ANNEXURE-A

Proposed Scheme of Examination for PM(Leather)/PM(WW)/PM(Glass and Ceramics)/PM(Electronics)/Asst. Mining Engineering/Supervisor(Tech)

Part-A

There shall be a written examination of 2 (two) papers – Paper-I & Paper-II of 100 Multiple Choice Questions each for the posts of PM(Leather)/PM(Woodworks)/PM(Glass&Ceramics)/PM(Electronics), Asst. Mining Engineer and Supervisor(Tech). Each question in Paper-I shall carry 1(one) marks totalling 100 marks and each question in Paper-II shall carry 2(two) marks totaling 200 marks.

Paper-I (100 questions) – 100 Marks (Duration – 2 Hours)

1. General Mental Ability including basic numeracy, data interpretation, logical reasoning, analytical ability, problem solving (30 questions) – 30 marks
2. General Studies (70 questions) – 70 marks

   The questions on General Studies will cover the following topics:
   - i. General Science
   - ii. Current Events of National and International Importance
   - iii. History of India
   - iv. Indian National Movement
   - v. Indian Polity and Economy
   - vi. World Geography and Population

Questions on General Science will cover general appreciation and understanding of Science, including matters of everyday observation and experience, as may be expected of a well-educated persons who has not made a special study of any scientific discipline. In History of India, emphasis should be on a broad understanding of economic, social, cultural and political aspects of Indian History. In Indian National Movement, the candidates are expected to have a synoptic view of the nature and character of the Indian freedom movement, growth of nationalism and attainment of Independence. In Indian Polity and Economy, questions will test knowledge of the candidate pertaining to Indian Polity including the Indian Constitution, Panchayati Raj and Community Development, broad features of Indian economy and planning. In world geography and population, only general understanding of the subject will be expected with emphasis on physical/ecological, economic and socio-demographic aspects of Geography of India.

Paper-II : Optional Subjects (100 questions) – 200 Marks (Duration – 2 Hours)

The questions will be from any one of the following Optional Subjects opted by the candidates

Sl No	Name of the Post	Optional Paper	Total Number of Marks
1.	Project Manager (Leather)	Leather Technology	200 Marks
2.	Project Manager (Woodworks)	Mechanical Engineering	200 Marks
3.	Project Manager (Glass & Ceramics)	Glass & Ceramics	200 Marks
4.	Project Manager (Electronics)	Electronic Engineering	200 Marks
5.	Asst. Mining Engineer	Mining Engineering	200 Marks
6.	Supervisor (Tech)	Mechanical Engineering/ Electrical Engineering	200 Marks

The detailed syllabus of the Optional Subjects is appended in Annexure-I. the questions will be of degree/Graduate level.

Part-B

The Interview/Personality Test carrying 45 marks will be conducted for the candidates who qualify in the written examination.

