SYLLABUS
FOR
B.TECH. DEGREE
IN
MARINE ENGINEERING

KUNJALI MARAKKAR SCHOOL OF MARINE ENGINEERING
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
KOCHI – 682 022
# COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
KUNJALI MARAKKAR SCHOOL OF MARINE ENGINEERING, COCHIN -22

## B.Tech. Degree Course: MARINE ENGINEERING

### Scheme of Examination

<table>
<thead>
<tr>
<th>Courses No.</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Max. Marks</th>
<th>Total</th>
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<tr>
<td><strong>Combined I &amp; II Semesters</strong></td>
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<td>MRE 101</td>
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<td>Engineering chemistry</td>
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<td>MRE 111</td>
<td>Computer Programming Lab</td>
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| **Semester III** |                                          |                |            |       |
|                 |                                          | **21  9  6**    | **450  800** | **1250** |
| MRE 301         | Engineering Mathematics - III            | 3  1  50       | 150        |       |
| MRE 302         | Electrical Technology                    | 5  1  50       | 150        |       |
| MRE 303         | Thermodynamics and Heat transfer         | 4  1  50       | 150        |       |
| MRE 304         | Mechanics of Solids                     | 4  1  50       | 150        |       |
| MRE 305         | Fluid Mechanics and Machinery            | 4  1  50       | 150        |       |
| MRE 306         | Machine Drawing                          | 1  4  50       | 150        |       |
| MRE 307         | Fluid Mechanics and Machinery Lab        | 2  50  50      | 150        |       |
| MRE 308         | Material Testing Lab                     | 2  50  50      | 150        |       |
| MRE 309         | Workshop Practices - II                  | 2  50  100     | 150        |       |

| **Semester IV** |                                          |                |            |       |
| MRE 401         | Mechanics of Machinery                   | 4  1  50       | 150        |       |
| MRE 402         | Production Technology                    | 4  50  100     | 150        |       |
| MRE 403         | Metallurgy and Material Science          | 5  50  100     | 150        |       |
| MRE 404         | Marine Electronics                       | 4  50  100     | 150        |       |
| MRE 405         | Marine Auxiliary Machinery - I           | 5  50  100     | 150        |       |
| MRE 406         | Seamanship and Navigation                | 3  50  100     | 150        |       |
| MRE 407         | Ship Technology                          | 4  50  100     | 150        |       |
| MRE 408         | Electrical Machines Lab                  | 3  50  50      | 150        |       |
| MRE 409         | Workshop Practices - III                 | 3  50  50      | 150        |       |
| **Total**       |                                          | **29  1  6**    | **450  800** | **1250** |

CUSAT B.Tech. Degree Syllabus for Marine Engineering
<table>
<thead>
<tr>
<th>Semester V</th>
<th>Course</th>
<th>Credits</th>
<th>Lab</th>
<th>Theory</th>
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<td>MRE 501</td>
<td>Dynamics of Machinery</td>
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<td>Marine Boiler and Steam Engineering</td>
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<td>MRE 608</td>
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MODULE I

**Differential calculus:** Continuity and differentiability of functions of one variable, Rolle’s theorem, Mean value theorem, Cauchy’s theorem, L’Hospital’s rule for the evaluation of limits of indeterminate forms. -4 hrs

**Application of derivatives:** Rate measure, Error, Extreme, Curvature, Asymptotes. -4 hrs

**Successive Differentiation:** Higher order derivatives, nth order derivatives, nth order derivative of rational functions and partial fraction, Leibniz formula for the nth derivative of the product of two functions, nth order derivative of the product of powers of sines and cosines. -6 hrs

MODULE II

**Function of more than one variable:** Partial differentiation, chain rule, Euler’s theorem for homogenous function, differentials and their applications in errors and approximations, Jacobians-Maxima, minima of functions of two variables. Lagrange multipliers, Exact differentials. -8 hrs

**Calculus of variations:** The Brachistochrome problem, Euler-Lagrange development, applications of Euler’s equation, several dependant variables, application to discrete mechanics, the Isoperimetric problem. -6 hrs

MODULE III

**Co-ordinate geometry of two dimensions:** Standard equations of parabola, ellipse and hyperbola, their parametric representations, equations of tangents and normals to these curves, simple properties of these curves, asymptotes of a hyperbola, rectangular hyperbola. -12 hrs

