

## “परिशिष्ट-01”

प्रवक्ता, राजकीय पॉलीटेक्निक एवं सहायक शोध अधिकारी, लोक निर्माण विभाग  
(समूह 'ख') परीक्षा-2024 पद पर चयन हेतु लिखित परीक्षा के लिए परीक्षा योजना

### 1. लिखित (मुख्य) परीक्षा (वस्तुनिष्ठ प्रकार)

क्र० सं०	प्रश्नपत्र	विषय	प्रश्नों की संख्या	अधिकतम अंक	समय अवधि
1	प्रथम प्रश्नपत्र	सामान्य हिन्दी	100	100 (प्रत्येक प्रश्न निर्धारित अंक-01)	02 घण्टा
2	*द्वितीय प्रश्नपत्र	सामान्य अंग्रेजी (केवल प्रवक्ता भौतिकी, रसायन, गणित एवं मार्डन आफिस मैनेजमेंट एण्ड सेक्रेट्रियल प्रैक्टिस हेतु )	100	100 (प्रत्येक प्रश्न निर्धारित अंक-01)	02 घण्टा
3	तृतीय प्रश्नपत्र	आवेदित विषय	150	300 (प्रत्येक प्रश्न निर्धारित अंक-02)	03 घण्टा

नोट: 1-\* प्रवक्ता भौतिकी, रसायन, गणित एवं मार्डन आफिस मैनेजमेंट एण्ड सेक्रेट्रियल प्रैक्टिस के लिए द्वितीय प्रश्न पत्र (सामान्य अंग्रेजी) की परीक्षा भी ली जाएगी।

2- उक्त वस्तुनिष्ठ प्रकृति की परीक्षाओं में ऋणात्मक मूल्यांकन (**Negative Marking**) पद्धति अपनाई जायेगी। अभ्यर्थी द्वारा प्रत्येक प्रश्न के लिए दिये गये गलत उत्तर के लिए या अभ्यर्थी द्वारा एक ही प्रश्न के एक से अधिक उत्तर देने के लिए (चाहे दिये गये उत्तर में से एक सही ही क्यों न हो), उस प्रश्न के लिए निर्धारित अंकों का एक चौथाई (1/4) दण्ड के रूप में काटा जायेगा।

3- सहायक शोध अधिकारी पद हेतु लिखित परीक्षा का पाठ्यक्रम वही होगा, जो प्रवक्ता, रसायन पद के लिए विषयगत पाठ्यक्रम निर्धारित है।

2. साक्षात्कार (व्यक्तित्व परीक्षा) – 50 अंक

“परिशिष्ट-02”

लिखित (मुख्य) परीक्षा (वस्तुनिष्ठ प्रकार) के लिए पाठ्यक्रम

सामान्य हिन्दी  
(वस्तुनिष्ठ प्रकार)

समयावधि : 2 घण्टे

प्रश्नों की संख्या: 100

अधिकतम अंक 100

- |    |   |    |
|----|---|----|
| 1  | वर्ण-विचार : स्वर एवं व्यंजन, स्वर और व्यंजन वर्णों का वर्गीकरण, वर्णों का उच्चारण-स्थान, अनुस्वार, अनुनासिक, विसर्ग आदि। | 15 |
| 2  | हिन्दी शब्द-समूह : तत्सम, तद्भव, देशज, विदेशी शब्द।   | 10 |
| 3  | हिन्दी शब्द-रचना : 1 – उपसर्ग, प्रत्यय, सन्धि, समास।  | 10 |
| 4  | हिन्दी शब्द-रचना : 2 – पर्यायवाची, विलोम शब्द।  | 10 |
| 5  | हिन्दी शब्द-रचना : 3 – अनेकार्थक शब्द, शब्द-युग्म, श्रुतिसम भिन्नार्थी शब्द।  | 10 |
| 6  | वाक्यांश के लिए एक शब्द।  | 05 |
| 7  | अशुद्धिशोधन : शब्दगत वर्तनी अशुद्धिशोधन, वाक्यगत अशुद्धिशोधन।   | 10 |
| 8  | लोकोक्ति एवं मुहावरे।   | 10 |
| 9  | विरामचिह्न।   | 05 |
| 10 | व्याकरण-विचार : संज्ञा, सर्वनाम, विशेषण, क्रिया, लिंग, वचन, काल, कारक।  | 15 |

(केवल प्रवक्ता भौतिकी, रसायन, गणित एवं मॉडर्न आफिस मैनेजमेंट एण्ड सेक्रेट्रियल प्रैक्टिस पद हेतु)

**General English (Objective Type)**

Time: 2 Hours

M M: 100

No of questions: 100

**Note:** Each multiple choice question shall be of one mark.

**Units:**

1. Terms commonly used in official communication
2. Direct and Indirect Narration
3. Voice
4. Articles, Adjectives, Adverbs, Conjunctions and Question tags
5. Synthesis: Simple, Compound and Complex
6. Correct use of tenses
7. One word substitution
8. Synonyms, Antonyms and Homonyms
9. Use of Correct prepositions
10. Subject Verb agreement
11. Correction of sentences
12. Idioms and Phrasal Verbs
13. Comprehension -- A passage of appropriate length on scientific/ technical theme for testing the ability of the candidate in the following areas:
  - a. Familiarity with vocabulary
  - b. Knowledge of the fundamentals of English Grammar
  - c. Thematic understanding of the passage

# SYLLABUS FOR LECTURER, MECHANICAL ENGINEERING GOVERNMENT POLYTECHNICS

## Section-A

1. **Statics and Dynamics:** Analysis of force system, Friction, Principle of Virtual work, Centroid and centre of gravity, Kinematics of rigid bodies; - plane motion, absolute motion, relative motion, Kinetics of rigid bodies; - plane motion, force, mass and acceleration, work and energy, impulse and momentum.
2. **Theory of Machines:** Basics of Mechanisms, Velocity and acceleration analysis, Cams and followers, Gears and gear trains, Clutches. Belt drives, Brakes and dynamometers, Flywheel and governors, balancing of rotating and reciprocating masses, balancing of multicylinder engines, Free and forced vibrations, Gyroscope, Critical speed and whirling of shafts.
3. **Mechanics of Solids:** Stresses and strains, Compound stresses and strains. Torsion of circular shafts, Slopes and deflections, Unsymmetrical bending, curved beams, thin and thick cylinders. stability of columns, helical and leaf springs, Theories of failures.
4. **Material Science:** Crystal systems & crystallography, Imperfections, phase diagram, Iron-carbon equilibrium diagram, heat treatment, mechanical behaviour of Materials- Elastics and inelastic action, Ferrous and non-ferrous metals and alloys, Mechanical properties and testing, Creep and Fatigue.
5. **Machine Design:** Design process, Design factors and factors of safety, Riveted and welded joints, power screw, Design of shafts, Design of belts, ropes and drives, Design of gears, mechanical springs, Journal bearings and Rolling contact bearing.
6. **Mechanical Measurement:** Elements of measurement systems. Sensors and Transducers, Strain gauges, Pressure and flow measurements, Bourdan tube, Diaphragm and bellows, Calibration methods, Temperature measurements, Thermocouple, Pyrometers, Speed, forces, torque and shaft power measurement, Tachometer and stroboscope.
7. **Industrial Engineering & Operation Research:** Production planning and control, Inventory Control, Work study, PERT and CPM, Graphical and simplex methods for linear programming, transportation model, Quality control and its uses in product design.

## Section-B

8. **Thermodynamics:** Application of the first and second laws of thermodynamics. Enthalpy. Entropy. Internal Energy. Specific Heat. Vapor and Combined power cycles. Properties of Pure substances. Mass and Energy analysis of Control Volumes. Gas power cycles. Gas mixtures.
9. **Energy Conversion:** Combustion phenomenon in S.I. and C.I. engines. Carburation and fuel injection. Fuels and combustion of fuels, Boilers; classification and performance. Steam turbines; impulse and reaction type, Unconventional power systems; Nuclear

power and MHD, Solar radiations and applications of solar energy, Fuel cells, Tidal power.

10. **Fluid Mechanics & Machinery:** Fluid Statics. Kinematics of fluid motion. Viscous flow and Compressive flow. Reynolds transport theorem and its applications. Ideal fluid flow. Laminar and turbulent flows. Boundary layer over a flat plate and inside tubes. Dimensional analysis and similitude. Forces on immersed bodies, Impact of jet, Impulse and Reaction turbines. Centrifugal and Reciprocating Pumps. Hydraulic devices; fluid couplings and hydraulic ram.
11. **Heat Transfer:** General heat conduction equation. Conduction in the presence of heat sources, fins, One dimensional unsteady conduction. Time constant for thermocouples. Natural and forced convection. Dimensionless numbers, Heat exchangers; effectiveness and number of transfer units (NTU). Boiling and condensation. Radiation heat transfer; Kirchhoff's law, Stefan-Boltzmann law, shape factor.
12. **Refrigeration and Air conditioning:** Principal of refrigeration, Units of refrigeration capacity. Vapour compression, vapour absorption, steam jet refrigeration and air refrigeration systems. Properties of important refrigerants. Ozone layer depletion and global warming, ecofriendly refrigerants. Psychrometric properties, Use of psychrometric chart, Psychrometric processes in air conditioning, supply air state and apparatus dew point (ADP), sensible heat factor, inside design conditions, metabolic rate, Cooling load calculations.

### Section-C

13. **Manufacturing Processes and Technology:** Mechanics of metal cutting, Machining and machine tool operations, Unconventional machining methods- EDM, ECM and ultrasonic machining, Limits, fits and tolerances, Inspection- Surface roughness & its measurement, gauging comparators, Metal casting, Metal Forming, Metal joining, Computer Integrated manufacturing, Flexible manufacturing systems, Jigs and fixtures.
14. **Production and Operation Management:** Production planning and control, Inventory Control, Work study, PERT and CPM, Graphical and simplex methods for linear programming, transportation model, Assignment Problem, Quality control and its uses in product design, Queuing theory.
15. **Maintenance & Safety:** Operating life cycle, Reliability, Failure data analysis, Breakdown maintenance planning, strategies, preventive maintenance, Replacement planning; maintain or replace decision, Safety in welding, cutting, finishing, Safety in heat treatments, Safety in handling and storage, Disposal of effluents, Health precautions, Elimination and prevention of hazardous fumes.
16. **Mechatronics and Robotics:** Microprocessors and micro controllers, Architecture, piezo-electric accelerometers, Optical encoder, resolver, Pneumatic and hydraulic actuators,

Stepper motors and Servo Motors, Basics of open and closed loop control. LVDT and interfacing sensors in mechatronic system. Actuation Systems- Fluid based actuation, actuators and accumulators. Concept of electro-mechanical actuation, Solenoids, Industrial Controllers, Programmable Logic Controllers, Programming Techniques, Applications of mechatronics. Robotics: Classification and specification, Grippers, tool and work handling, Notation, Direct and inverse kinematics, homogeneous coordinates and arm equations of 4-axis SCARA robots.

## **SYLLABUS FOR LECTURER, ELECTRICAL ENGINEERING GOVERNMENT POLYTECHNICS**

**Electrical Circuits:** - AC & DC circuit elements, Electrical circuit laws, Network Theorems and applications, Star and delta transformation, Single Phase and Three Phase power in AC circuits, Three Phase balanced and unbalanced circuits, Natural responses and forced responses, steady state and transient response for standard inputs, resonant circuits. Two-Port networks, Laplace, Fourier and Z-transform and their applications, Filter types and parameters, RL and RC Network synthesis.

**E.M. Theory:** - Electric and magnetic fields, Faraday's Law, Lorentz Force, Biot-Savart's Law, Gauss's Law, Ampere's Law, Coulomb's Law, Divergence and Curl, Electric fields and potential due to point, line, plane, and spherical charge distributions, Fields in dielectrics, conductors and magnetic materials, Maxwell's equations, Time-varying fields, Wave propagation in dielectric and conducting media.

**Engineering Materials:** Classification of materials on the basis of permanent magnetic dipoles, Electrical and electronic behaviour of materials, Classification on the basis of conductivity, Behaviour of dielectrics in steady and alternating fields, Phenomenon of polarization, Super conductivity, Applications of magnetic, conducting, dielectric and insulating materials, Piezoelectricity.

**Control System:** Mathematical Modelling of dynamic linear continuous and digital control system Open and closed loop systems, Block diagrams and signal flow graphs, transfer function, Response analysis, time-domain, frequency-domain, steady-state error analysis, Root locus technique, Bode plot, Routh-Hurwitz and Nyquist Criteria of stability, State space analysis of linear systems, State transition matrix, Eigen values and stability analysis, Concepts of controllability and observability, Compensating Networks, P, PI and PID Controllers.

**Elements of Electronics:** - Semiconductor device physics, P-N junction diodes, junction transistors and their applications, circuit models and parameters, Small-signal amplifiers, biasing circuits, frequency response, multistage amplifiers and feedback amplifiers. D.C. amplifiers, oscillators, Large-signal amplifiers: coupling methods, push-pull amplifiers, operational amplifier-properties and applications, wave shaping circuits, Multivibrators, flip-flop and their applications, Digital logic gate families, universal gates, combinational circuit for arithmetic and logic operation, sequential logic circuits, Multiplexers, demultiplexer, AD and DA converters, Counters, registers, Memory, Communication: Generation and detection of AM and FM, noise behavior of AM and FM systems.

**Power Electronics:** Power switching devices namely diode, MOSFET, IGBT, GTO, etc. characteristics and circuits, Device Protection, Principle and design of single phase and polyphase rectifiers, AC to DC, DC to DC and AC to AC converters, Performance parameters, single phase and three phase voltage source inverters (VSI), single phase and three phase PWM, SMPS, chopper fed multi-quadrant and closed-loop control of DC drives, Speed control of drives.

**Electrical Machines:** Electro Magnetic Energy Conversion, DC Machines-types, generator and motor characteristics, Starting and control of motors, Synchronous machines-Principle and performance, Regulation, Parallel operation of generators, Motor starting, Characteristics and application, Single phase, Three Phase transformers-Principle, Equivalent circuit, efficiency, Regulation, Connections, Three-phase induction motors-rotating magnetic field theory,

Equivalent circuit and determination of its parameters, Torque-slip characteristics, Starters, Speed Control, induction generators, single-phase induction motors-theory, Characteristics, Starting and applications, Servomotors, stepper motors, brushless DC (BLDC) motors.

