## UNIVERSITY OF MUMBAI

### SEMESTER – I

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APPLIED MATHEMATICS-I

Lectures per week: 5                                                                                                      Theory: 100 marks

DETAIL SYLLABUS

1. Complex numbers

- Idea of Argand diagram (Problems based on Geometry are not expected) Cartesian, Polar and Exponential form of complex number.
- De’Moivre’s theorem (without proof), Power and roots of exponential and trigonometric functions.
- Hyperbolic and logarithmic functions, inverse trigonometric functions.

- Separation of real and imaginary parts of all types of functions

2. Vector algebra and vector calculus

- Vector triple product (proof is not expected), product of 4 vectors.
- Differentiation of a vector function of a single scalar variable. Proofs of theorems on derivatives of sum and product are not expected.

- Curves in space, Serret Frenet formulae (without proof), curvature, torsion, osculating plane, normal plane and rectifying plane.

3. Mean value theorems

- Rolles theorem, Lagrange’s and Cauchy’s mean value theorem (Proofs are not expected but geometrical interpretations are expected)
- Taylor’s and Maclaurin’s theorem (without proof), Taylor’s and Maclaurin’s series.

4. Differential calculus

- Successive differentiation of $n^{th}$ derivatives of function such as $(ax+b)^m$, $(ax+b)^{-1}$, $e^{ax}$, $\sin(ax+b)$, $\cos(ax+b)$, $\log (ax+b)$, $e^{ax}\sin (bx+c)$, $e^{ax}\cos (bx+c)$

- Leibnitz theorem (without proof), Expansions of power series, indeterminate forms and L’ Hospital rule.

5. Partial differentiation

- Partial derivatives of first and higher order, total differentials, composite functions and implicit functions
- Euler’s theorem on homogeneous functions with two and three independent variables (with proof), deductions from Euler’s theorem.
- Errors and approximations, Maxima & minima of a function of two variables.
RECOMMENDED BOOKS

- Higher Engineering Mathematics – Dr. B.S. Grewal, Khanna Publications
- Applied Mathematics-I - Dr. B.V. Jungam, K.P. Patil, Mrs. N.M.Kumthekar, Nandu Publications.
APPLIED SCIENCES-I

Lectures per week: 4                                              Theory: 100 marks
Practicals per week: 2                                              Term Work: 25 marks

DETAILED SYLLABUS

SECTION I - APPLIED PHYSICS

1. Solid State Physics:
   · Crystal structure: structure of cubic crystals, special form in cubic crystals, diamond structure,
     Barium Titanate Miller indices, planes & directions, Legacy and critical radius ratio in tonic
     crystals.
   · Formation of energy brands and classification of solids, conductor, semiconductor, insulator,
     Physics of semiconductor junctions, (bipolar) photo diode.
   · C-B characteristics, concept of fermi-level, energy gap, temperature dependence.

2. Sound waves:
   · Audible, ultrasonic and infrasonic waves propogation, piezo-electric effect, principles of
     ultrasonic transducers and oscillations, production of ultrasonic waves, echo sounding, thickness
     measurement, cavitation and non-destructive testing and flow detection.

3. Electricity and Magnetism:
   · Motion of charges, particles in electric and magnetic fields, magnetic and electro-static focusing
     system and its use in CRO, use of CRO for measuring amplitude of D.C. and A.C., voltage and
     phase difference between two A.C. sinusoidal voltages

4. Quantum Physics:
   · Introduction to wave nature of particles, De Broglie waves.

SECTION II – APPLIED CHEMISTRY

5. Water and its Treatment
   · Introduction to hard and soft water
   · Hardness: types, units, estimation be EDTA method, numericals, understanding effect of hard
     water in various industries.
   · Softening of water
   · Lime-soda process, Zeolite – Permutit method, ion exchange method, comparison of methods,
     numerical problems based on lime-soda and Zeolite process.

6. High polymers & elastomers:
   · Introduction & definition of polymers and elastomers
• Classification of polymers: homopolymer & copolymer, linear branched and cross linked, organic and inorganic
• Types of polymerization: addition (e.g. polyethylene, polypropylene), condensation (e.g. phenol formaldehyde, urea formaldehyde, urea formaldehyde)
• Plastics: classification (thermoplastic and thermosetting), compounding of plastics, fabrication of plastics - compression, extrusion, transfer and injection moulding, industrial applications.
• Rubber structure – Cis and trans isomer, properties and drawbacks, vulcanization - mechanism, agents, advantages, effects on properties, synthetic rubber – manufacture, properties and uses of polyurethane, silicon rubber.