MODULE IV

**Definite Integrals:** Reduction formula for \( \sin^n x, \cos^n x, \sin^m x \cdot \cos^n x \) applications of definite integrals in the evaluation of length arcs, areas, area of surface of revolution and volumes. -7 hrs

**Multiple Integrals:** Evaluation of double and triple integrals, volumes and surface areas of solids using multiple integrals. -6 hrs

MODULE V

**Vector Algebra:** Scalar and vector product, orthogonal triad, scalar triple product, Linear dependence of vectors, other repeated products, identity of Lagrange, Reciprocal system. -6 hrs

**Vector differential calculus:** Scalar and Vector point functions, their derivatives, curves, gradient, divergence and curl, their physical meanings. conservative force fields, scalar potential. -6 hrs

Reference:

5. Calculus and Anlytic Geometry: G.B. Thomas, Addison Wesley
7. Advanced Mathematics for Engg. : S. Narayanan, Manickavachagom Pillai & Dr. G. Ramanaiah
MRE 102 ENGINEERING MATHEMATICS II (66 hrs)

MODULE I
Matrix Algebra: Concept of rank of matrix, Echelon and normal form, liner systems of algebraic equations, consistency, Gauss elimination method, homogenous system of equation, Eigen values and eigen vectors, Cayley-Hamilton (no proof), eigen values of Hermitian and skew-Hermitian and unitary matrices, real quadratic forms, diagonalisation of quadratic forms.


MODULE II

Ordinary differential equations of higher order: Linear equations with constant coefficients, methods of solution of these equations, solution of homogeneous and non-homogeneous simultaneous linear differential equations, phase plane, critical points, stability.

MODULE III
Fourier Series and Fourier Integrals: Periodic functions, Euler formulae for Fourier coefficients, Functions having arbitrary period even and odd functions, half range expansions, Fourier integral. Gamma and Beta functions, error functions – definitions and simple properties.

MODULE IV
Laplace transforms: Linearity property, transforms of elementary functions, Laplace transforms of derivatives and integrals, differentiation and integration of transforms, convolution theorem (no proof), use of Laplace transforms in the solution of initial value problems, unit step function, impulse function – transform of step functions, transforms of periodic functions.

MODULE V


Special Distributions: Binomial, Poisson and Normal distributions and their properties. \( \chi^2 \) Distribution, t and F distribution. Problems and Applications.

Reference:
2. Advanced Engineering Mathematics : Erwin Kreyszig
3. Mathematicsl Methods : Potter, Goldberg (Prentice Hall)
7. Advanced Mathematics for Engineering : S. Narayanan, Manickavachagom Pillai & Dr. G. Ramanish

CUSAT B.Tech. Degree Syllabus for Marine Engineering- Sem I
MRE 103 ENGINEERING PHYSICS (60 hrs)

MODULE I
Interference of light: Interference of thin films, colours of thin films – Newton’s rings (reflected system) – determination of wave length and refractive index. Air wedge-diameter of thin wire-Testing of plainness of surfaces. -12 hrs

MODULE II
Diffraction: Fresnel and Fraunhofer diffraction-Zone place-place diffraction grating-Measurement of wave length-Dispersive of power of grating. Resolving power-Raleigh’s criterion-Resolving power of telescope and gratin. -6 hrs

MODULE III
Electronic waves-Production, properties and application.
Recording and reproduction of sound-Magnetic tape recording sound recording on cine films. -6 hrs

MODULE IV
Fiber optics and its applications: General ideas of optical fiber-NA of fiber-step index and graded index of fibers-multimode and single mode fibers-applications of optical fiber-optic communication-optical fiber sensors-general ideas of intergraded optics. -10 hrs

MODULE V
Marine Physics: Gyroscope; gyroscopic effect, gyro compass, SONAR, repeaters, Echo sounder, Ultra sonic-use of ultra sound to measure the depth, flaw detection.
Dielectrics: Types and applications -8 hrs
Superconductivity: Transition temperature-Meissner effect-Isotope effect-Type I and type II-super conductors-B.C.S. theory (qualitative study)-High temperature super conductivity (General idea)-Josephson effect-SQUIDS. -4 hrs