ANNEXURE-I

Proposed Syllabus for Project Manager (Leather) Examination

1. **Leather Microscopy and Bacteriology** – History of hides and skin cells, histological characteristics of buffalo and cow hides, goat and sheep skins, reptile skins; compound microscope, microscopical slides, fibre structure and assessment, the bacterial cell and its Internal Structure, mycology, entomology, leather biotechnology.
2. **Skin Protein (Keratin) and Pre-Tannage** – chemical constituents of hides and skins, general and physical chemistry of proteins, structure of collagen, aggregation phenomenon of collagen,thermal transition, effect of enzymes on collagen, reactive groups in collagen, other skin properties, non-protenous skin components, pre-tanning process.
3. **Inorganic Tannages** – theory and behavior of group elements, chrome tanning, alluminium tanning, zirconium tanning, other tanning and neutralization, combination tannage.
4. **Analysis of Materials of Leather Manufacture (Chemical)** – anaylysis of water, analysis of various chemicals and auxiliaries used in leather processing, analysis of liquors of beam Houses Processes, Analysis of tanning agent
5. **Mechanical Operations and Machines** – Splitting, fleshing, buffing, drumming, press, togging, etc and its relevant machines.
6. **Post Tanning and Finishing Operations** – chemistry of bleaching and mordanting agent; oil, fat and fat liquoring, water proofing, finishing materials; properties, chemistry and methods of preparation of the following finishing materials – nitrocellulose lacquers and lacquer emulsions, wax emulsions, silicone emulsions.
7. **Processing of Leather** – Finished leathers and composition of finishes, tanned leathers, semic finished leathers, wet blue-wet white properties, general practices in vegetable and chrome tanning; heavy leathers, leather for liquification plants, sport goods leather, light leather, water proof and water repellent upper leather, nubuk and white leather, E.I. tanning, dressing of E.I. tanned leather in to upper, lining leather, bag leather; different types of leathers using chrome splits, formulation and different dyestuffs, fat liquors, retaining agents.
8. **Processing of Leather (II)** – Goat skins, processes for chamois leather, printed leathers,morocco and book binding leathers, E.I goat skins and their dressing; Sheep skins; exotic and others, upgrading of leathers.
9. **Leather analysis and quality control** – chemical analysis of pelts and leathers, physical testing of leather, standards and quality control, instrument analysis
10. **Organic Tannages** (Animal and Tannery by-products) – collagen tanning, vegetable tannins, hydrolysable tannins, condensed tannins, biosynthesis of plant polyphenols, vegetable tanning, synthetic tannins, resin and polymeric tannages, aldehyde tannage.
11. **Transport Phenomenon**
12. **Tannery effluent treatment** – pollution, tannery effluents, primary treatments, secondary treatment systems, effluent disposal, water for tanning, solid waste management
13. **Leather products technology** – classification of leather goods & garments, selection of materials, grading and assorting of leathers, property requirement for leather and lining materials, accessories for leather goods & garments; cutting; machinery needs and various types of sewing machines; sport goods, harnesses & saddlery industries, classification of leather based sports goods; organization and management.

ANNEXURE-I

Proposed Syllabus for Project Manager (Woodworks) Examination, 2020

1. **Fluid Mechanics** – basic concepts and properties of fluids, manometry, fluid statics, buoyancy, equations of motion, Bernoulli's equation and applications, viscous flow of incompressible fluids, laminar and turbulent flows, flow through pipes and head losses in pipes.
2. **Thermodynamics and Heat Transfer** – Thermodynamics systems and processes; properties of pure substance; Zeroth, First and Second Laws of Thermodynamics; Entropy, Irreversibility and availability; analysis of thermodynamic cycles related to energy conversion; Rankine, Otto, Diesel and Dual Cycles; ideal and real gases; compressibility factor; Gas mixtures.
   Modes of heat transfer, Steady and Unsteady heat conduction, Thermal resistance, fins, Free and forced convection, Radiative heat transfer – Radiation heat transfer co-efficient; boiling and condensation, Heat exchanger performance analysis.
3. **IC Engines, Refrigeration and Air Conditioning** – SI and CI engines, Engine systems and Components, Performance characteristics and testing of IC engines; Fuels, Emission and Emission control. Vapour compression refrigeration, Refrigerants and working cycles, Compressors, Condensers, Evaporators and Expansion devices, other types of refrigeration systems like Vapour Absorption, Vapour jet, thermo electric and vortex tube refrigeration. Psychometric properties and processes, Comfort chart, Comfort and Industrial air conditioning, Load calculations and heat pumps.
4. **Turbo Machinery** – Reciprocating and rotary pumps, Pelton whells, Kaplan and Francis Turbines, velocity diagrams, Impulse and Reaction principles, Steam and Gas Turbines, Theory of Jet Propulsion – Pulse jet and Ram Jet engines, Reciprocating and Rotary Compressors – Theory and applications.
5. **Power Plant Engineering** – Rankine and Brayton cycles with regeneration and reheat, Fuels and their properties, Flue gas analysis, Boilers, steam turbines and other power plant components like condensers, air ejectors, electrostatic precipitators and cooling towers – their theory and design, types and applications;
6. **Renewable Sources of Energy** – solar radiation, Solar Thermal Energy Collection – Flat Plate and focusing collectors their materials and performance. Solar thermal energy storage, Application – heating cooling and Power generation; solar Photovoltaic Conversion; Harnessing of Wind Energy, Bio-mass and Tidal Energy – Methods and Applications, Working principles of Fuel Cells.
7. **Engineering Mechanics** – Analysis of System of Forces, Friction, Centroid and Centre of Gravity, Dynamics; Stresses and Strains – Compound Stresses and Strain, Bending Moment and Shear Force Diagrams, Theory of Bending Stresses – Slope and defection – Torsion, Thin and thick cylinders, spheres
8. **Engineering Materials** – Basic Cyrstallography, Alloys and Phase diagrams, Heat Treatment, Ferrous and Non-Ferrous Metals, Non metallic materials, Basics of Nano-materials, Mechanical Properties and Testing, Corrosion prevention and control
9. **Mechanisms and Machines** – Types of Kinematics Pair, Mobility, Inversions, Kinematic Analysis, Velocity and Acceleration Analysis of Planar Mechanisms, CAMs with uniform acceleration and retardation, cycloideal motion, oscillating followers; Vibration