7. Pollution and pollution control:

• Definition of pollution and pollutant
• Introduction to atmospheric pollution: nature of atmospheric pollutants and their effect, methods of reducing atmospheric pollution in brief
• Introduction to water pollution: nature of water pollutants and their effect, methods of reducing water pollution in brief

8. Introduction to lubricants:

• Definition of lubricants, lubrication, purpose of lubrication
• Classification of lubricants with examples: solid, semi-solid, liquid, blended, synthetic
• Mechanism of lubrication – thick film, thin film and extreme lubrication
• Properties of ideal lubricant (definition and significance) – viscosity, viscosity index, flash and fire point, cloud and pom point, saponification value, acid value, numerical problems on saponification value and acid value

TERM WORK

Each student has to appear for at least one written test during the term. Report on experiments conducted (at least five each based on above syllabus of Section-I and Section-II), assignments consisting of minimum ten numerical problems covering the syllabus, along with the graded answer paper shall be submitted as term work. The distribution of term work marks will be as follows:-

Report on experiments demonstrated, assignments: 15 marks; Written Test: 10 Mks

RECOMMENDED BOOKS

Concept of Modern Physics – Arthur Beiser, Tata McGraw Hill
Modern Physics – J.B. Rajam, S. Chand & Co.
Environmental Chemistry – B.K. Sharma, Goel Publishing House

Engineering Chemistry – S.S. Dara, S.Chand and Co.
Lectures per week: 6  
Practicals per week: 3  
Theory: 100 marks  
Term Work: 25 marks  

DETAILED SYLLABUS

SECTION I - STATICS

1. System of coplanar forces:
   - Resultant of (i) Concurrent forces, (ii) Parallel forces and (iii) Non-concurrent non parallel system of forces. Moment of force about any point, couples, Varignon’s theorem, Distributed forces in plane.

2. Equilibrium of System of coplanar forces:
   - Conditions of equilibrium for (i) Concurrent forces, (ii) Parallel forces, (iii) Non-concurrent non-parallel (general) system of forces and couples.
   - Types of supports, determination of reactions at supports for various types of determinate structures (with/without internal hinge)
   - Centroids of plane areas. Center of gravity of wires bent into different shapes.
   - Analysis of determinate pin jointed plane frames by method of joint and method of sections.

3. Forces in space:
   - Resultant of (i) Concurrent forces, (ii) Parallel forces & (iii) General force system. Moment of a force about a point, finding scalar and vector components of the force & the moment of the force about an axis.

4. Friction:
   - Laws of friction, Cone of friction, Equilibrium of bodies on inclined plane, Application to problems involving wedges and ladders, Screw and belt friction-only simple type involving tension on both side of pulley to be covered.

5. Principle of virtual work:
   - Equilibrium of an ideal system, Applications to link systems with single degree of freedom only.

SECTION II – DYNAMICS

6. Kinematics of particle:
   - Rectilinear motion, acceleration time and velocity time graphs & their uses.
   - Velocity and acceleration in terms of rectangular co-ordinate system. Motion along plane curved path, tangential & normal components of acceleration, projectile motion, simple harmonic motion.

7. Kinematics of rigid bodies:
• Relative velocity, translation, pure rotation & plane motion of rigid bodies, link mechanism, instantaneous center of rotation for the velocity & velocity diagrams for bodies in plane motion.

8. **Kinetics of particles & kinetics of rigid bodies:**

• D’Alembert’s principle, equation of dynamic equilibrium, linear motion, curvilinear motion.
• Area moment of inertia, parallel axis theorem, perpendicular axis theorem, mass moment of inertia about centroidal axis and about any other axis. D’Alembert’s principle for bodies under rotational motion about a fixed axis and plane motion. Application to motion of bars, cylinders, spheres only.
• Linear momentum, impulse momentum, principle of conservation of momentum, impact of solid bodies, elastic impact, semi-elastic impact and plastic impact, work done by a force, potential and kinetic energy and power work-energy equation, principle of conservation of energy.

**TERM WORK**

Each student has to appear for at least one written test during the term. At least 6 laboratory experiments from those mentioned below (minimum 2 on Dynamics) should be conducted.

List of experiments (Statics & Dynamics)

- Polygon law of coplanar forces (concurrent)
- Non-concurrent non-parallel (general)
- Simple jib crane
- Bell-Crank lever
- Support reactions for Beam
- Link polygon
- Inclined plane or wedge friction or Ladder friction (to determine coefficient of friction)
- Coil friction
- Simple/Compound Pendulum (time period of vibration)
- Fly Wheel (mass moment of inertia)
- Collision of elastic bodies (law of conservation of momentum)
- Rolling Disc on inclined plane (to determine experimental mass moment of inertia of disc.)

Four problems should be solved graphically along with analytical solutions. Also assignments consisting of minimum 20 (almost equal numbers on statics and dynamics) numerical problems based on the above syllabus shall be solved during practical periods. Report on experiments performed, assignments as mentioned above, along with the graded answer paper shall be submitted as term work.