Reference
Modern Physics : J.B. Rajan
Optics and Automatic Physics : Sathyaprakash
Modern Physics : Theraja
Solid State Physics : Charles Kittel
Optical Fibre Communication : Agarwal
Optics : Ajoy Ghatak
MRE 104 ENGINEERING CHEMISTRY (68 hrs)

MODULE I
Environmental pollution: Pollution of water-Domestic sewage and Industrial wastes-Air pollution-Causes and control. -4 hrs

MODULE II
Corrosion: Theories of Corrosion - Factors influencing corrosion - Corrosion control - Anodic and Cathodic protection. -4 hrs
Protective coatings: Metallic coatings-hot dipping, electroplating, metal spraying, cladding, Non-metallic coatings-Properties and functions of ingredients used in Paints-Varnishes, Enamels and Lacquers-Special paints. -4 hrs

MODULE III
Electrochemistry: Electrode potentials and Electromotive Force-Nemst's equation for single electrode potentials-Measurement of e.m.f. and electrode potentials-Standard hydrogen electrode-E.M.F. series of metals-concentration cells-Commercial cells primary cell like simple Voltaic cell, Daniel cell, Laclanche cell and Weston Cadmium cell-secondary cells-Lead-Acid and Edison cell-Fuel cells-Hydrogen-Oxygen fuel cell-Applications of e.m.f. measurements-Determination of PH and potentiometric Titrations. -10 hrs

MODULE IV
Lubrication and Lubricants - Theories of friction and Mechanism of Lubrication - classification and properties lubricants - production of Lubricating oils - additives of lubricating oils - Synthetic lubricants, Greases, Solid Lubricants. -6 hrs

MODULE V
High Polymers: Classification of High Polymers-production of high polymers-general methods-Some important plastics, their production, properties and uses-Polystyrene, Teflon, Acrylis, Nylon, Polyesters, Phenol Formaldehyde Resins, Urea Formaldehyde Resins and silicones-compounding and moulding of high polymers. -8 hrs
Plastics and Rubber: Thermoplastics and thermosetting plastics. Natural rubber, production and properties, Compounding and Vulcanization of Rubber. Synthetic Rubbers – Buna Rubbers, Butyle Rubbers, Neoprene Thiokols, Polyurethane and a Silicons Rubbers. -6 hrs

References
Chemistry in Engineering & Technology Volume II: J.C. Kuriakose & Rajaram
Chemistry of Engineering Materials: C.V. Agarwal
Engineering Chemistry: P.C. Jain & Monika
Chemistry of Engineering Materials: L. Munroe
Chemistry of Engineering Materials: Leighou
Chemistry of Engineering Materials: Paul & Salger
Chemistry of Engineering Materials: M. Uppal
MRE 105 ENGINEERING MECHANICS (94 hrs)
A) STATICS

MODULE I
Concurrent forces in a plane: Principles of Statics. Composition and resolution of forces, Equilibrium of concurrent forces in a plane. Method of projection. Method of moments. -8 hrs
Friction: Static and kinetic friction, laws of friction, effort required to pull a body up or down an incline. Friction in square and V-threaded screws, friction in pivots and collars, conical bearing and thrust bearing plates. -6 hrs

MODULE II
Properties of areas: Centroids of composite plane figures and curves. Moment of inertia of a plane figure with respect top an axis in its plane. Polar moment of inertia, Product of inertia, Principal axes. Mass moment of inertia of material bodies, Radius of Gyration, Product of inertia of material bodies. -16 hrs

MODULE III
General case of forces in a plane: Composition of forces in a plane, Equilibrium of forces in a plane. Plane trusses: Method of joints. Method of sections. Plane frames: Method of members. -12 hrs
Principal of virtual work: Equilibrium of ideal systems, stable and unstable equilibrium. -6 hrs

B) DYNAMICS

MODULE IV

MODULE V

MODULE VI

REFERENCES:

CUSAT B.Tech. Degree Syllabus for Marine Engineering- Sem I
MODULE I

Introduction to Technical Drawing: Drawing instruments and their use, Lettering, dimensioning, types of lines, Indian Standard Code of Practice for general engineering drawing. -6 hrs

Scales: Plain Scale, Vernier Scale, Diagonal Scale. -4 hrs

Curves used in Engineering practice: Conic Sections – Construction of ellipse, parabola, hyperbola – construction of cycloid, involute, Archimedian spiral and logarithmic spiral – drawing tangents and normals to these curves. -8 hrs