**Power System Analysis and Protection:** Conventional and Renewable energy systems, Thermal power plants basic schemes and working principles, hydroelectric power plants, nuclear power plant, combined working of power plants, renewable sources-wind, solar, tidal etc. Line parameters and calculations, Performance of Transmission lines, voltage distribution over an insulator string, string efficiency improvement, sag and tension calculations, conductor vibrations, Disruptive and visual critical voltage, Corona loss, Interference between Power and Communication Line, Bus admittance matrix, Load flow equations and methods of solutions, Fast decoupled load flow, Balance and unbalanced faults and its analysis, Power system transients and travelling waves, Power system stability, EHV Transmission, HVDC transmission, general design considerations for distribution systems, Design of transmission lines, Switch gear methods of Arc Extinction, Restriking and recovery voltage, Testing of circuit breakers, Protective relays, protective schemes for power system equipment, C.T. and P.T. surges in transmission lines and protection.

**Measurement and instrumentation:** Basic methods of measurement, standards, error analysis, indicating and recording instruments, measurement of voltage, current, power, resistance, inductance, capacitance, power factor, frequency and flux, Instrumentation system for pressure and temperature measurements, CRO, potentiometers, earth fault detection and measurement of earth resistance, Transducers and their applications for the measurement for non-electrical quantities like temperature, pressure, flow rate, displacement, velocity, acceleration, Telemetry and data transmission, Data acquisition systems.

**Microprocessor Systems and Computers:** Data representation and representation of Integer and floating-point numbers, organisation and Programming of 8-bit microprocessor, 8085 microprocessor architecture, assemblers and compilers, memory and I/O interfacing of general-purpose peripheral devices and their applications, Applications of microprocessors. Basic layout of digital computers, input-output devices, memory organizations. Algorithms, Introduction to MATLAB.



## **SYLLABUS FOR LECTURER, CIVIL ENGINEERING GOVERNMENT POLYTECHNICS**

### **1. Structural Analysis:**

Slopes and deflections in determinate beams using conjugate beam method and moment area method; Maxwell's reciprocal, Betti's and Castigliano's theorems. Strain Energy method and unit load method for statically determinate beams, frames and trusses. Area moment theorem and its application. Types of Arches, suspension bridges and their design.

### **2. Surveying and Estimation.**

Basic principles of surveying, Measurement of distance and directions, Theodolite, Total station, temporary and permanent adjustment. Measurement using GPS. Levelling, Contouring, Traversing, Adjustment of survey data, Plane table survey, Curves. Application of Remote Sensing and GIS in Civil Engineering. Estimation of quantities for various types of construction; Building construction, Road construction. Analysis of rates, Preparation of tender, specifications and contract documents. Building layout and Shuttering plans.

### **3. Building Technology & Construction Management:**

Building materials: Stone, Brick, Tiles, Cement, Mortar, Concrete, Steel and Wood. Introduction to Glass, Paint, Plastic, Aluminium, Reinforced & Fiber reinforced cement concrete; Ferro cement, Fiber-Reinforced Polymer, Environment friendly materials.

Brick and stone masonry: Brick bonds and type of walls; Lintels and Arches, Flat and Pitched roofs, Plastering, Pointing, Flooring, Damp proofing, Water proofing, Sound proofing and Fire proofing. Expansion and construction joints, Centering and shuttering, Stairs and Lifts, Doors & Windows. Load bearing and framed structure construction. Building bye laws. Aspects in modern building planning. Eco-friendly and green buildings. Anti-corrosive treatment. Wood varieties and uses.

Bar charts, Milestone charts. Preparation of construction schedules, CPM & PERT, Project Cost Management, National Building Code provisions.

### **4. Strength of Material:**

Simple stresses and strains, stress-strain curve for ductile and brittle materials. Elastic constants, stress, plane stress, Mohr's circle of stress, Strain, Plain strain, Mohr's circle of strain, Combined stress. Shear force and Bending moment diagrams. Elastic theories of failure; Bending of beams, shear and bending stresses. Torsions of circular and rectangular sections and simple members, columns. Buckling and stability, slenderness ratio.

### **5. Fluid Mechanics.**

Properties of fluids; Newtonian and non-Newtonian fluids; Principles of fluid statics, Kinematics of flow; Equations and motion; Energy and momentum application; Uniform and non-uniform flow. Bernoulli's equation, Flow measurement in pipes and open channels. Dimensional analysis and similitude. Introduction to boundary layer theory, Laminar and turbulent flow through pipes, Stokes' law, Performance parameters of pumps and turbines

## **6. Soil Mechanics and Foundation Engineering.**

Soil and soil mass constituents; weight-volume relationship, index properties, recognition and classification of soils, soil structure and clay minerals. Capillary, permeability and seepage through soil, piping phenomenon. Determination of liquid, plastic and shrinkage limits. Shearing strength of soil, Determination of parameters by direct shear box, tri-axial and unconfined compression test, vane shear test. Typical stress- strain curves for soil. Determination of pore pressure coefficients, liquefaction of soil, soil compaction, laboratory tests and field control. Ground improvement techniques, mechanical stabilisation, cement line and bitumen stabilisation. Field tests of soils and compaction methods.

Types of foundations, selection criteria, bearing capacity, settlement, laboratory and field tests. Types of piles, their design and layout. Foundation on expansive soils, swelling and its prevention. Design of earth retaining structures and tunnels.

## **7. Transportation Engineering:**

Classification of Roads, Highway Material & Testing: Properties of subgrade soil, stone aggregates and bituminous material. Significance, methods and application of various tests on soil, stone aggregate and bitumen. Design elements, cross-sectional elements, horizontal and vertical alignment, sight distance, super elevation, types of road crossings, roundabouts, grade-separated intersection. Traffic studies on flow, speed and travel time. Improvement based on accident study, traffic capacity, density, extra widening, transitional curves and geometric improvement of intersection. Traffic signs, traffic control and parking.

Design of highway pavements and pavement materials using California Bearing Ratio (C.B.R.) and Group Index (G.I) method; Westergaard's analysis of wheel load stresses in rigid pavement; IRC design method for concrete pavement. Methods of constructing different types of roads; Mega Highways, National Highways, State highways, district and village roads. Specifications of MORTH & IRC, safety codes for roads, highway drainage and highway maintenance.

Railway Engineering: Gauges; right of way, gradient and super-elevation, Resistance to traction and stresses in track. Track components their functions and requirements, track geometrics, turnouts and crossings, signalling and interlocking, rail joints. Stations and yards and centralised train control system.

Airport site selection, classification, layout, zoning laws, runway/ taxiway orientation and design, traffic control and runway lighting.

## **8. Environmental Engineering:**

Water supply: Demand; forecasting of water demand, sources, Quality standards; Water treatment; Coagulation, flocculation, settling, filtration, Water softening; Iron Manganese, Fluoride and Nitrate removal; Electro-dialysis, R.O and Iron exchange process and Desalination. Water distribution system design, tanks and reservoirs, pumping station.

Sewerage system: Layout and design. Characteristics of municipal waste water and its treatment; Activated sludge process, trickling filters, Rotating Biological Contactor (RBC), Up flow anaerobic sludge blanket (UASB), Stabilisation ponds and lagoons; Septic tanks; Sludge handling and disposal.

Basics of noise pollution; Standards, Measurement and its abatement. Air Quality; standards, Air pollution, ill effects on human being, control of air pollution. International, National and State pollution control by laws.

### **9. Design of Concrete Structure**

Material for cement concrete, properties and testing of cement, water, fine and coarse aggregates. Introduction to admixtures, IS Concrete mix design procedure, properties and testing of fresh and hardened concrete, durability of concrete. Introduction to self-compacting concrete. Limit State design as per IS; 456 for bending, shear, axial compression and combined forces. Design of slabs, beams, columns, walls, footing as per IS codes. Working stress method of design of Reinforced Concrete members. Design of cantilever and counterfort Retaining walls. Principles of pre-stresses concrete design, materials, methods of prestressing and losses. Design of simple members and determinate structures as per provisions of IS: 1343.

### **10. Design of Steel Structures:**

Mild and high tensile steel, working stresses, factor of safety, imposed loads on various types of floors and roofs; Introduction to IS: 875 with respect to Dead Loads, Imposed Loads and Wind Loads. Design of riveted, welded and bolted joints. Plastic analysis. Types of cross sections. Design of steel structure as per latest version of IS: 800. Design of tension members, compression members, axially and eccentrically loaded columns; built up columns; Design of connections, Plate girders, roof trusses, floor system, column bases, column footing, grillage foundation. Lateral Loads: Determination of wind and earthquake effect as per IS Codes.

### **11. Water Resource Engineering.**

Need for harnessing water resources; Irrigation practices, Irrigation – its importance and impact on environment, assessment of water requirement for crops; irrigation system major and minor; Method of irrigation; Drip and sprinkle methods their importance; canal and well irrigation; design principles of irrigation canal, estimation of design discharge and storage capacity; energy dissipation; salient features of diversion head works; falls; regulators and cross drainage structures, Different types of Reservoir, flood routing through reservoir, basic principles for design of dams and spillways, General features and component of Hydropower station.

Hydrological cycle and hydrologic budget; Precipitation, its measurement and analysis; Stream flow; Rainfall – runoff relationship, frequency analysis; Flood Routing and flood discharge calculation. Major rivers, Dams and hydropower plants of India and specially Uttarakhand.

# **SYLLABUS FOR LECTURER, ELECTRONICS ENGINEERING/ELECTRONICS & COMMUNICATION ENGINEERING, GOVERNMENT POLYTECHNICS**

## **1. Electronic Devices, components and Analog circuits:**

Energy bands in semiconductor, band-gap, different types of P-N junction diodes and their applications, Active and passive devices, and symbols of the electronic components, Wave shaping circuits, Principle and applications of BJT, FET, MOSFET devices, biasing schemes for BJT and FET amplifiers, thyristors and various configurations. High frequency transistor models, frequency response of single stage and multistage amplifiers. Oscillators, Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitts, Clapp etc.), non-sinusoidal oscillators. Push pull amplifier Op-Amp applications

## **2. Advance Electronics:**

VLSI technology: Processing, lithography, interconnects, packaging, testing; VLSI design principles, MUX/ROM/PLA-based design, Moore & Mealy circuit design; Pipeline concepts & functions; Design for testability and examples.

## **3. Network Theory and Basic Machines:**

DC Circuits-Ohm's & Kirchoff's laws, mesh and nodal analysis, circuit theorems; Single phase AC circuits; Network graphs & matrices; Wye (\*) -Delta transformation; Linear constant coefficient differential equations-time domain analysis of RLC circuits; Solution of network equations using Laplace transforms, frequency domain analysis of RLC circuits; 2-port network parameters, driving point & transfer functions; Steady state sinusoidal analysis.

## **4. Digital Electronics:**

Number system, binary, Octal, hexadecimal. integer and floating-point-numbers. Different type of codes, Combinatorial circuits, Boolean algebra, minimization of functions using identities and Karnaugh map, logic gates and universal gate, arithmetic circuits, code converters, decoders, Sequential circuits: latches and flip-flops, counters, shift-registers, Data converters; sample and hold circuits, ADCs and DACs. Basics of multiplexers, counters/registers/memories.

## **5. Control systems:**

Basic control system components, Feedback principle; Transfer function; Block diagram representation, Transforms & their applications; Signal flow graph, Frequency response, Routh-Hurwitz criteria, root loci, Nyquist/Bode plots, stability analysis, steady state, transient and frequency response analysis, compensation: Lag, lead and lag-lead. State variable model and solution of state equations of LTI systems. Transient and steady-state analysis of LTI systems.

## **6. Electronics measurement and Instrumentation:**

Principles of measurement, accuracy, precision and standards, Analog and Digital systems for measurement, measuring instruments for different applications, Static/dynamic characteristics of measurement systems, errors, statistical analysis and curve fitting. Various Electronics measuring instruments, Ammeter, voltmeter, General purpose multimeter and its specification and applications, V.T.V.M, power meter, photometer, DSO. Different types of sensors, their working and usages, Data acquisition system.

## **7. Electromagnetics:**

Electric and Magnetic fields, Faraday's law, Lorentz Force, Biot- Savart's Law, Gauss's Law, Ampere's Law, Elements of vector calculus, Maxwell's equation-basic concept, Stoke's theorem, pointing Vector, Wave propagation through different media, transmission lines: Characteristic

impedance, impedance matching, s-parameters Smith chart, Waveguides & Antennas and their types, and their parameters. Antenna's array.

### **8. Computer Organization, Architecture and Microprocessor.**

Basic architecture, CPU, I/O organization, memory organization, peripheral devices, Operating systems-basics, processes, characteristics, applications. Microprocessors & microcontrollers, basics, interrupts, DMA, instruction sets, interfacing; Controllers & uses; Embedded systems. Microprocessor 8085 and microcontroller 8051, their architecture and programming, PLC. Ladder diagram programming's. Basics of C programming's.

### **9. Analog and Digital communication Systems:**

AM, FM, transmitters/ receivers; amplitude modulation and demodulation, angle modulation, demodulation, spectra of AM and FM, superheterodyne receivers, Sampling, quantizing, coding, PCM/ DPCM, multiplexing audio/video; Digital modulation: ASK, FSK, PSK; Multiple access: TDMA, FDMA, CDMA, & various Switches /Routers/Hubs.

### **10. Communication Networks:**

Principles/practices/technologies/uses/OSI model/security; Basic packet multiplexed streams/scheduling; Cellular networks, types, analysis, protocols (TCP/TCP/IP). Mobile communication, and its various types, BTS, BSC and MSC, hand on and hand off techniques.

### **11. Random Signals, Processes and Information Theory:**

Auto correlation and power spectral density, properties of white noise, filtering of random signals, entropy, mutual information and channel capacity theorem, Huffman coding| algebraic and convolutional coding.

### **12. Microwave Communication, Satellite Communication and Fiber Optics Communication:**

Microwave communication and its principle of working, applications & limitations, Principle of Magnetron, klystron, Reflex klystron, Terrestrial/space type LOS systems, block schematics link calculations, system design; Communication satellites, orbits, characteristics, systems, uses; Fibre-optics: Theory of Fibre optics, Light propagation through optical fiber, fiber optic communication: practice/standards, systems,

### **13. Power Electronics:**

Power switching devices, AC to DC, DC to DC and AC to AC converters, Performance parameters, single phase and three voltage source inverters, chopper fed multi quadrant and closed loop control of DC drives, speed control of drives.

