY
The objective of this course is to enable students to acquire and enhance communication and professional skills required for personality development, corporate and business world and to become successful entrepreneur. During the practical sessions, it is expected that the contents of all modules should be delivered to the students of different batches and assignments to be given based on the modules. Students must demonstrate the acquired skills by means of giving presentations (oral/written), group discussions, interviews, etc.

Course Learning Outcomes:
Students will be able to:
1. Improve level of linguistic competency with respect to listening and speaking.
2. Comprehend and use the skills required as a professional working in the Engineering Industry.
3. Prepare and deliver a presentation on technical issues.
4. Be able to use body language effectively.
5. Develop competencies required for effective communication.

Course Prerequisite: A Student, who is going to enroll himself for this course, should have following English language abilities:
1. A student should have adequate knowledge of English as a language.
2. A student should have an introduction to various registers in English language.
3. A student should have basic engineering aptitude.

Details of the Practical

1. Communicative Concepts: Greeting people; Inviting people; Leave taking; Likes and dislikes; Agreement and disagreement; Expressing – joy, fear, surprise, worry; Opinions, beliefs, disbeliefs; Possibility and ability; Prediction and probability; Permission.

2. Natural English: Begin the conversation, Keep the conversation moving, Ask questions, Receive visitors, Asking for information, Making offers, Friendly warnings and instructions, Giving advice and making suggestions.

3. Interpersonal Skills: Self-esteem and strategies for developing self-confidence; SMART goal setting; Dealing with emotions – anger, conflict, depression; Developing assertiveness.

4. Lifelong Learning: Steps in lifelong learning, Tips to achieve effective learning, Challenges in lifelong learning, Misconceptions about lifelong learning.

(To be Implemented from Year 2014-15)
5. **Body Language**: Non verbal communication – Eye contact, Facial expressions, Gestures, Posture and body orientation, Proximity, Vocal; Non-verbal behaviour interpretation.

6. **Acting Ethically**: Ethics and self-righteousness, Right and wrong in the workplace, Striving for integrity.

7. **Creative and Critical Thinking**: Developing your creativity, Factors that block creativity, Creativity in workplace, Importance of critical thinking.

8. **Entrepreneurial Skills Development**: Entrepreneurial competencies, Entrepreneurship in daily life, Venture project planning.

**Recommended Readings:**


3. *Soft Skills: Module 1 to 5* (Infosys Campus Connect Programme)