MODULE II

Orthographic Projections: Plane of projection of first angle and third angle projections, projection of points in different quadrants. -4 hrs

Orthographic projection of straight lines: Lines parallel to one plane and inclined to the other plane, straight lines inclined to both the planes, true length and inclination of lines with reference planes, traces of lines. -8 hrs

Projection of plane lamina: Projection of plane lamina of geometrical shapes in oblique positions. -4 hrs

MODULE III

Projection of solids: Projection of solids with axis perpendicular to one plane, axis parallel to both plane, axis inclined to horizontal or vertical planes and parallel to the other plane, axis inclined to both planes -10 hrs

Section of Solids: Projection of solids sectioned with planes perpendicular to H.P. or VP, inclined to axis of the solids. Drawing true shape of the section. -6 hrs

MODULE IV

Development of surface: Developing the surface of prisms, cylinders, pyramids and cones. -8 hrs

Intersection of surfaces: Drawing the curves of intersection prism to prism, intersection of cylinder to cylinder and intersection of cylinder to cone. -8 hrs

MODULE V

Isometric projection: Isometric scales, isometric views, isometric projections of prisms, pyramids, cylinders, cones and spheres. Sectional views of simple machine components in isometric. -10 hrs

Perspective projections: Visual ray method and vanishing point method of perspective projection of circles, prisms and pyramids. -6 hrs

REFERNECES

2. Elementary Engineering Drawing house N.D. Bhat, Charotar Publishing House,

CUSAT B.Tech. Degree Syllabus for Marine Engineering- Sem I 10
MRE 107 FUNDAMENTALS OF ENGINEERING – I (91 hrs)
(A) MECHANICAL ENGINEERING

MODULE I

MODULE II
Ideal Gas cycles: Air standard efficiency of Otto cycle, Diesel Cycle, Dual Cycle, Brayton Cycle. 4 stroke and 2 stroke cycles, indicator diagram, compression ratio and thermal efficiency. Indicated power, brake power, frictional power, Mechanical efficiency, specific fuel consumption, Energy balance. -12 hrs

MODULE III
Steam and Two Phase System: Phase equation of steam, Temperature – Pressure diagram, Triple point, Specific Enthalpy and Entropy, Use of steam tables and charts, Pressure – volume , Enthalpy- Entropy diagrams, Internal Energy of vapours, Super critical vapours, non flow process with steam. -10 hrs

Boilers and evaporators: Boiler Calculations, Boiler thermal efficiency and equivalent evaporation of boiler, Basic calculations on the effect of condenser leakage and impure feed, dissolved solid and scale in Boilers, Density of water and its control in Boilers and evaporators. Basic calculations on performance of single effect, multi effect and flash type evaporators. -7 hrs

(B) ELECTRICAL ENGINEERING

MODULE IV
Basic Principles of Electric Circuits: Review of Ohms law – Definitions of resistance, current, voltage and power series and parallel circuits – constant voltage source and constant current source. Maximum power transfer and grouping of cells. -8 hrs

Network Theorems: Kirchoff’s laws – Network analysis by Maxillas circulation currents, Thevenin theorem, super – position theorem, Norton’s theorem, simple illustrative problem on network theorems. -6 hrs

MODULE V
Electrostatics: Coulomb’s Law, Electric field strength and Electric flux density, capacitance. Magnetic circuits: magnetic fields of a coil – Ampere turns and its calculations, magnetic flux, flux density, field strengths. Hysteresis, magnetic leakage and fringing, magnetic circuits involving air gaps. -8 hrs

Electromagnetic Induction: Faraday’s Law, Lenz’s Law, self and mutual induction, energy stored in a magnetic field. -6 hrs

MODULE VI
AC Fundamentals: Generation of alternative voltage and current, equations of sinusoidal voltage and current, wave form, cycle frequency, time period, amplitude, phase difference r.m.s. value, average value, power factor, form factor, vector diagram using r.m.s. values, sine waves in phase and out of phase. -8 hrs

A.C. Circuits: RC, RL, RLC circuits, series and parallel current, voltage and power relationships. Poly phase circuits: vector representations, phase sequence, stat and delta connections. -8 hrs

References:
1. Engineering Thermodynamics: P.K. Nag
3. Engineering Thermodynamics: Van Wylon
4. Thermal Engineering: P.L. Ballancy
5. Electrical Technology: ELBS

CUSAT B.Tech. Degree Syllabus for Marine Engineering- Sem I
MRE 108 FUNDAMENTALS OF ENGINEERING II (90 hrs)

(A) MEASUREMENTS

MODULE I
Basic requirements of measuring instrument, control and damping devices. Moving coil, moving iron, dynamometer and thermocouple type of ammeters, voltmeters and wattmeters. Extension of instrument range.