### **14. Power Engineering:**

Electro magnetic Energy conversion, DC Machines: working and types, generators and motor characteristics, starting and control of motors, Synchronous Machines: principle and performance, regulation, Single phase transformer: principle, equivalent circuit, efficiency. Three phase transformers. Three phase induction motors: working principle, equivalent circuit, Torque - slip curve, starter, Conventional and renewable energy system, Various power generating plants, Transmission and distribution systems.

### **15. Introduction to the Measurements and Measurement systems:**

Need and Methods of measurements, Instruments, Mechanical, Electrical and Electronics instruments, Deflection and null types instruments, Types of instrumentation system. Terms used in measurement, Accuracy, precision, sensitivity, input impedance, Range, and Span, Current sensitivity, Voltage sensitivity, noise and high frequency limitations in measurement,

Measurement system performance, static calibration and various types of errors encountered in measurement, Sources of error, Types of errors and their remedies.

### **16 Applications of impedance bridges in Measurement**

Need of bridges in measurement, DC bridge, AC bridge, Maxwell bridge, Hays bridge, Schering bridge, Wien's bridge, RCL bridge, Universal bridge.

### **17. Cathode Ray Oscilloscope (CRO)**

Need of CRO in measurement, constructional details of CRT, Deflection system, focusing system, fluorescent screen, used in CRT, Various materials used for fluorescent screen, characteristics of fluorescent materials. Acquadag coating its need and function, Various type of CRO used in measurement their operation and applications and their specifications.

## **SYLLABUS FOR LECTURER, INSTRUMENTATION & CONTROL** **ENGINEERING GOVERNMENT POLYTECHNICS**

### **1. Introduction to the Measurements and Measurement systems:**

Need and Methods of measurements, Instruments, Mechanical, Electrical and Electronics instruments, Deflection and null types instruments, Types of instrumentation system. Terms used in measurement, Accuracy, precision, sensitivity, input impedance, Range, and Span, Current sensitivity, Voltage sensitivity, noise and high frequency limitations in measurement, Measurement system performance, static calibration and various types of errors encountered in measurement, Sources of error, Types of errors and their remedies.

### **2. Applications of impedance bridges in Measurement:**

Need of bridges in measurement, DC bridge, AC bridge, Maxwell bridge, Hays bridge, Schering bridge, Wien's bridge, RCL bridge, Universal bridge.

### **3. Generators, Oscillators and multivibrator:**

Need of generators in measurement. classification of generators and their specifications, types of oscillators, RC oscillator, Wien's bridge oscillators, Hartley oscillator, Colpitts oscillator, Crystal oscillator. Square wave and pulse generation, Astable multivibrator, Monostable multivibrator and Bi-stable multivibrator

### **4. Statistical Treatment of Data:**

Histogram, arithmetic mean, measure of dispersion from the mean, range, standard deviation, average deviation, variance, precision index, probable error, average deviation for the normal curve. standard deviation from the normal curve, linearity, hysteresis, threshold, dead time, dead zone.

### **5. Units, systems, dimensions and standard:**

Units, absolute units, fundamental and derived units, Dimensional equation, Relationship between electrostatic and electromagnetic systems of units M.K.S. system (Giorgi System), Absolute measurement of current, Rayleigh's current balance, Absolute measurement of resistance, Lorentz's methods, Standards for mass and length, Atomic frequency and time standards.

### **6. Data acquisition systems:**

Instrumentation system and their types, Analog and digital data acquisition system, Digital recording system, analog multiplexer, uses of data acquisition systems, Digitaliser, Limit detectors.

## **7. Sensors, Actuators and Transducers:**

Types of modern sensors, (nano technology, biocatalyst, biosensors, immobilization, glucose electrode. Nano sensors, types of actuators, advance instrumentation techniques, classifications, characteristics and choice of transducers, potentiometer, strain gauge, Piezo electric transducers, thermistor, thermocouple, Resistive transducer, capacitive transducers, inductive transducers, LVDT, Hall effect transducer, digital encoding transducer, elastic transducer, photo-optics, optical encoder, shaft encoder, introduction to inverse transducer, its principle and applications

## **8. Introduction to the control system:**

Plants, models, classification of systems Single input single output system (SISO) and multi input multioutput system (MIMO), open loop and closed loop systems. effect of feedback, linear and nonlinear systems, time invariant system, linear time invariant (LTI) systems. Continuous and sampled data system, modeling and formation of equations of electrical, mechanical, thermal, pneumatic and hydraulic systems, Servomechanism, Regulating systems, casual systems, disturbances, analogous systems, force voltage and force current analogies, Block diagram representation and some illustrative examples.

## **9. Transfer Function analysis:**

Definition of transfer function, open loop and closed loop transfer function, block diagram reduction techniques, signal flowgraph, simplification of signal flow graphs, Masson gain formula, description of linear time invariant system by differential equations. Use of Lapace transform, Laplace transforms of basic functions, inverse Laplace transform, Transfer function from impulse response of the system. Transfer function from differential equation, Poles and zeroes, order of the system, characteristic equation.

## **10. Time domain analysis:**

Standard test input signals, transient response of first and second order system, steady state response, impulse, ramp and step response of first and second order system, time domain specifications of step response of first and second order systems, steady state error, and error coefficients, Dominant poles of higher order systems. Types of the systems.

## **11. Frequency Domain Analysis:**

Steady state response to sinusoidal inputs, Polar plots. Nyquist plot, Bode plots, frequency response specifications, relation between time and frequency response of second order system. Log magnitude v/s Phase angle plot. Phase margin and gain margin, sensitivity analysis in frequency domain. closed loop frequency response, M and N circles.



## **12. Root locus techniques.**

Definition of root Locus and its construction, Magnitude and phase angle criterion, Gain margin and Phase margin using root locus. sensitivity of root of characteristic equation, systems with transportation lag, asymptote of root locus. Break away and break in points, intersection of root locus branches with imaginary axis. Extreme points of root loci for positive gain, location of roots with given gain, root contours.

## **13. Compensation Techniques and control system components:**

Necessity of compensations, series and parallel compensations, compensating networks, lag, lead, and lead lag compensation. Error detectors, AC and DC servo motor, Techo Generators. Magnetic amplifier.

## **14. Introduction to Nonlinear system & State Space analysis:**

Nonlinear system, types of nonlinearities, linearization methods, phase plane methods types of phase portraits, singular points, describing function methods, Concept of state variable modeling, definition of state and states variables. Advantages of state space techniques over transfer function techniques, state variables representation of electrical network, conversion of state variable models to transfer function model for continuous time system and vice versa, Solution of state equations, state transition matrix and its properties, controllability and observability. State observer and controller, PID controller.

## **15. Discrete time systems:**

Relation between s-plane and z- plane, state variable model of discrete time system, definition of z transform and its properties, z transform of basic functions, inverse z- transform, difference equation, conversion of discrete state variable model to transfer function model and vice versa. Solution of state difference equation, sample and hold circuits, Fourier transform.

## **16. Stability Analysis:**

Definition of stability, stability and transient response, location of poles and stability, various approaches of linear system stability analysis, relative stability, stability using root locus plots, Routh Hurwitz criterion, Nyquist criterion for stability, stability of z plane, stability using bilinear transformation and Routh stability test., Jury's stability test, stability analysis of linear and nonlinear system using Lyapunov stability theorem.

## **17. Cathode Ray Oscilloscope (CRO):**

Need of CRO in measurement, constructional details of CRT, Deflection system, focusing system, fluorescent screen, used in CRT, Various materials used for fluorescent screen,

characteristics of fluorescent materials. Acquadag coating its need and function, Various type of CRO used in measurement their operation and applications and their specifications.

### **18. Multimeter:**

General purpose multimeter, constructional details, extension of current and voltage ranges, measurement of resistance using series and shunt type ohm meter, specification and applications.

### **19. Digital Electronics:**

Number system, binary, Octal, hexadecimal. integer and floating-point-numbers. Different type of codes, Combinatorial circuits, Boolean algebra, minimization of functions using identities and Karnaugh map, logic gates and circuits, arithmetic circuits, code converters, decoders, Sequential circuits: latches and flip-flops, counters, shift-registers, Data converters; sample and hold circuits, ADCs and DACs. Basics of multiplexers, demultiplexer, counters/registers/memories.

### **20. Power Electronics:**

Power switching devices, AC to DC, DC to DC and AC to AC converters, Performance parameters, single phase and three voltage source inverters, chopper fed multi quadrant and closed loop control of DC drives, speed control of drives.

### **21. Advance Electronics:**

VLSI technology: Processing, lithography, interconnects, packaging, testing; VLSI design principles, MUX/ROM/PLA-based design, Moore & Mealy circuit design; Pipeline concepts & functions; Design for testability and examples.

### **22. Computer Organization, Architecture and Microprocessor:**

Basic architecture, CPU, I/O organization, memory organization, peripheral devices, Operating systems-basics, processes, characteristics, applications. Microprocessors & microcontrollers, basics, interrupts, DMA, instruction sets, interfacing; Controllers & uses; Embedded systems. Microprocessor 8085 and microcontroller 8051, their architecture and programming, PLC. Ladder diagram programming's. Basics of C programming's.

**SYLLABUS FOR LECTURER, COMPUTER ENGINEERING/ A.I./  
AUTOMATION/COMPUTER SCIENCE / APPLICATION/ INFORMATION  
TECHNOLOGY GOVERNMENT POLYTECHNICS**

**1. Algorithm and Problem-Solving Using C/C++**

Introduction to Programs and Algorithms, Problem Solving Aspect (Algorithm Devising), Algorithm Design Aspect (Top-Down Design). Algorithm Implementation Essential and Desirable Features of An Algorithm. Basic Algorithms — Exchanging the Values of Two Variables. Counting. Summation of a Set of Numbers, Factorial. Computation. Sine Function Computation. Generation of the Fibonacci Sequence. Reversing the Digits of An Integer. Base Conversion, etc. Flowchart: Generating Prime Numbers, Computing Prime Factors of An Integer, Generation of Pseudo Random Numbers, Raising a Number to a Large Power, Computing the Nth Fibonacci Number. Problems on Arrays Handling: Array Order Reversal, Array Counting, Finding the Maximum Number in a Set. Removing Duplicate Elements from an Ordered Array, Partitioning an Array. Merging. Sorting and Searching.

Program Design Using C/C++: Input-Output Processing, Data Types and Structure Data Types, Control Structure, Conditional Statements and Loops. Implementations of Arrays and Pointers/Linked List, Structure, Union, Enumeration and Files.

**2. Digital Computer Design**

Number System and Data Representation Binary, Octal, Decimal and Hexa-Decimal Number Systems, Base Conversions, Binary Arithmetic, Complements: (R-1)'S and R'S Complement, Subtraction Using Complements, Floating and Fixed-Point Representation, Binary Codes for Decimal Digits: BCD Code, Error Detection Code, ASCII, EBCDIC Codes, Boolean Algebra and Logic Gates: Boolean Algebra-Basic Definitions. Huntington's Postulate, Switching Algebra, Basic Theorems and Properties, Boolean Functions: Digital Logic Gates: Basic Gates - AND, OR, NOT, Universal Gates, Simplification of Boolean Functions: Karnaugh Maps Method: Two Variables K-Map. Three, Four and Five Variables K-maps, Product of Sum Simplification, Combinational Logic: Design Procedure, Design of Half and Full Adder, Half and Full Subtractor, Code Conversion, Decoders, Encoder, Multiplexers, De-Multiplexer, ROM and PLA, Sequential Logic: Flip-Flops: RS Flip Flop, Clocked RS, JK Flip Flop, Master Slave JK FF, D Type FF, T Type FF, Flip Flop Input Functions, FF, Characteristic Tables, Registers: Register With Parallel Load, Shift Registers, Bidirectional Shift Register With Parallel Load, Serial, Addition Using Shift Registers.

**3. Discrete Mathematical Structure**

Basic Structures: Set, Multi-Set and Sequences, Type of Sets, Set Operations, Relation, Functions, Types of Functions, Inverse of a Functions, Compositions of Functions, Function Representation, Sequences, Special Integer Sequences, Summations, Algebraic Structures: Groups, Rings, Vector Space and their Applications, Equivalence Relation and Partial Order Relation, Equivalence Classes and Partitions, Lattices and Topological Sorting, Logic, Reasoning and Inferences: Foundations of Logic, Propositions. Conditional Statements, Bi-Conditionals, Truth Table, Precedence of Logical Operators, De Morgan's Laws, Quantifiers- Predicates, Quantifiers, Universal Quantifiers, Variables, Logical Equivalences, Rules of Inferences, Valid Arguments, Proof Techniques, Counting: Simple and Complex Counting Problems, Inclusion-Exclusion Principle, Tree Diagrams, The Pigeonhole Principle, Permutations, Combinations, Binomial Coefficients, Examples and Applications, Binomial Coefficients, Binomial, Generating Permutations and Combinations, Graphs: Graph Models and Terminologies, types of Graphs,

Graph Isomorphism, Euler and Hamiltonian Paths and Circuits. Spanning Tree, Number of Spanning Trees of a Graph, Some Graph Algorithms.

#### **4. Data Structure Using C/C++/Java**

Stacks and Queues: Stack Data Structure, Push & Pop Operations, Representation and Implementation of Stack Using Array and Linked List, Applications of Stack: Conversion of Infix to Postfix Expressions, Parenthesis Matching, Towers of Hanoi, Recursive Functions. Various Queue Operations, Circular Queue, Representation and Implementation of Queues Using Array and Linked List, Dequeue, Applications of Queue, Trees: Binary Trees and their Properties, Representation of Binary Trees: Array-Based and linked Representations, Binary Tree Traversals, Binary Search Trees (BST), Operations on BST: Search, Insertion and Deletion, B-Tree: Search, Insertion and Deletion, B+-Trees, AVL Trees. AVL Tree Representation and its Operations, Trees: Search, Insertion and Deletion, Sorting and Searching: Insertion Sort, Bubble Sorting, Selection Sorting, Quick Sort, Merge Sort, Heap Sort, Shell Sort, Sequential Search, Binary Search, Introduction to Hashing, Hash Table Representation, Hash Functions, Collision and Overflows, Graphs and File Structure: Terminology & Representations, Graphs & Multi- Graphs. Directed Graphs, Representations of Graphs, Tree and Shortest Path Finding Problems, Physical Storage Media File Organization, Organization of Records into Blocks. Sequential Files, Indexing and Hashing, Primary Indices, Secondary Indices, B+ Tree Index Files, B Tree Index Files, Indexing and Hashing Comparisons.