The distribution of term work marks will be as follows:

Report on experiments performed, assignments: 10 marks
Assignments and solutions to problems: 05 marks

Written test: 10 marks

**RECOMMENDED BOOKS**

- R.C. Hibbeler - Engineering Mechanics, Mac Millan
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Lectures per week: 6  Theory: 100 marks
Practicals per week: 3  Term Work: 25 marks

DETAILED SYLLABUS

1. Units of work, power and energy, Ohm’s law, effect of temperature on resistance, series and parallel circuits, lead acid battery construction and charging

2. AC fundamentals: sinusoidal voltage and current waveforms, RMS and average value of various waveforms, form factor, crest factor, frequency, R-L, R-C and R-L-C, 1-phase series circuit (with resonance), parallel circuit (with resonance). Statement of relation for line current, phase voltage and power in three-phase circuits for a balanced three-phase load.

3. Elementary network theorems (for DC circuits only), star-delta transformations, superpositions theorem, Thevenin’s and Norton’s theorem, maximum power transfer theorem.


5. General principles and working of electrical motors and generators: DC series and shunt machine, I-f induction motor.

6. P-N junction diode as rectifier (half wave and full wave), introduction to filters, light emitting diodes (LEDs)

7. Principle and working of bipolar junction transistor (BJT and FET) and its use as an amplifier.

8. SCR characteristics and its applications for single phase converter and inverter circuits. (Numerical problems not expected).

9. Transducers: Classification of transducers, study of transducers like displacement, temperature, and pressure transducers, flowmeters, LVDT, microphones, loud-speakers (Numerical problems not expected).

10. Basic principles of measurement of electrical quantities. Voltmeters, ammeters, wattmeter, multimeter, and power supplies (Numerical problems not expected).

TERM WORK

Each student has to appear for at least one written test during the term. List of laboratory experiments:

- R-L-C series and R-L-C parallel circuit and study of resonance
- Study of relationships between line current/voltage and phase current/voltage for balanced star load
- Study of relationships between line current/voltage and phase current/voltage for balanced delta load
- Verification of Norton’s theorem, Thevenin’s theorem, and superposition theorem
- Load test on single phase transformer
- Diode rectifier HW/FW circuit
Transistor I/P and O/P characteristics
- Measurement of power using 2 wattmeter method
- Transistor as an amplifier
- SCR as control rectifier
- Transducer Characteristics

Report on experiments performed, assignments consisting of minimum 10 numerical problems based on the above syllabus, along with the graded answer paper shall be submitted as term work. The distribution of term work marks will be as follows:

Report on experiments performed, assignments: 10 marks
Assignments and solutions to problems: 05 marks

Written test: 10 marks

RECOMMENDED BOOKS
COMPUTER PROGRAMMING-I

Lectures per week: 4                                                    Theory: 100 marks
Practicals per week: 3                                                  Term Work: 25 marks

DETAILED SYLLABUS

1. **Fundamentals of UNIX:**
   - Multi-user System: Logging in and passwords, Electronic mail, Time for UNIX.
   - UNIX file system: Files and Directories, Subdirectories and Path names, searching the tree for files
   - File utilities: Ownership and access to files, Make simple text files, Basic editing techniques, Print files
   - File and data processing utilities: Searching for patterns, Rearranging file, structures, Sorting a file, Relational files.

2. **Structured Programming:**
   - C Fundamentals.
     Character set, Identifiers and Keywords, Data Types, Constants, Variables and Arrays, Declarations, Operators & Expressions, Library functions, Statements, Symbolic Constants, Preprocessor directives
   - Data Input and Output
     getchar(), putchar(), scanf(), print(), gets(), puts() functions
   - Control Statements
     if-else, while, do-while, goto, for statements nested control structures, switch, break, continue statements comma operator
   - Functions
     Function prototypes, passing arguments to a function by value, recursion storage classes, automatic, External, static, register variables in single file environment.
   - Arrays
     Defining – processing array, passing arrays to functions, introduction to multidimensional arrays, arrays and strings.
   - Pointers
     Declarations, Referencing and de-referencing, passing pointers to functions, pointer to array. (No reference to dynamic memory allocation)
   - Structures and Unions, Defining and processing a structure

TERM WORK

Each student is to appear for at least one written test (preferably on-line) during the term. Term work shall consist of graded answer paper of the test and at least five assignments covering UNIX fundamentals, and ten programs developed under control structures using C, ten programs under arrays, functions and structures using C. Programs should be debugged (hand written/computer print out) and should have suitable comments.

Recommended compilers: UNIX/LINUX, Turbo C/Borland C

The distribution of term work shall be as follows:

Written test (at least one): 10 marks
Assignments: 05 marks
RECOMMENDED BOOKS

- Programming in C – Balagurusamy, Tata McGraw Hill
- A structured Programming approach using C – Behrouz Forouzan, Thomas Learning
- UNIX training guide – Clifford Mould, Wheeler Publications
- Programming in C – Schuam out line series
- Let us C – Yaswant Kanetkar, BPB Publications
- Practical C programming – O’Reilly
- Algorithms with C – O’Reilly
- Internet for everyone – A Leon, Leon Techworld