-18 hrs

MODULE II
Single phase and three phase wattmeter for power measurement
Measurement of energy.
Measurement of speed, frequency and phase difference.
Measurement of resistance, inductance and capacitance by Bridge Method.
Magnetic measurement, localization of cable faults.

-14 hrs

MODULE III
Transducers and its application in the measurement of pressure, flow and temperature.
Simple electronic measuring devices such as CRO, IC Tester, Signal generators, Timers etc.
Illumination and its measurements

-12 hrs

(B) ELECTRONICS ENGINEERING

MODULE IV
Electron Emission: Thermionic emission, Photoelectric emission, electric field emission and their applications.
Semiconductors: Types, electrical characteristics, diffusion and drift, mobility, Varistors, Thermistors and Non linear resistors.
Semi conductor Diodes: Characteristics of diodes, diode as a rectifier, Zener diodes, tunnel diodes.
Transistors: The junction transistor and its basic characteristics. The transistor as a switch, The transistor as an amplifier, Stabilised biased circuits, Self biased, low and high frequency responses. Effect of positive and negative feedback in transistor amplifiers

-4 hrs
-4 hrs
-3 hrs
-7 hrs

MODULE V
JFET & MOSFET, BJT, UJT, SCR, Full wave and bridge rectifiers, TRIAC, DIAC.
Regulated Power Supplies: Series Regulators, Shunt Regulators, PNM Regulator.

-6 hrs
-6 hrs

MODULE VI
Oscillators: Requirements for oscillations, phase shift scillator, Wein Bridge Oscillator, Crystal Oscillators.
Wave Shaping and Switching: Clipping, Clamping, time base or Sweep Generator, Multivibrators & Schmitt Triggers.

-10 hrs
-6 hrs

References:
1. Measurements: Doblin
3. Electronics Devices & Circuits: G.K. Mithal
4. Solid State Electronics Devices: Streetman

CUSAT B.Tech. Degree Syllabus for Marine Engineering- Sem I
MRE 109 COMPUTER FUNDAMENTALS (80 hrs)

MODULE I
Introduction of Computer Organization: Central Processing Unit, Memory, Input-Output devices. Secondary storage devices, machine language, assembly language, and high level language, system software, operating system, BIOS, DOS, GUI based OS (Windows), Compilers and assemblers, General introduction to computer network, LAN, WAN, MAN, INTERNET. -16 hrs

MODULE II
Introduction to programming in C: Fundamental data types – integer, floating point and enumerated data types, Expression – arithmetic, relational and logic operations, type convention – simple and compound statement, IF, SWITCH, WHILE, DO WHILE, FOR, BREAK, CONTINUE, GOTO, RETURN statements. -16 hrs

MODULE III
Function: Declaration and functions, parameter passing mechanism, storage classes – scope, visibility and life time of variables, AUTO, EXTERN, STATIC and REGISTER modifiers, Recursion. -16 hrs

MODULE IV
Arrays: Single and multi dimensional arrays, storing, selection sort, search-linear search and binary search, Structures to union, pointer and addresses, pointer arrays, function returning pointers, pointers to function, pointer arithmetic, pointer to structures, arrays of structures, preprocessor directive, command line arguments, type def. -16 hrs

MODULE V
Introduction to DBMS: Relational, network and hierarchical models (description only).
Introduction to relational algebra and SQL.
Object Oriented Programming (OOP): OOP concepts and fundamentals, encapsulation, definition of an object, inheritance and multiple inheritance, attributes and methods, polymorphism, Interfaces, class diagrams, virtual functions. -16 hrs