#### **5. Operating System**

OS Primitives: Definition and Views of Operating System, Types of OS, Batch Systems. Multi Programming, Time—Sharing, Parallel, Distributed and Real-Time Systems, Operating System Structure, Operating System Components and Services, System Calls, System Programs. Virtual Machines, Process Management: Process Concept, Process Scheduling, Cooperating Processes, Threads, Inter Process Communication, CPU Scheduling Criteria, Scheduling Algorithms, Semaphores. Deadlocks, Memory Management -1 Logical and Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Virtual Memory, Demand Paging and its Performance, Page Replacement Algorithms, Allocation of frames. Thrashing, Page size and Other Considerations, Demand Segmentation, Paging And Segmentation, Secondary Storage Structure, File Handling and Organization, Disk Organization, Threats And Security, Linux System Design Principles, Kernel Modules, Process Management, Shell Programming.

#### **6. Analysis and Design of Algorithms**

Algorithms Analysis and ADT: Fundamentals of Algorithms Design Techniques (ADT), Importance of Developing Efficient Algorithms, Worst, Best, Average Case Time Complexity Analysis, Notations: Big-O(O), Theta ( $\Theta$ ), Big-Omega ( $\Omega$ ), Small-O (o), and Small-Omega ( $\Omega$ ) Notations. Properties of Complexity Notations, Limit Approach To Determine Order, Master Theorem, Divide and Conquer Approach, Design and Analysis of Binary Search (Recursive and Non-Recursive), Merge Sort, Quicksort, and Strassen's Matrix Multiplication Algorithms, Advanced Case Studies, Dynamic Programming: Introduction to Dynamic Programming, Difference Between Divide-and- Conquer and Dynamic Programming Approaches, Using Dynamic Programming, Calculate Binomial Coefficient, Optimization Problem, Chained Matrix Multiplication and Longest Common Subsequence Problems, Travelling Salesman Problem, Greedy Approach: Introduction to Greedy Approach, Components of Greedy Approach: Selection Procedure, Feasibility Check, and Solution Check, Minimum Spanning Tree Generation: Prim's and Kruskal's Algorithms, Dijkstra's Algorithm for Single-Source Shortest Paths. Huffman Code, The Knapsack Problem (Greedy Approach vs Dynamic Programming): 0-1 Knapsack and

Fractional Knapsack Problems, Backtracking: Introduction To Backtracking, Backtracking Technique: Pruned State Space Tree, Backtracking Algorithms for N-Queens, Sum-of-Subsets, Graph Colouring, and 0-1

Knapsack Problems Branch-And-Bound Method and Intractable Problems: Introduction to Branch-and-Bound Method, Solving 0-1 Knapsack Problem Using Branch-and-Bound Method: Breadth-First Search With Branch-And- Bound Pruning, Best-First Search with Branch-and-Bound Pruning, Solving Traveling Salesman Problem Using Branch-and-Bound Method, Randomized Algorithm with Examples.

## **7. Data Communication and Computer Networks**

Data Communication and Networking Overview: Communication Model, Data Communications, Data Transmission, Guided Media, Unguided Media, Direct Link, Point-To-Point and Multipoint Guided Configuration, Simplex, Half-Duplex, and Full-Duplex Transmission, Frequency, Spectrum, Bandwidth, Time Domain and Frequency Domain Concepts, Analog and Digital Data Transmission, Distortion, Delay Distortion, Noise, Channel Capacity, Computer Networks and Reference Models: Computer Networks and Its Applications, Broadcast and Point-To-Point Networks, Personal Area Networks, Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Protocols, and Interfaces, Connection-Oriented and Connectionless Services. OSI Reference Model, TCP/IP Reference Model, Internet and Its Usage, Internet Architecture, Connection-Oriented Networks: X.25, Frame Relay, and ATM, Ethernet, Wireless LANs - 802.11, Transmission Media: Twisted Pair, Coaxial Cable, Optical Fibre, Wireless Transmission: Antennas, Terrestrial Microwave, Data Link Layer: Error Detection and Correction, Error-Correcting Codes, Error-Detecting Codes, Simplex Stop-and-Wait Protocol, Sliding Window Protocols, High-Level Data Link Control (HDLC), Point-To-Point Protocol (PPP), Medium Access Control, Access Protocol- ALOHA (Pure and Slotted), Carrier Sense Multiple Access (CSMA), Ethernet, Wireless LANs-802.11 Protocol Stack, 802.11 Physical Layer, 802.11 MAC Sublayer Protocol, 802.11, The Network and Application Layer: Routing Algorithms, Shortest Path Routing, Flooding, Distance Vector Routing , Link State Routing, etc. Congestion Control Algorithms, IP Protocol, IP Addresses, Subnets, Subnet Mask, Internet Control Protocols, Domain Name System (DNS), DNS Name Space, Name Servers, Electronic Mail- Architecture and Services, User Agent, Message Formats, Simple Mail Transfer Protocol (SMTP), POP3, World Wide Web and Hyper Text Transfer Protocol.

## **8. Database Management System**

Basic Concepts: Data, Database and DBMS, Database Vs. Traditional File System Approach, Three Schema Architecture of DBMS and Data Independence, Database Models: Hierarchical, Network and Relational Database Systems, High-Level or Conceptual Data Models, Physical Data Models, Object Data Models. Entity Relationship (ER) Model, Relational Constraints-Domain Constraints, Key Constraints, Entity Integrity and Referential Integrity Constraints, Relational Algebra Operations— Select, Project, Rename, Union, Intersection, Set Difference, Join, and Division Operations, Aggregate Functions and Groupings, Structured Query Language (SQL): DDL, DML and DCL Commands, EXISTS and UNIQUE Functions, Aggregate Functions, Introduction to PL/SQL, Functional Dependencies and Normalization: Functional Dependencies, Normalization Using Functional Dependencies — First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), And Boyce-Codd Normal Form (BCNF), Multi- Valued Dependencies and Fourth Normal Form (4NF), Join Dependencies and Fifth Normal Form (5NF), Transaction Management and Concurrency Control: Transaction Concept, Transaction State,

Concurrent Executions, Serializability and Recoverability, Testing for Serializability. Concurrency Control — Lock-Based Protocols and Timestamp-Based Protocols.

## **9. Software Engineering**

Phases of Software Engineering: Definition, Design and Maintenance Phase.

Definition Phase: Basics and Concepts Related to Software Engineering and Development, Software and Its Components, Software Characteristics, Problem of Size and Complexity, Evolving Role of Software, Changing Nature, Legacy Software and Software Myths, Software Engineering—A Layered Approach, CMMI, Technology, Product and Process.

Software Process Models: Waterfall Model, Classic Life Cycle, Incremental Process Models, RAD, Evolutionary Models, Prototyping, Spiral, And Concurrent Models, The Unified Process: Phases and Work Products, Agile Process Models, SE Principles and Practices: Software Engineering Practices, Essence and Principles, System Modelling and Simulation, Business Process Reengineering, Object Oriented Analysis, Scenario Based and Flow Oriented Modelling.

Design Phase: Concepts and Models, Process and Quality, Design Concept: Abstraction, Architecture, Pattern, Modularity, Information Hiding, Functional Independence, Refinement, Design Classes, Design Models—Data Elements, Interface Elements, Architecture Elements, User Interface Design- Process and Models, User Interface Design-The Golden Rules, Component-Level Design.

Maintenance Phase: Testing and Maintenance, Type of Testing. Unit, Integration, System, Acceptance Testings, Alpha and Beta Testing, Black Box and White Box Testing, Stress Testing, Types of Maintenance: Error Detection and Error Correction, Enhancement and Perfecting Maintenance, Legacy System and Related Issues.

## **10. Artificial Intelligence**

History and Applications: Artificial Intelligence, Foundations and History of Artificial Intelligence, Defining AI: Acting Humanly (Turing Test Approach), Thinking Humanly (Cognitive Modelling Approach), Thinking Rationally (Laws of thought Approach), Acting Rationally (Rational Agent Approach), Foundations of Artificial Intelligence, AI Techniques, Expert Systems, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents.

Basic Concepts, Functional and Operational Knowledge Using Prolog/LISP: Introduction to Expert System, Robotics, Data Mining, and Datawarehouse (DM&DW). Natural Language Processing (NLP), Speech Recognition, Voice Recognition, Computer Vision, Neural Network, Deep Learning, Machine Learning, Pattern Matching, Classification and Clustering, Theorem Proving, Block Chain and Smart Computing.

## **SYLLABUS FOR LECTURER, AUTOMOBILE ENGINEERING, GOVERNMENT POLYTECHNICS**

### **Part-A**

- Statics & Dynamics: Analysis of force system, Friction, Principle of Virtual work, Centroid and centre of gravity, Kinematics of rigid bodies- plane motion, absolute motion, relative motion, kinetics of rigid bodies- plane motion, force, mass and acceleration, work and energy, impulse and momentum.
- Theory of Machines: Basics of Mechanisms, Velocity and acceleration analysis, Cams and followers, Gears and gear trains, Clutches. Belt drives, Brakes and dynamometers, Flywheel and governors, balancing of rotating and reciprocating masses, balancing of multicylinder engines, Free and forced vibrations, Critical speed and whirling of shafts.
- Mechanics of Solids: Analysis of Stress and strain, Mohr's circle. Torsion of circular shafts, Stresses and deflections due to bending of beams, Unsymmetrical bending, curved beams, thin cylinders. Stability of columns, Theories of failures.
- Material Science: Crystal systems & crystallography, Imperfections, phase diagram, Iron-carbon equilibrium diagram, heat treatment, mechanical behaviour of Materials- Elastics and inelastic action, Ferrous and non-ferrous metals and alloys, Mechanical properties and testing, Creep and Fatigue.
- Machine Design: Design process, Design factors and factors of safety, Riveted and welded joints, power screw, Design of shafts, Design of belts, ropes and drives, Design of gears, mechanical springs, Journal bearings and Rolling contact bearing.
- Mechanical Measurement: Elements of measurement systems. Sensors and Transducers, Strain gauges, Pressure and flow measurements, Bourdan tube, Diaphragm and bellows, Obstruction meters, Calibration methods, Temperature measurements, Thermocouple, Pyrometers, Speed, forces, torque and shaft power measurement, Tachometer and stroboscope.
- Manufacturing Processes: Mechanics of metal cutting, Machining and machine tool operations, Unconventional machining methods- EDM, ECM and ultrasonic machining, Limits, fits and tolerances, Inspection- Surface roughness & its measurement, gauging comparators, Metal casting, Metal Forming, Metal joining, Computer Integrated manufacturing, Flexible Manufacturing systems, Jigs and fixtures.
- Industrial Engineering & Operation Research: Production planning and control Inventory Control, Work study, PERT and CPM, Graphical and simplex methods for linear programming, transportation model, Quality control and its uses in product design.

### Part-B

- Thermodynamics: First and second laws of thermodynamics, Specific Heats, Entropy, Availability, Properties of Pure substances, Vapor and Combined Power cycles. Gas power cycles, boilers.
- Fluid Mechanics & Machinery: Fluid statics, kinematics of fluid motion, Viscous flow and Compressive flow, Reynold's transport theorem and its applications, Ideal fluid flow, Laminar and turbulent flow, boundary layer over a flat plate and in tube, Dimensional analysis and similitude, forces on immersed bodies, impact of jet, Impulse and reaction turbines, Centrifugal and reciprocating Pumps, Hydraulic devices.
- Heat Transfer: Steady state heat conduction, Critical thickness of insulation, Fins, One dimensional unsteady conduction, Dimensionless numbers, Natural and forced convection, Heat exchanger- effectiveness and number of transfer units, Radiation heat transfer, Stefan-Boltzmann law, Kirchhoff's law, Shape factor.

### Part-C

- Automotive Transmission; Clutch, Braking systems; manual, automatic braking and anti-lock braking system, Gear Box, Fluid Coupling, Hydrodynamic Torque converters, Hydrostatic and Electric Drives, Components and types of Automatic transmission, Variable transmission (CVT).
- Combustion phenomenon in S.I. and C.I. engines, Carburetion, fuel injection system in SI & CI Engines, MPFI, Types of injection systems, Fuel pumps, Fuel injectors, Turbocharging, Super charger, Engine Emission and Control, Fuels for SI and CI engine, Engine Cooling and Lubrication, Air compressor.
- Automotive chassis and suspension; Automotive Frames, Suspension System, Axles, Steering System, Steering Mechanisms, Steering Linkages. Different Types of Steering Gears, Hydraulic Power Assisted Steering, Under steering and over steering, Turning Radius Calculation.
- Wheels and Tyres; Wheel Balancing, and Wheel Alignment, Recent Trends In Chassis Systems.
- Automotive Air Conditioning: Fundamentals of automotive air conditioning, Automotive cooling and heating system, Air-conditioning controls, delivery system and refrigerants, Automatic temperature control.
- Automotive Electrical and Electronics: Charge storing devices, Starter systems. Charging Systems, Automotive Ignition systems, Auxiliary Systems, Control Units, Automotive Sensors and Actuators.
- Vehicle Transport Management and maintenance: Vehicle Maintenance, Motor Vehicle Act. Engine Maintenance, Chassis and Drive Line Maintenance, Electric System Maintenance, Charging system.



## SYLLABUS FOR LECTURER, CHEMICAL ENGINEERING, GOVERNMENT POLYTECHNICS

### **Process Calculations**

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non-reacting systems. Recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis. Humidity and Psychrometric chart.

### **Chemical Engineering Thermodynamics**

Laws of thermodynamics. Applications of first law to close and open systems. Second law and entropy. Thermodynamic properties of pure substances: Equations of state and residual properties. Properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

### **Fluid and Particle Mechanics**

Fluid statics, Newtonian and non-Newtonian fluids, transport properties, shell-balances including differential form of Bernoulli equation and energy balance, basic equations of fluid flow, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, velocity profiles, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds. Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

### **Heat Transfer**

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, LMTD, fouling factors; heat transfer by forced convection in laminar flow and turbulent flow, empirical equations; boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators, steam economy.

### **Chemical Reaction Engineering**

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, design equations for batch and flow reactors; single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single and two parameter models; non-isothermal reactors. kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

### **Mass Transfer**

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories, momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HETP, HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption, membrane separations.

### **Instrumentation and Process Control**

Qualities of measurement; measurement of temperature, pressure, liquid level, density, viscosity and composition. Sensors and transducers; P&ID equipment symbols.

Process modeling and linearization, transfer functions and dynamic responses of various systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop

systems including stability, frequency response, controller tuning, cascade and feed forward control.

### **Plant Design and Economics**

Principles of process economics, annuity and perpetuity; cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow and cash flow chart, optimization in process design and sizing of chemical engineering equipment such as heat exchangers and multistage contactors.

### **Chemical Technology**

Inorganic chemical industries (sulfuric acid, nitric acid, phosphoric acid, chlor-alkali industry), fertilizers (ammonia, urea, single and triple superphosphates); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers). Generic information regarding manufacturing of Cement, Pulp and Paper, Sugar and Distillery, Oil and Fats, Soaps and Detergents, Coal Chemicals, Paints and Pigments.

### **Industrial Pollution and Safety**

Air, water, and noise pollution; parameters and their classification; environmental pollution acts; pollution indices; measurement techniques and control strategies Fire and explosion hazards, HAZOP and HAZAN, disaster management.

## **SYLLABUS FOR LECTURER, AGRICULTURE ENGINEERING, GOVERNMENT POLYTECHNICS**

### **Soil and Water Conservation Engineering**

#### **Surveying and Levelling:**

Surveying – Principles, classification and measurements, types of scales, principles of chain surveying, types of ranging and chaining, Methods of traversing, Prismatic and surveyors' compass, angles and bearings. Errors in measurement, Plane tabling - Instruments and accessories, methods and principles. Computation of areas - methods. Levelling – Definition and benchmarks, types of levels, optical principles, lenses, telescopes, sensitivity of bubble tubes. Theodolite traversing, Total station, Introduction to setting of curves.

#### **Soil and Water Conservation Engineering:**

Soil erosion, types and agents of soil erosion. Forms of water erosion, Gullies and their classification. Soil loss estimation, USLE and MUSLE, determination of their parameters. Characteristics of Contours and preparation of contour maps. Erosion control measures. Cultural, agronomical and mechanical measures of erosion control including Contour bunds, graded bunds, broad base terraces and their design. Bench terraces and their design. Principles of gully control, ravine reclamation. Wind erosion- mechanics of wind erosion and soil loss estimation. Wind erosion control measures, wind breaks and shelter belts, sand dunes stabilization. Sedimentation in reservoirs and streams, estimation and measurement of sediment. Land capability classification. Grassed water ways and their design. Waste lands and their types, Introduction to water harvesting techniques.

#### **Soil and Water Conservation Structures:**

Introduction, classification and functional requirements of soil erosion control structures. Flow in open channels, types of flow, state and regimes of flow. Specific energy and specific force. Hydraulic jump, energy dissipation in hydraulic jump, Jump classification and applications. Runoff measuring devices and structures. Straight drop spillway. Components of spillway. Hydrologic and hydraulic design, Structural design of a drop spillway- uplift force calculations, safety against sliding, overturning, crushing and tension. Chute spillway- description and its components, Hydraulic design, energy dissipaters and design criteria of a SAF stilling basin. Drop inlet spillway- description, functional use and design criteria; Design of retaining wall and diversions; Small earth embankments- utility and types, design principles of earth embankments; Farm ponds and reservoirs. Cost estimation of structures.

#### **Watershed Hydrology:**

Introduction- Definition and importance, hydrological cycle. Precipitation- its forms and types. Measurement and analysis of precipitation. Point and areal rainfall analysis- mass curve, frequency analysis, plotting position, estimation of missing data, test of consistency of rainfall records, average areal rainfall. Interception, Infiltration, evaporation and evapotranspiration- measurements and estimation. Geomorphology of watersheds, Horton's laws. Runoff- components and estimation of runoff rate, runoff volume and peak runoff, SCS curve number method. Hydrograph- Unit hydrograph and its derivation for simple and complex storms, S-curve hydrograph. Dimensionless unit hydrograph. Synthetic unit hydrograph, distribution

hydrograph. Stream flow measurement, rating curve and its extension, Flood control methods. Hydrologic flood routing. Introduction to watershed management.

### **Watershed Planning and Management:**

Watershed management- Introduction, objectives, Problems and prospects. Watershed characteristics. Factors affecting watershed management. Hydrologic and climatological data for watershed planning and management. Land capability classification; Application of Remote sensing and GIS technologies in watershed planning and management. Watershed delineation and prioritization, Role of watershed management in flood control and drought mitigation, water yield assessment and measurement from a watershed. Sediment yield estimation and measurement from a watershed, Effect of cropping system, land management and cultural practices on watershed hydrology. People's participation in watershed management programmes. Planning and formulation of project proposal. Cost benefit analysis of watershed programmes. Optimal land use models.

## **Irrigation and Drainage Engineering**

### **Irrigation Engineering:**

Irrigation, major, medium and minor irrigation schemes of India, purpose of irrigation, sources of irrigation water, present status of development and utilization of different water resources of the country. Measurement of irrigation water, weir, notches, flumes, orifices and other methods. Water conveyance and design of irrigation field channels. Underground pipe conveyance system and irrigation structures. Channel lining. Land grading, different design methods and estimation of earth work and cost. Soil water plant relationship, soil water movement, soil moisture characteristic, crop water requirement, soil moisture constants, depth of irrigation, frequency of irrigation and irrigation efficiencies. Surface irrigation methods of water application, border, check basin, furrow and contour irrigation. Micro irrigation systems-Sprinkler and drip irrigation methods, merits, demerits, selection, design, installation, evaluation and maintenance. Command area development-basic concepts and development approaches, Irrigation water quality. Participatory irrigation management. Economics of water resources utilization.

### **Drainage Engineering:**

Drainage and familiarization with the drainage problems. Surface drainage and types of surface drainage systems. Sub-surface drainage and types of sub-surface drainage systems. Hydraulic conductivity and drainable porosity. Design of surface drains, interceptor and relief drains. Derivation of Hooghoudt's and Ernst's drain spacing equations. Design of subsurface drainage system. Drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains. Drainage structures. Vertical drainage. Bio-drainage. Tile Drains. Drainage of irrigated and humid areas. Salt balance, reclamation of saline and alkaline soils. Leaching requirements. Conjunctive use of fresh and saline waters. Economic aspects of drainage.

### **Design and maintenance of greenhouse:**

History and types of greenhouse, importance, function and features of greenhouse, scope and development of green-house technology. Location, planning and various component of component of greenhouse; design criteria and calculation; constructional material and methods of construction; post production quality and handling, cost analysis of greenhouse production, applications of greenhouse & its repairs and maintenance.

### **Groundwater, Wells and Pumps:**

Occurrence and movement of ground water. Aquifer and its types. Classification of wells. Steady and transient flow into partially, fully and non-penetrating and open wells. Groundwater exploration techniques. Design, construction and development of tube-wells. Determination of aquifer parameters. Well interference. Multiple well systems. Surface and subsurface exploitation and estimation of ground water potential. Quality of ground water. Artificial groundwater recharge planning. Different types of water lifting device. Types of pumps. Design principles, performance curves and selection of centrifugal, submersible, turbine and propeller pumps. Selection of prime mover and pulleys. Trouble shooting in pumping sets. Priming and self priming devices. Positive displacement pumps and Hydraulic ram. Centrifugal pumps performance curve, effect of speed on head capacity, power capacity and efficiency curve, effect of change on impeller on performance characteristics.

### **Farm Machinery & Power Engineering**

#### **Farm Power:**

Sources of farm power - conventional & non-conventional energy sources. Internal Combustion (IC) engines and terminology along with its classification. Thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle. Working principles of two stroke and four stroke engines. Study of engine components their construction, operating principles and functions. Engine systems: valves & valve mechanism. Fuel & air supply, cooling, lubricating, ignition, starting and electrical systems. IC engine fuels - their properties & combustion of fuels, gasoline tests, diesel fuel tests and their significance, detonation and knocking in IC engines. Study of properties of coolants, anti-freeze and anti-corrosion materials, lubricant types & study of their properties. Engine governing systems.

#### **Farm Machinery and Equipment:**

Objectives of farm mechanization. Classification of farm machines & terminology. Materials of construction & heat treatment. Principles of operation and selection of machines used for production of crops. Primary and secondary tillage implements. Forces acting on tillage tools. Minimum tillage, no-tillage equipment, happy seeder, super seeder and machinery for conservation agriculture. Hitching systems and controls. Draft measurement of tillage equipment. Earth moving equipment. Sowing, planting & transplanting machinery viz. seed drills, planters and transplanters, pneumatic planters, etc. Implements for intercultural operation. Fertilizer application equipment. Weed control and plant protection equipment – sprayers, dusters and their calibration, selection, constructional features of different components and adjustments. Harvesting and threshing machinery. Principles & types of cutting mechanisms. Construction & adjustments of shear & impact-type cutting mechanisms. Hay conditioning. Threshing mechanics. Equipment for harvesting viz, mowers, windrowers, reapers, reaper binders etc. Forage chopping & handling equipment. Straw combines & grain combines, maize harvesting & shelling equipment, cotton picking equipment. Straw management equipment viz, paddy straw chopper, SMS, rake and balers etc. Horticultural tools and gadgets. Principles of fruit harvesting tools and machines. Root crop harvesting equipment. Economics and cost of operation of tractor and machinery. Testing of farm machines. Test codes interpretation & procedure. Analysis of test results. Selection and management of farm machines for optimum performance. Human

engineering and safety- Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

### **Field Operation and Maintenance of Tractors and Farm Machinery:**

Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10, 50,100, 250,500 and 1000 hrs of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance and workshop requirements. Study operation and field adjustments of common primary and secondary tillage equipment and seed drills.

### **Tractor Systems and Controls:**

Different systems of tractors, types and selection. Study of transmission systems, clutch, gear box, differential and final drive mechanism. Familiarization of brake mechanism. Different steering and hydraulic systems. Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability. Ergonomic considerations and operational safety. Study of parameters for balanced design of tractor for stability & weight distribution, hydraulic lift and hitch system design. Controls of an agricultural tractor. Tractor Testing.

### **Farm Power and Machinery Management:**

The role of mechanization and its relationship to productivity, employment, social and technological change; performance and power analysis; cost analysis of machinery: fixed cost and variable costs, effect of inflation on cost; selection of optimum machinery and replacement criteria; Break-even analysis, reliability and cash flow problems; mechanization planning; case studies of agricultural mechanization in India.

### **Renewable Energy Sources, Biomass Management for Fodder and Energy:**

Classification of energy sources, Introduction to renewable energy sources, Introduction to biomass management – characterization, type, construction, working principle, uses and safety, environmental aspects of different energy devices. Brief introduction to wind energy, hydroelectric energy, ocean energy, biomass combustion, biodiesel preparation and energy conservation in agriculture. Biomass resource assessment management techniques/supply chains, Processing of paddy straw, densification - Extrusion process, pellets, mills and cubes, Briquetting and Baling-classification, uses; Processing of straw/ fodder for animal use; agricultural and horticultural use.

### **Post Harvest Engineering and Others**

#### **Engineering Properties of Biological Materials:**

Importance of engineering properties of biological materials, Study of physical characteristics of biological materials like shape, size, volume, density, roundness, sphericity, surface area, etc. Study of thermal properties such as specific heat, thermal conductivity, thermal diffusivity, etc. Study of mechanical properties such as texture, consistency, viscosity, etc. Rheological characteristics like stress, strain time effects, rheological models and their equations. Aerodynamic characteristics and frictional properties, terminal velocity, drag coefficient, internal and external friction, etc. Application of engineering properties in handling processing machines and storage structures.

**Dairy and Food Engineering:**

Importance of food processing, principles and methods of food processing. Unit operations in food processing such as drying, dehydration, milling, grinding, cutting, blanching, pasteurization, sterilization, evaporation, concentration, freezing, extraction etc. Processing of farm crops; cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed. Importance of moisture content and EMC and methods of their determination, EMC curve and models, principle of drying, theory of diffusion, periods of drying, thin layer, deep bed and their analysis, critical moisture content, drying models, calculation of drying air temperature and air flow rate, air pressure within the grain bed, Shred's and Hukill's curve, different methods of drying; Dryers- performance, energy utilization pattern and efficiency. Principal of size reduction and size reduction machines; crushers, grinders, cutting machines etc. - operation, efficiency and power requirement – Rittinger's, Kick's and Bond's equation, fineness modulus. Theory of mixing, types of mixtures for dry and paste materials, rate of mixing and power requirement, mixing index. Theory of separation, grading, sorting, etc. types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation. Theory of filtration, study of different types of filters, rate of filtration. Study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, pneumatic conveying, gravity conveyor- design consideration, capacity and power requirement. Dairy- development and scope. Processing of animal products. Engineering, thermal and chemical properties of milk and milk products, process flow charts for product manufacture. Unit operation of various dairy processing systems, pasteurization, sterilization, homogenization, centrifugation and cream separation. Dairy plant design and layout, plant utilities.

**Food Quality Analysis:**

Concept, objectives and need of quality, quality control, methods of quality control, sampling techniques, Food Laws and Regulations in India. Food grades and standards BIS, AGMARK, PFA, FPO, CAC (Codex Alimentarius Commission), sanitation in food industry, GMP, HACCP (Hazard analysis and critical control point) and ISO 9000 Series.

**Principle of Refrigeration and Cold Storage:**

Principles of refrigeration, second law of thermodynamics applied to refrigeration, Carnot cycle, reversed Carnot cycle, coefficient of performance, unit of refrigeration. Refrigeration in food industry, types of refrigeration system, design of cold storages, defrosting. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, humidifiers and dehumidifiers – cooling and calculations, psychometric chart and its use, elementary psychometric process.

**Agricultural structures:**

Planning and layout of farm stead, animal shelters, compost pit, fodder silos, fencing and implement sheds, barn for cows, buffaloes, sheep/goat, poultry etc; norms of water supply for human beings and animals, sewage system and its design, design of septic tank for a family. BIS standards for dairy, piggery, poultry and other farm structures. Traditional and improved grain storage structures. Shallow and deep bins, storage of seeds. Site and orientation of building in regard to sanitation, community sanitation system. Cost analysis and maintenance.