Reference:
1. Computers and Common Sense: Roger Hunt and Jihn Shelly (PHI)
2. Internet for everyone: Leon & Leon (Leon Tech World, Chennai)
3. Programming in C: B.S. Gotfried (Schaum seris, TMH)
MRE 110 HUMANITIES (72 hrs)

MODULE I
-14 hrs

MODULE II
Official and Business Communication: Downward communication, Upward communication, Horizontal communication. Comprehension: Comprehension of ideas in a passage, expansion of an idea for a particular purpose. Summarizing a passage for official usage, communicating a given idea to suit different contexts. Report writing—importance of reports, preparing a report technical report writing.
-15 hrs

MODULE III
Society: Definition, function, Norms, Social Groups, Community, Associations, Customs, Folkways, Mores, Social Norms, Race, Caste, Class and conflict.
-3 hrs
Social Changes & Social Institutions: Theory, characteristics, social progress and control, Definition of Institution, Family, Educational institutions—its aims, problems, standards, Religion—Functions; Secularism; Communism, industry, Markets.
-3 hrs
Ethical and Social Values: Ethics, values; Human spirit, moral values; Code of conduct, Cultural Advancement, Rationalism, Social values, Laws, Justice, Liberty, Equality & Fraternity.
-3 hrs
-6 hrs

MODULE IV
-7 hrs
Science in the 20th Century: The transportation and communication revolution, Indian Science and Technology in the post independence period. Achievements in the fields of agriculture, space and atomic energy.
-6 hrs

MODULE V
Social Welfare & Welfare State: Planned economy, Democratic planning in a developing country frame work, Prerequisite limitations, five year plans. meaning of economic planning, need for planning in under developed countries, achievements and failure of economic planning.
-4 hrs
Industrial Psychology: Aims, Motivation, Ethical & social values in human relations, environment, safety, Pollution. Productivity and efficiency methods, Participative management.
-4 hrs
-7 hrs

Reference:
2. Business Communication: Gyani (Jeevandeep, Prakashan, Bombay)
3. Industrial Economics: R.R. Barthwalk

CUSAT B.Tech. Degree Syllabus for Marine Engineering—Sem I

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<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Author/Source</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>Economics - An Introductory Analysis</td>
<td>Paul A. Samuelson</td>
</tr>
<tr>
<td>5</td>
<td>Science in History</td>
<td>J.D. Bernal (Penguin Books Ltd.)</td>
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<tr>
<td>6</td>
<td>History of Science</td>
<td>W.C. Dampier (Cambridge University Press)</td>
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<tr>
<td>7</td>
<td>History of Science</td>
<td>History of Technology, Encyclopedia Britannica.</td>
</tr>
</tbody>
</table>
1. Evaluation of a polynomial for single and multiple values.
2. Lowercase to uppercase text conversion (using while, do-while, for statements).
3. Averaging a set of numbers.
4. Repeated averaging a set of numbers.
5. Calculating averages for different sets of numbers using nested loops.
6. Programs of lowercase to uppercase character conversion using function.
7. Programs illustrating switch and break statements.
8. Largest and smallest of a set of numbers using function.
9. Calculating factorial of a +ve number using function
12. Programs illustrating relationship between array elements & their addresses.
13. Adding two tables of numbers.
15. To design a simple class object.
MECHANICAL WORKSHOP
1. Fitting Shop
2. Sheet metal Shop
3. Smithy Shop
4. Welding Shop
5. Carpentry Shop
(Preliminary exercises for beginners in all shops. Specific models may be designed by the teachers)

ELECTRICAL WORKSHOP
1. Determination of equivalent resistance under (a) series and (b)parallel and (c) series – parallel connections.
3. Continuity test by ohmmeter and multi-meter.
4. Study of constant current source.
5. Measurement of high resistance.
7. Calibration of voltmeter (dc&ac).
8. Volt-ampere characteristics of lamps.
9. To study the connections of a fluorescent tube with electromagnetic ballast (To measure input power, voltage and current and to compute power loss in the ballast resistor).
10. To study the connections of a fluorescent tube operated from a 220 V dc mains. (To measure input power, voltage and current and to compute power loss in the ballast resistor).
12. Wattmeter connections and measurement of power.
13. Localisation of faults in electrical circuits.
15. Characteristics of an ac parallel circuit and set to resonance.
17. Hospital wiring.
18. Gowdown wiring.
19. Different types of joints.