# **SYLLABUS FOR LECTURER, PHARMACY, GOVERNMENT POLYTECHNICS**

## **PHARMACEUTICS**

### **GENERAL PHARMACY & DISPENSING PHARMACY**

History of Pharmacy, Introduction to official Books, Principles of dispensing: Definition of prescription & its parts, handling, pricing of the prescription, detection of overdose in prescription, common Latin terms & abbreviations useful in the interpretation of prescription & their translation into English. Preparation of dosage forms (Syrups, elixirs, infusions, decoctions, tinctures, spirits, extracts, jellies, lotions, liniments, douches, gargles, enemas, inhalations, sprays, eye drops, ear drops & nasal drops, aromatic water), Pharmaceutical Dosage forms: Dispensing of powders, creams, ointments, pastes, gels, suppositories, with special reference to closures & containers required to dispense the above dosage forms, Extraction Process, Posology, Pharmaceutical Calculations, Incompatibility

### **PHYSICAL PHARMACY**

States of matter, Micromeritics and Powder Rheology, Surface and Interfacial Phenomenon, Viscosity and Rheology, Disperse Systems (Colloidal Dispersions, Suspensions, Emulsions), Kinetics and Drug Stability, Complexation, Solubility and Distribution Phenomenon

### **PHARMACEUTICAL UNIT OPERATIONS**

Concept of Unit Operations, Fluid Flow, Material Handling Systems, Size reduction & size separation, Filtration, Mixing, Centrifugation, Crystallization, Dehumidification and Humidity Control, humidification operations, refrigeration, Heat Transfer, Evaporation, Distillation, Drying, lyophilization

### **HOSPITAL & COMMUNITY PHARMACY**

Organization of a hospital & hospital pharmacy, Hospital formulary, Drugs store Management & inventory control, Central sterile supply unit & its management, Surgical products, Pharmacy of Biological products, Radio diagnostic techniques, Blood products and plasma substitutes

### **COMMUNITY PHARMACY**

Organization & structure of retail & wholesale drug store, Concept of health, Theories of concept of disease, demographic cycle & family planning methods.

Communicable Disease: Causative agents, modes of transmission, prevention & control (Respiratory infections, Intestinal Infections, Arthropod borne infection, Surface infections, Sexually transmitted diseases).



## **PHARMACEUTICAL TECHNOLOGY**

Preformulation Studies, Semisolid Dosage Forms, Tablets, Capsules, Microencapsulation, Pharmaceutical Process Validation, Parenteral Products, Ophthalmic Preparations, Pharmaceutical Aerosols, Sustained and Controlled Drug Delivery System, Novel Drug Delivery Systems, Packaging of Pharmaceutical Products, Stability Testing Protocols, Cosmetology and Cosmetic Preparations, Quality Control and Quality Assurance (including c-GMP) GLP, ISO 9000, TQM, Quality Review and Quality, Documentation, Regulatory Control, Regulatory Drug Analysis, Interpretation of Analytical Data.

## **BIOPHARMACEUTICS AND PHARMACOKINETICS**

Drug Absorption, Drug Distribution, Bioavailability and Bioequivalence, Drug Biotransformation, Drug Excretion, Pharmacokinetics, Compartment Models, Non-Compartment Models, Dosage Regimen

## **PHARMACEUTICAL INDUSTRIAL MANAGEMENT**

Plant Location and layout of an Industry, Planning and Decision making, Production Planning and Control, Personnel Management, Pharmaceutical Marketing, Sales forecasting, Salesmanship, Market Research, Finance, Accountancy.

## **PHARMACEUTICAL MICROBIOLOGY**

Definition of microbiology & application of microbiology in pharmacy, Structure of bacterial cell, Classification of microbes and their taxonomy, General microbiological techniques, Control of microbes by physical and chemical methods, Microbial genetics and variation, Microbial attack and host defense, virulence and pathogenicity, primary and specific defense mechanisms of body, infection and its transmission, interferons, Microbial standardization of antibiotics, vitamins and amino acids, Immunology and Immunological preparations, Genetic engineering, Biologicals products obtained by fermentation (production of penicillin, streptomycin, tetracycline, vitamin C, riboflavin, citric acid, statin)

Aseptic techniques, source of contamination and method of prevention, design of aseptic area.

## **PHARMACEUTICAL CHEMISTRY**

### **PHARMACEUTICAL ORGANIC CHEMISTRY**

General principles, Pericyclic reactions, Aromaticity & chemistry of aromatic compounds, Chemistry of Amino acids & proteins, Chemistry of Polycyclic aromatic hydrocarbons, Stereochemistry, Carbohydrates, Carbonyl Chemistry, Heterocyclic Chemistry, Protection & deprotection of groups, Bridged rings Kinetic & thermodynamic control.

Stereochemistry: nomenclature, isomerism, stereoisomerism, conformational and configurational isomerism, optical activity, specification of configuration, reactions involving stereoisomers, chirality, conformations.

## **PHARMACEUTICAL INORGANIC CHEMISTRY**

Acid & bases, buffers, Limit Test of Chloride, Iron, lead, Sulphur, arsenic, heavy metals, Dentifrices, desensitizing & anti-caries agents Pharmaceutical Impurities, Isotopes, Radiopharmaceuticals, Gastrointestinal agents, Topical agents.

## **MEDICINAL CHEMISTRY**

Drug nomenclature, classification, MOA, SAR, synthesis of simple and prototype molecules, drug metabolism, therapeutic uses and side effect of different classes of therapeutic drugs (General and local anesthetics, diagnostic agents, coagulants and anti-coagulants, antiseptics and disinfectants, anti- protozoal, anti- malarial, anthelmintic, anti- bacterial, anti-mycobacterial, anti- viral, Anti-cancer, hypoglycemic, anti- convulsant, hypnotics and sedative, anti-hypertensive, adrenergic and cholinergic drugs. Computer Aided Drug Design (QSAR & Hansch analysis).

## **BIOCHEMISTRY**

Biomolecules, Bioenergetics, Enzymes, Nucleic acids, Vitamins, Biological oxidations & reductions, Metabolism of Carbohydrates, lipids and Proteins.

## **PHARMACOLOGY**

Human Anatomy and Physiology: Cell physiology, Introduction to genetics, Endocrine Glands, Gastrointestinal tract, Respiratory System, Autonomic nervous system, Central Nervous system, Cardiovascular system, Lymphatic system. Blood, Sense organs, Skeletal System Urinary System. Reproductive System.

General Pharmacology, Principles of toxicology, Drugs acting on urinary system, Pharmacology of peripheral nervous system, Pharmacology of central nervous System, Pharmacology of cardiovascular system, Immunopharmacology, Drugs acting on Respiratory system, Pharmacology of Endocrine system, Neurohumoral transmission in autonomic and central nervous system, Vitamins & Minerals, Chemotherapy, Autacoids and their Antagonists, Pharmacology of drug acting on the gastrointestinal tract, Chronopharmacology. Pharmacological Screening methods.

## **CLINICAL PHARMACY AND THERAPEUTICS**

Drugs used in pregnancy and lactation, Drug therapy in gastrointestinal, hepatic, renal, cardiovascular and Respiratory Disorders, Pharmacovigilance, Dietary supplements and Nutraceuticals, essential drugs and rational drug usage, General Principles, preparation, maintenance, analysis of observational records in Clinical Pharmacy, Drug therapy in infections of respiratory system, urinary system, infective meningitis, TB, HIV, malaria and filaria, Drug therapy for thyroid and parathyroid disorders, diabetes mellitus, menstrual cycle disorders, menopause and male sexual dysfunction, Drug therapy for malignant disorders like leukaemia, lymphoma and solid tumours, Drug therapy for rheumatic, eye and skin disorders Clinical trials,

type and phases of clinical trials, placebo, ethical and regulatory issues including Good clinical practice in clinical trials, Drug therapy for neurological and psychological disorders.

### **PATHOPHYSIOLOGY**

Basic principles of cell injury and adaptation, Neoplastic diseases, Pathophysiology of common diseases, Laboratory tests for Liver function tests and kidney function tests, Immunopathology including amyloidosis, Infectious diseases, Basic mechanisms of inflammation and repair, Disorders of fluid, electrolyte and acid-base balance, Disorders of homeostasis: white blood cells, lymphoid tissues, and red blood cells related diseases, Bones and joints, STD.

### **PHARMACOGNOSY AND PHYTOCHEMISTRY**

Introductory Pharmacognosy, Classification of crude drugs, Plant products, Principles of plant classification, Pharmaceutical aids, Animal products, Traditional herbal drugs, Plants based industries and research institutes in India, Ayurvedic system of medicine, Toxic drugs, Natural pesticides and insecticides, Adulteration and evaluation of crude drugs, Quantitative microscopy, Factors influencing quality of crude drugs, Techniques in microscopy, Introduction to phyto-constituents, Biogenetic pathways, Carbohydrates & lipids Tannins Volatile oils, Resinous drugs, Glycosides Alkaloids, Flavonoids, terpenoids, Marine drug, Extraction and Isolation Techniques of Phytopharmaceuticals, Quality control and Standardization of herbal drugs, Herbal formulations, Regulatory issues, Worldwide trade of crude drugs and volatile oils, Herbal cosmetics.

### **PHARMACEUTICAL ANALYSIS**

Quality control in pharmacy, Acid-base titrations, Non-aqueous titrations, Precipitation titrations, Gravimetry, Oxidation-reduction titrations, Complexometric titrations, Potentiometry, Polarography, Nephelometry & Turbidimetry, Flame photometry

**General principles of spectroscopy:** Ultraviolet-visible Spectrometry, Infrared spectrometry, Spectrofluorimetry, atomic absorption spectrometry, Proton nuclear magnetic resonance spectrometry, Mass spectrometry, Principles and general classification of Chromatography, HPLC, HPTLC and GLC.

### **PHARMACEUTICAL JURISPRUDENCE**

Historical background of Drug legislation in India, New Drug applications, Consumer Protection Act, Indian Pharmaceutical Industry and Rules there under Factory Act Shops and Establishment Act, Minimum Wages Act 1948, Prevention of Food Adulteration Act 1954 and Rules Industrial Development and Regulation act 1951, The Pharmacy Act 1948 Drugs and Cosmetics Act 1940, Rules 1945, Drug (Price Control) Order, National Pharmaceutical Pricing Authority, Code of Ethics for Pharmacists, Narcotic Drugs and Psychotropic Substances Act, Medicinal and Toilet Preparations (Excise Duties) Act 1955, Prevention of Cruelty to Animals Act 1960, An Overview

Medical Termination of Pregnancy Act 1970 and Rules 1975, Introduction to Intellectual Property Rights and Indian Patent Act 1970, Drugs and Magic Remedies (Objectionable Advertisements) Act 1954, Rules 1976.

### **COMPUTER AND ENVIRONMENTAL SCIENCES**

Computer language and programming, Computer application to pharmaceutical and clinical studies (Pharmaceutical Research & Development, Computational Modeling, Market Analysis, in Clinical Development, Artificial Intelligence (AI) and Robotics.

Environmental studies of Natural Resources, Eco system, Environmental pollution, Biomedical and Biochemical waste disposal management.

## SYLLABUS FOR LECTURER, PHYSICS, GOVERNMENT POLYTECHNICS

### 1. Mathematical Methods in Physics:

Dimensional Analysis, Vector Algebra and vector calculus, Concepts of Tensors, Linear ordinary differential equations of first and second order, Special functions (Legendre, Hermite, Bessel, Laguerre functions), Fourier series, Fourier and Laplace transforms, Partial differential equations (Laplace, wave and heat equations in two and three dimensions), Elementary probability theory, Random variables, binomial, Poisson and normal distributions.

### 2. Classical Mechanics:

Dynamics of particle and system of particles, Conservation laws of linear momentum, angular momentum and energy, Central force motion, Reduction of two body central force problem, Planets and satellite motion, Communication satellite, D'Alembert's principle, Generalised coordinates, Lagrangian equations, Cyclic coordinates, Hamiltonian formulations, Canonical transformation, Poisson brackets, Hamilton – Jacobi theory, Rigid body motion, Relative motion and Galilean transformation, Special theory of relativity; Lorentz transformation, length contraction, time dilation, velocity addition, simultaneity, Mass-energy equivalence, Doppler effect in light.

Elastic behaviour of loaded wire, Elastic constants, Torsion of cylinder, Bending of beams, cantilever, surface tension, surface energy, angle of contact, capillarity, Excess pressure, ideal fluid, hydrodynamic equations, Viscous force (Newton's law, Poiseuille's law)

### 3. Thermodynamics and Statistical Physics:

Laws of thermodynamics and their consequences; Thermodynamical scales, Thermodynamical potentials, Maxwell's relations, Clausius–Clapeyron equation, Heat engine, Carnot cycle, Refrigerator, Transport phenomenon of gases, kinetic theory of gases, Equipartition of energy, Viscosity, Black body radiation, Kirchhoff's laws, Planck's distribution law and derivation of Stefan's law, Wien's law, Phase space, micro and macro-states, Micro-canonical, canonical and grand canonical ensembles and partition functions, Free energy and connection with thermodynamic quantities, First and second order phase transitions, Classical and quantum statistics, ideal Fermi and Bose gases, Bose-Einstein condensation, Thermodynamic and statistical Entropy, Gibb's paradox and its resolution, Free electrons in metals.

### 4. Quantum Mechanics:

Wave-particle duality, Matter waves, Uncertainty principle, Photo electric and Compton effects, Davisson-Germer experiment, Wave packets, Time dependant and time independent Schrödinger equations, Physical significance of wave function, Normalisation, Orthogonality, Eigen value, Eigen function, Eigen value problems such as particle in a box, Harmonic oscillator, etc, Tunnelling through a barrier, Motion in a central potential, Orbital angular momentum, Angular momentum algebra, Hydrogen atom, spin-orbit coupling, fine structure, Time-independent perturbation theory and its applications, Time-dependant perturbation theory and Fermi's Golden rule, Elementary theory of scattering, phase shifts, partial waves, Born approximation, Pauli's exclusion principle, spin-statistics connection.

### 5. Atomic and Molecular Physics:

Bohr's and Somerfield atomic models, Hydrogen like atoms, Optical spectra and x-ray spectra, Moseley law, Vector atom model, Bohr magnetron, Larmor frequency, Stern-Gerlach experiment, Quantum states of electron in atom, Spectrum of Hydrogen, helium and alkali atoms, Relativistic correction for energy levels of hydrogen, Hyperfine structure and isotopic shift, Selection rules, Width of spectral lines, L-S and J-J couplings, Lande g-factor, Zeeman effect (normal and

anomalous), Paschen-Beck effect, Stark effect, Electronic, rotational, vibrational molecular spectra, Raman effect, Phosphorescence effect, Electron spin resonance, Nuclear magnetic resonance, Spontaneous and stimulated emission, Einstein A and B coefficients, Lasers, Optical pumping, Population inversion, Rate equation.

#### **6. Electromagnetic Theory:**

Gauss's law and applications, Laplace and Poisson equations, Boundary value problems, Biot-Savart law, Ampere's law, Electromagnetic induction, Conduction and displacement currents, Maxwell's equations in free space and linear isotropic media, Boundary conditions at interfaces, Scalar and Vector potentials, Gauge transformations, Poynting theorem, Electromagnetic waves in free space, dielectrics and conductors, Transmission line and waveguides, Reflection, Refraction and Polarisation, Fresnel's equation, Dispersion of electromagnetic waves, Dynamics of charged particle in uniform electromagnetic field, Radiation from moving charges, dipoles and retarded potentials.

#### **7. Optics:**

General theory of image formation, Cardinal points, Thick and thin lenses, Huygen's and Ramsden eyepieces, Telescopes and microscopes, Defects of vision, Human eye and camera, Theories of light, Concept and condition of interference, Young's double slit experiment and its results, Biprism, Colours in thin films, Newton's rings, Michelson interferometer, Fabry-Perot interferometer, Fresnel and Fraunhofer diffraction, Zone plate, Diffraction from single and multiple slits, Plane grating, Resolving power of grating and optical instruments, Limit and criteria of resolution, Unpolarized and polarized light, Polarization of light, Production and analysis of polarized light, Double refraction, Malus law, Nicol prism, Half and quarter wave plates, Optical rotation, Polarimeters, Ruby lasers, He-Ne lasers, semi-conductor lasers, applications of lasers, Holography.

#### **8. Electronics:**

Intrinsic and extrinsic semi-conductors, Physics of P-N junction, Diode and its applications as a circuit element, clipping and clamping, Zener diode regulated power supply, Transistor as common cathode(CC), common base(CB) and common emitter(CE) amplifiers, Transistor as a switch, Feedback in amplifiers, Oscillators, FET, MOSFET and their applications, Operational amplifier and its applications, Analog and digital signals, Digital integrated circuits, Logic gates, NAND and NOR gates as building blocks, XOR gate, Half and full adder circuits, Truth tables, Venn diagram, Boolean functions, Boolean theorems, Microprocessors, Flip-flops, Opto electronic devices(LED, photo detectors, photo transistors, solar cells), Mean and rms values in AC circuits, Series and parallel resonances in LR, CR, LCR circuits, Quality factor.

#### **9. Condensed Matter Physics:**

Crystal structure, Miller Indices, Bravais Lattice, diffraction and the structure factor, Bonding of solids, Elastic properties, Phonons, Lattice specific heat, Free electron theory and electron specific heat, Einstein and Debye models, Response and relaxation phenomenon, Drude model of electrical and thermal conductivity, Boltzmann transport equation, Sommerfeld theory of electrical conductivity, Mathiessen's rule, Hall effect and thermoelectrical power, Origin of atomic magnetism, Dia-magnetism, Para-magnetism and Ferro-magnetism, Electron motion in periodic potential, Band theory of metals, Kronig-Penny model, Effective mass of free electrons and holes, concept of holes, insulators and semi-conductors, Superconductivity, Type I and type II superconductors, BCS theory, DC and AC Josephson effects, Semi-conductors: laws of mass action, impurity conductivity, Photo conductivity and photo luminescence.

#### **10. Nuclear and Particle Physics:**

Nuclear size, shape, charge distribution, spin and parity, Binding energy, Binding energy per nucleon curve, Semi-empirical mass formula, Nature of nuclear forces, Charge-independence and charge symmetry of nuclear forces, Deuteron problem, Radioactivity, Age of rocks and carbon dating, Theory of beta-decay and selection rules, Nuclear reactions, Compound nuclear formation and direct reactions, Nuclear fission and fusion, Controlled and uncontrolled chain reactions, Thermo nuclear reactions, Nuclear reactors, Liquid drop model, shell model, collective model, Nuclear detectors (ionisation chambers, G.M. counters, semi-conductor detectors), Fundamental forces, Classification of elementary particles on the basis of spin, mass, and interaction, Quantum numbers (charge, spin, parity, isospin, strangeness) of elementary particles, Quark model, Baryons, Leptons, Mesons and conservative laws, Parity non-conservation in weak interaction, Particle accelerators.

**SYLLABUS FOR LECTURER, CHEMISTRY, GOVERNMENT  
POLYTECHNICS  
INORGANIC CHEMISTRY**

**1. Atomic and nuclear and radio chemistry:**

Bohr's theory and its limitation, De- Broglie equation, Heisenberg S principle of uncertainty, quantum theory-wave particle duality, Schrodinger wave equation, Quantum numbers and their significance, shape of the orbitals, energy of H atom orbitals.

Nuclear models, radioactive decay, mass defect, binding energy, fission and fusion, isotopes, isobars, isodiapheres and application of isotopes in medicinal science.

**2. Periodicity in properties of atoms:** Variation of orbital energies of atoms, atomic size, ionic size, ionization energies, electron affinity, electronegativity, hydration energy, lattice energy.

**3. Chemical bonding:** Hybridization, valence bond theory, valence shell electron pair repulsion theory (VSEPR), MO theory-molecular orbital diagram of homo and hetero molecular diatomic molecules.

General properties of s and p block elements

Oxidation-reduction, oxidizing and reducing agents, balancing of redox reactions.

Concepts of acids and bases, Bronsted-Lowry theory, Lewis concepts of acids and bases, Hard and soft acids and bases.

**4. Chemistry of transition elements and coordination chemistry:**

Properties with special reference to variable oxidation state, magnetic, colour and complexation behavior, metal to ligand and ligand to metal charge transfer spectra, metal atom clusters.

Nomenclature and isomerism in co-ordination compounds, ligand field theory, high spin and low spin complexes, CFT, CFSE and John-Teller effect, MOT, Orgel diagrams, selection rules for electronic transitions, spectroscopic ground state for  $d^1$  to  $d^9$  system.

**5 Chemistry of non-transition and inner transition elements:**

Preparation, properties and bonding in diborane and higher boranes, polyhedral borane anions and carboranes, borazines, borane nitrile, silicones and silicates, phosphonitrilic compounds, interhalogen xenon compounds.

Lanthanides and actinides contraction, oxidation state, super heavy elements, analytical and medicinal applications, spectral and magnetic properties, principle of separation and isolation.

**6. Organometallic compounds:** Synthesis, structure, bonding, reactions and reactivity, applications in homogeneous Catalysis cage and cluster compounds.

**Symmetry and group theory:** Symmetry elements and symmetry operations, definition of group and sub groups, point symmetry groups assignment of point groups of molecules like-NH<sub>3</sub>, H<sub>2</sub>O, PCl<sub>5</sub> and XeF<sub>4</sub>.

**7. Bioinorganic and supra molecular chemistry:** Essential and trace elements in biological processes, hemoglobin and myoglobin, biological role of alkali and alkaline earth metals with special reference to Ca<sup>2+</sup>, photosynthesis and nitrogen fixation, introduction and nomenclature of supramolecules, molecular recognition and carrier design.

**8. Green chemistry and nano chemistry:** Principles of green chemistry and sustainable development, green reagents and green synthesis. Introduction to nano particles, Nano science and nano technology, optical and magnetic properties of nano material, characterization of nano materials by TEM, SEM, SPMT, AFM, X-ray diffraction and ASCA.



**9. Environmental chemistry:** Air pollution- pollution due to SO<sub>x</sub>, NO<sub>x</sub>, Ozone depletion and green house effect, photochemical smog, reaction of hydroxyl radical with CH<sub>4</sub>, SO<sub>x</sub>, and NO<sub>x</sub>.  
Water pollution-international standards of drinking water, water quality parameters COD, BOD, TDS, pH etc., treatment of potable and sewage waste water.

Soil pollution-contamination of soil with anomalous concentrations of toxic substances.

**10. Statistical data analysis and analytical technique:** Introduction to error analysis and statistical methods in chemical analysis. and applications of AAS, DTA, TGA, complexometric estimations and Chromatographic techniques.

## ORGANIC CHEMISTRY

**1. Spectroscopy:** (i) Basic principles of IR, UV, microwave spectroscopy, mass spectrometry.

(ii) Application of UV, IR, NMR, and mass spectrometry in structure elucidation of organic molecules.

**2. Nomenclature of organic compounds:** (a) IUPAC nomenclature of aliphatic, aromatic, bicyclo compounds and spiranes.

(b) **isomerism:** (i) Structural isomerism, tautomerism.

(ii) Stereochemistry- elements of symmetry, chirality, prochirality, RS nomenclature, enantiomerism, diastereoisomerism, racemic modifications, methods of resolution, optical purity, asymmetric synthesis, enantiotropic and diastereotropic groups and faces, stereospecific and stereoselective reactions.

E, Z isomerism, conformational analysis of mono and disubstituted cyclohexanes, effect of conformation on reactivity of compounds.

**3. Organic reaction mechanism:** (a) General methods of determination of mechanism of a reaction. Steric and field effects (Inductive, electromeric, mesomeric and hyperconjugative effects). Reaction intermediates- carbocations (classical and non-classical), carbanions, free radicals, carbenes, nitrene and benzyne.

(b) Mechanism of following name reactions: Aldol condensation, Benzoin condensation, Cannizzaro reaction, Dieckmann condensation, Diels-Alder reaction, Ene-Barton reaction, Hoffmann degradation reaction, Knoevenagel reaction, Mannich reaction, Perkin reaction, Reformatsky reaction, Reimer -Tiemann reaction, Robinson annulation, sharpless epoxidation, Vilsmeier reaction, Wittig reaction, Rearrangement reaction- Backmann rearrangement, Curtius, Baeyer-Villiger, Hoffmann, Pinacol-Pinacolone, Schmidt, Sommelet-Hauser, Wagner-Meerwein.

**4 (a) Aromaticity:** Concept of aromaticity, Anti-aromaticity, Homo- aromaticity.

(b) (i) Aromatic electrophilic substitution- mechanism, orientation and reactivity, o/p ratio. Ipso attack, Introduction of 3rd group into benzene ring, Vilsmeier- Haack reaction

(ii) Aromatic nucleophilic substitution- ArSN<sup>1</sup>, ArSN<sup>2</sup>, Benzyne and SRN<sup>1</sup> mechanism.

**5. Pericyclic reactions.** Molecular orbital symmetry, classification of pericyclic reactions. Woodward-Hoffmann rule. correlation diagrams, FMO and PMO approach, electrocyclic and cycloaddition reactions, sigmatropic rearrangements

(Cope, Aza-Cope and Claisen rearrangements), group transfer reaction-Ene reactions.

**6. Organic photochemistry:** Jablonsky diagram, Fluorescence and phosphorescence, photosensitization, photochemistry of alkenes- cis-trans isomerization, photochemical additions of (1,3), (1,4) and (1,5) dienes, dimerization. Photochemistry of Carbonyl compounds- Norrish Type- I and Norrish Type- II reactions, Paterno-Buchi reaction, photoreduction,

rearrangement reactions of  $\beta$ - $\gamma$  unsaturated ketones, cyclohexanones, and 2,5 cyclohexadienes. Photochemistry of aromatic compounds.

**7. Heterocyclic Compounds:** Classification and nomenclature of monocyclic and polycyclic Heterocyclic compounds, Chemistry of 5 and 6 membered Heterocycles- pyrrol, furan, thiophene and pyridine.

**8. Natural products:** Classification, Nomenclature, isolation techniques and structure determination of (a) Alkaloids (b) Terpenoids (c) Terpenes and (d) Carotenoids.

**9 Natural polymers:** Classification and structure determination of- (a) Carbohydrates (b) Proteins (c) Nucleic acids.

**10. Medicinal Chemistry:** Drug designing, an introduction to pharmacodynamics

## PHYSICAL CHEMISTRY

### 1. Quantum Chemistry

Operators and basic postulates. Time — dependent and time -independent Schrodinger wave equation. Schrodinger wave equation for hydrogen atom (a complete solution). Time — dependent perturbation theory of non-degenerate and Variation method. First-order correction to energy and wave function. Application to: ground state Helium atom, particle in one — dimensional box and harmonic oscillator. The Born-Oppenheimer approximation. Huckel molecular orbital theory for  $\pi$  — electron system and its application to benzene and 1,3 — butadiene and cyclobutadiene.

### 2. Solid State Chemistry

Types of solids and defects and non- stoichiometry associated with. Thermal, electrical and magnetic properties of solids. Crystallinity of solids, unit — cell, Bravais lattice and Miller indices. X-ray diffraction by crystalline solids (Bragg's law). Crystal defects and non-stoichiometry. Semiconductors and their electronic properties and band theory.

### 3. Electrochemistry

Electrolysis, electrochemical cells and electrochemical series. Thermodynamics of electrochemical cell. Chemistry of fuel cell. Electrochemistry of corrosion, causes and prevention. Debye — Huckel theory (a complete quantitative treatment). Activity, activity — coefficient and mean activity coefficient.

### 4. Thermodynamics

First - , second and third — Law of thermodynamics. Hess's law and Its applications. Heat capacity at constant volume and pressure. Joules — Thomson effect. Thermodynamics of ideal gas expansion under isothermal adiabatic conditions for reversible processes. Carnot cycle and its efficiency. Heats of reaction at constant volume and pressure. partial molar quantities and their determination. Gibbs- Duhem equation. Gibbs and Helmholtz functions and their variation with P, v, anT. Maxwell relations

### 5. Statistical Thermodynamics

Ensembles, canonical ensembles and grand canonical a=ensembles. Molecular partition function (vibrational, rotational and translational) and their relation with thermodynamic quantities. Boltzmann-statistics, Bose-Einstein and Fermi — Dirac statistics. Phase rule.

### 6. Chemical Kinetics

Order and molecularity of a reaction. Kinetic and thermodynamic controlled reaction. Kinetics of photo — induced ( $H_2 + Cl_2$ ), thermally induced ( $H_2 + Br_2$ ), consecutive and parallel reactions. Transition state theory of reaction state.

and activation energy of reaction rate. Catalysis (homogeneous and heterogeneous), and activation energy. Fundamentals of Enzyme catalyzed reaction.

### **7. Solutions**

Ionic equilibria, pH, buffer and buffer action. Units of Concentration of solutions.

Theory of indicators. Colligative properties and their determination and applications. Law of chemical equilibrium and rate constant. Phase Rule and construction of phase diagram in respect of one and two-component systems.

### **8. Spectroscopy**

Nuclear magnetic resonance (NMR): principle, chemical shift and spin — spin coupling. Factors influencing chemical shift and spin — spin coupling. First — order Coupling in NMR. Relaxation phenomenon in NMR: longitudinal and transverse relaxations. Electron spin resonance (ESR): principle. Shielding constant, fine and hyperfine structure in ESR. Zero-field splitting in ESR and McConnell relation. Rotational, vibrational and rotational — vibrational spectra rigid and non-rigid diatomic molecule.

Raman spectroscopy: principle and mutual exclusion principle.

### **9. Physical Chemistry of Polymers**

Molecular weights of polymers, and their methods of determination (viscosity, osmometry, sedimentation and light — scattering). Crystallization and morphology of polymer. Glass-transition temperature ( $T_g$ ) and melting temperature ( $T_m$ ) of polymer.

Chemistry of Zeigler — Natta catalysis in context of polymer. Introduction to rheology, mechanical and conducting properties of polymer. Florry — Krigbaum theory of dilute polymer solution.

### **10. Surface Chemistry and Colloids**

Adsorption, types of adsorption and adsorption isotherms (Freundlich, Langmuir and BET adsorption isotherms). Colloids and their properties. Electrical phenomenon at solid / liquid interface (zeta — potential) Introduction to surfactants, micelle, reverse — micelle and micellar action. Micellization, critical micelle concentration and thermodynamics of micellization. Catalytic activity at solid surface: hydrogenation, oxidation, cracking and reforming.

## SYLLABUS FOR LECTURER, MATHEMATICS, GOVERNMENT POLYTECHNICS

**1. Algebra:** Sets, relations and mappings. Groups and their properties, Order of an element, Order of a group, Permutation groups, Cyclic groups and their properties, Subgroups and their properties, Cosets and their properties, Homomorphism and isomorphism, Normal sub-groups and their properties, Definitions and examples of rings, integral domains and fields.

**2. Matrices and Determinants:** Types of matrices, Elementary operations, Rank and inverse of matrices. Determinants and their properties, Solution of system of linear equations upto three variables, Characteristic values and vectors, Cayley- Hamilton theorem, Diagonalisation.

**3. Differential Calculus:** Limit, continuity and differentiability, Rolle's and mean value theorems. Tangents and normals, Curvature, Asymptotes, Partial differentiation, Euler's theorem, Maxima and minima of functions of one and two variables.

**4. Integral Calculus:** Definite integrals and their properties, Beta and Gamma functions, Double and triple integrals, Quadrature, rectification, surface area and volume.

**5. Analytical Geometry:** Circle, parabola, ellipse and hyperbola (Cartesian system), Coordinates in three dimensions, Planes, straight lines, sphere, cylinder and cone.

**6. Vector Analysis:** Scalar and vector products of three and four vectors, Differentiation of Vectors, Directional derivative, Gradient, divergence, curl and their identities. Line, surface and volume integration of vectors, Gauss divergence, Stoke's and Green's theorems.

**7. Differential Equations:** First order linear and non-linear differential equations, Singular solutions, Second order linear differential equation with constant and variable coefficients. Simultaneous and total differential equations. Solution of partial differential equations of first order by Lagrange's and Charpit's methods.

**8. Statics:** Equilibrium of co-planner forces, Virtual work, Centre of gravity, Common catenary.

**9. Dynamics:** Velocity and acceleration along radial, transverse, tangential and normal directions. Simple harmonic motion, Rectilinear motion under various laws, Moments and products of inertia, Motion in two dimensions.

**10. Complex Analysis:** Complex numbers and their algebraic properties, De Moivre's theorem and its applications, Exponential, logarithmic, hyperbolic, inverse circular and inverse hyperbolic functions. Separation into real and imaginary parts. Continuity and differentiability of complex functions, Analytic function, Cauchy-Riemann equations. Complex integration, Cauchy's theorem, Cauchy's integral formula Taylor's and Laurent's theorems, Singularities, Residues and Cauchy's residue theorem.

**11. Numerical Analysis:** Numerical solution of non-linear equations by Bisection, fixed point iteration, Secant, Regula-Falsi and Newton-Raphson Methods. Finite difference operators, Interpolation by Newton-Gregory, Lagrange's and Newton's divided difference formulae. Numerical differentiation, Numerical integration by Trapezoidal rule, Simpson Rules and Weddle's rule. Numerical solution of system of linear equations by Jacobi, Gauss-Seidel methods. Numerical solution of ordinary differential equations by Euler's and Runge-Kutta methods.

**12. Mathematical Statistics:** Probability, Conditional probability, Addition and multiplication theorems, Bayes' theorem, Expectations, Moment generating function, Probability distributions: Binomial, Poisson and Normal, Correlation and regression.

**13. Operations Research:** Convex sets and functions, LPP and its solution by graphical and Simplex methods. Degeneracy and duality. Transportation and assignment problems. Game theory.

**14.Real Analysis:** Convergence of numerical sequences and series, Uniform convergence of sequences and series of functions, Convergence of improper integrals.

**15.Linear Algebra:** Vector spaces, sub spaces, linear and direct sums, Quotient space, Linear dependence and independence, Basis and dimension, Linear transformations, Rank and nullity.

**16. Integral equations and calculus of variations:** Volterra and Fredholm integral equations of first and second kinds, Solution by successive substitutions and successive approximations, Separable and symmetric kernels.

Variation of a functional, Euler's equation, Fixed end point problems, variable end point problems, Invariance of Euler's equation, isoperimetric problems.

## SYLLABUS FOR LECTURER, ENGLISH, GOVERNMENT POLYTECHNICS

**Note:** Each multiple choice question shall be of two marks:

1. Language: Basic concepts and theories
2. History of English Language, English Language Teaching
3. Drama, Poetry, Fiction, Short Story, Non-Fictional Prose, Travelogue, Biography, Memoir
4. Greek and Roman Classical literature
5. Literature from Chaucer to Shakespeare
6. Jacobean to Restoration Period
7. Metaphysical Movement
8. Augustan Age: 18th Century Literature
9. Romantic Period
10. Pre-Raphaelite Movement
11. Modern and Contemporary English Literature
12. American, Australian, Canadian, Caribbean, South African and other Non-British Literatures
13. Subaltern Literature
14. English Literature in India: History, Evolution and Prospects. Contribution of Indian, Anglo-Indian and Diasporic Writers
15. Literary Theory and Criticism
16. Rhetoric and Prosody
17. Research Methodology
18. Communication: Meaning and Definition, Importance of Communication. Principles of Communication, Process of Communication, Types of Communication, Verbal and Non-verbal Communication, Barriers to effective communication, Mass communication.
19. Inter-personal and Intra-personal Skills
20. Group Discussion
21. Leadership Skills, Motivation and Teamwork
22. Letter Writing: Types of letters, Parts of official letters, Sales and tender letters, D O Letters, Notice, agenda and Minutes
23. Tenses, Concord, Participles and Gerunds
25. Common Errors on Miscellaneous items
26. Usage: Articles, Prepositions, Adjectives, Adverbs, Conjunctions and Question Tags
27. Auxiliaries and Modals
28. Voice and Narration
29. Types of Sentences
30. Idioms and Phrasal Verbs
31. Homonyms, Antonyms, Synonyms, one-word substitutes, words that cause confusion and Spelling Errors
32. Comprehension (Five objective questions based on an unseen passage)

## **SYLLABUS FOR LECTURER, MODERN OFFICE MANAGEMENT AND SECRETARIAL PRACTICE (MOM&SP), GOVERNMENT POLYTECHNICS**

1- **Hindi Shorthand (हिन्दी आशुलिपि):-** व्यंजन, स्वर, माध्यमिक स्वर, द्विध्वनिक तथा त्रिध्वनिक स्वर, 'त' वर्ग के दायें व बांये चाप का प्रयोग, शब्द चिन्ह, वाक्यांश, छोटा एवं बड़ा वृत्त, अनुस्वार, सर्वनाम, छोटा एवं बड़ा लूप (चाप), छोटा एवं बड़ा आंकड़ा, शन/षण का आंकड़ा 'र', 'ल' तथा 'ह' के उर्ध्वमुखी एवं अधोमुखी प्रयोग, वैकल्पिक चाप, संयुक्त व्यंजन, व्यंजनों का द्विगुणन एवं अर्द्धकरण सिद्धान्त, प्रत्यय एवं उपसर्ग, विराम चिन्ह तथा संख्या वाचक चिन्ह, जुट-शब्द एवं विलोम शब्द।

2- **English Shorthand:-** Consonant, Vowels, Diphthongs and Triphones, Alternative forms of 'R', 'L' and 'SH', Alternative form of 'H', Tick 'H' and Dot 'H', Abbreviated 'W', Phraseography, Gramalogues and logograms, Small circle 'S' & 'Z', Large Circle 'Sw', 'Ss', 'Sz', Loop 'St', and 'Str', Initial and Final Hooks, Shun Hooks, Alternative forms of 'Fr' and 'Vr' etc., Circle and Loop to preceding Initial hooks, Circle and Loops to final hook, Compound Consonant, Doubling and Halving Principle, Diphonic or Two vowel sound, Medial Semicircle, Prefix and suffix, Figures.

**3- Knowledge of Hindi and English Typing.**

**4-Office Management:-** Office Meaning and Importance, Office practice & Secretarial Practice, Modern office and its Principal Departments and their Functions, Centralization of office services V/s Decentralization, Office Stationary, Mailing Department, Special Mail and postal services, Filing and Indexing.

**5-Principle of Management:-** Introduction of Management, Level of Managers, Planning, Decision Making, Organizing, Staffing, Directing, Controlling.

**6-Patra Lekhan (पत्र-लेखन):-** पारिवारिक पत्र, निमंत्रण एवं बधाई पत्र, धन्यवाद एवं संवेदना पत्र शासकीय एवं अर्द्धशासकीय पत्र, अधिसूचना पत्र, पृष्ठाकनं पत्र, कार्यालय आदेश, ज्ञापन, अनुस्मारक पत्र, प्रेस विज्ञप्ति तथा शोक पत्र, आवेदन पत्र, व्यापारिक पत्र, कोटेशन, आदेश एवं पूर्ति पत्र एवं शिकायती पत्र।

**7-Elementary of Book Keeping and Accountancy:-** Definition, Need and importance of Book-Keeping and Accountancy, Double Entry System Debit and Credit, Journal Entries, Cash Book, Ledger, Bank Reconciliation Statement, Trial Balance, Final Accounts, Handling Cash Transaction.

**8- Secretarial Practice and Office Automation:-**

Secretarial/Official Functions of PA/PS, Sources of Information, Public Relation of PA/PS, Need and Importance of Office machines (Billing Machines, Time Recorder, Cash Register, Computer and Fax etc. & Other Equipments of Office use), Development of Management Information System.

**9-Office and Business Correspondence:-** Meaning, Importance, Process and uses of Correspondence, Essential of a Good Business Letter, Official Correspondence, Business Letters (Circular letters, Enquiry Letters, Orders Letter, Sales Letters, Claims, Complaints and Adjustment, Remittance and Collection Letter etc.) Bank Correspondence, Drafting, Certificates Writing.

**10-Personality Development:-** Understanding Personality (Meaning of Personality, Various stages of personality Development, Composition of Personality, Techniques for Improvement of Personality), Attitude at Work Place, Negotiation Skills, Team Building, Meaning and Importance of Groups, Types of Group, Inter and Intra group conflicts and resolving conflicts Professional Relations, Motivation, Grievances Descriptive, Stress Management, Time Management and Quality Management, Interview preparation.

**11-Professional Terminology(Hindi&English):-** संज्ञा— केन्द्रीय एवं प्रादेशिक सरकारों तथा विभिन्न कार्यालयों से संबंधित पद संज्ञा का हिन्दी एवं अंग्रेजी रूपान्तरण, कार्यालय नामावली, विभिन्न कार्यालयों के नामों का हिन्दी एवं अंग्रेजी रूपान्तर, सामान्य प्रशासनिक शब्दावली का हिन्दी एवं अंग्रेजी रूपान्तरण पारिभाषिक उप वाक्यों का हिन्दी एवं अंग्रेजी रूपान्तर, संक्षेपण की उचित विधि,

Translation from English to Hindi and Hindi to English, Grammar and usage, punctuation, one word substitute, Idioms and phrases and pair of words, Short form of official and Govt vocabulary Hindi and English, Paragraph writing.

**12-Tally Accounting:-** Basic concept of Accounting, Financial Statement and analysis, Basic concept of inventory, Tally configuration, Data Directory and folder configuration, single and multiple user, Tally screen components, Maintaining company data, Basic company details, chart of accounts, company feature and configuration, create alter and display(groups and ledgers all accounting vouchers type) accounting voucher and invoice transactions excise and export invoice, journal transaction, payment voucher, godown summary, create payroll masters in tally, accounting for employer PF and GPF, Tally E-text filing, reports like balance sheet, profit and Loss account, ratio analysis, Trial Balance, Accounts Books Like Cash/Bank Book, All Ledger groups summary ,cost centre and category summary and breakup ledger and group, Create alter and display stock groups and stock items, all inventory voucher types and transactions , inventory detail in accounting voucher, reports like stock summary, Stock item, Group summery, Stock Transfers, Physical stock Register etc., check printing, common printing options different printing format, multi account printing, creating group company, use of Tally vault using security control and defining different security levels, use of Tally Audit, Backup and restore splitting company data, export and import of Data.



प्रवक्ता (अभियन्त्रणेत्तर विषय) के अन्तर्गत प्रवक्ता भौतिकी, रसायन, गणित, अंग्रेजी, भाषा एवं मॉडर्न आफिस मैनेजमेंट एण्ड सेक्रेट्रियल प्रैक्टिस (एम0ओ0एम0 एण्ड एस0पी0) पदों हेतु

**Basic Knowledge of computer Operation Practical Examination Ability Test**  
**(Qualifying Nature)**

**Time Allowed: One hours**

**M.M.: 100**

Microsoft Windows Operating system and Microsoft Office (Maximum Marks – 100; Minimum Qualifying Marks to be obtained – 40; Time allowed: One Hour)

The paper shall be set from the given syllabus broadly taking one question from each i.e. - (1) Windows and internet (2) M.S. - word (3) M.S. - Access (4) M.S. - Excel and (5) M.S. - Power Point.

**Note -1-** Each question shall have one action to be performed on the system each having 20 marks.

**Note -2 -** Printout of the output shall be taken and given for evaluation.

**Note- 3 -** उक्त परीक्षा अर्हकारी प्रकृति (Qualifying Nature) की होगी, जिसमें न्यूनतम 40 प्रतिशत अंक प्राप्त करना अनिवार्य होगा। उक्त परीक्षा में प्राप्त अंकों को अन्तिम चयन परिणाम में सम्मिलित नहीं किया जायेगा।