forced vibration of undamped and damped SDOF systems, Transmissibility Ratio, Vibration Isolation, Critical Speed

ANNEXURE-I

of Shafts. Gears – Geometry of tooth profiles, Law of gearing, involute profile, Interference, Helical, Spiral and Worm Gears, Gear Trains – Simple, Compound and Epicyclic; Dynamic Analysis – Slider – crank mechanism, turning moment computations, balancing of Revolving and Recriprocating masses, Gyroscopes – Effect of Gyroscopic couple on automobiles, ships and aircrafts, Governors

10. **Design of Machine Elements** – Design for static and dynamic loading; failure theories; fatique strength and the S-N diagram; principles of the design of machine elements such as riveted, welded and bolted joints. Shafts, Spur gears, rolling and sliding contact bearings, Brakes and clutches, flywheels.
11. **Manufacturing, Industrial and Maintenance Engineering** – Metal casting – Metal forming, Metal Joining, Machining and machine tool operations, Limits, fits and tolerances, Metrology and inspection, computer integrated manufacturing, FMS, Production planning and Control, Inventory control and operations research – CPM-PERT. Failure concepts and characteristics – Reliability, Failure analysis, Machine Vibration, Data acquisition, Fault Detection, Vibration Monitoring, Field Balancing of Rotors, Noise Monitoring, Wear and Tear Debris Analysis, Signature Analysis, NDT Techniques in Condition Monitoring.
12. **Mechatronics and Robotics** – Microprocessors and Microcontrollers, Architecture, programming, I/O, Computer interfacing, Programmable logic controller, Sensors and actuators, Piezoelectric accelerometer, Hall effect sensor, Optical Encoder, Resolver, Inductosyn, Pneumatic and Hydraulic actuators, stepper motor, Control Systems – Mathematical modeling of Physical systems, control signals, controllability and observability, Robotics, Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics; Homogenous Coordinates and Arm Equation of four Axis SCARA Robot.

ANNEXURE-I

Proposed Syllabus for Project Manager (Electronics) Examination

1. **Basic Electronics Engineering** – basics of semiconductors; Diode/Transistor basics and characteristics; Diodes for different uses; Junction and Field Effect Transistors (BJTs, JFETs, MOSFETs); Transistor amplifiers of different types, oscillators and other circuits; Basics of Integrated Circuits (ICs); Bipolar, MOS and CMOS ICs; Basics of linear ICs, operational amplifiers and their applications – linear/non-linear; Optical sources/detectors; Basics of Opto electronics and its application.
2. **Basic Electrical Engineering** – DC circuits – Ohm's &Kirchoff's laws, mesh and modal analysis, circuit theorams, Electro-magnetism, Faraday's & Lenz's laws, induced EMF and its uses; Single-phase AC circuits; Transformers, efficiency; Basics – DC machines, induction machines, and synchronous machines; Electrical Power sources – hydroelectric, thermal, nuclear, solar; Basics of Batteries and their uses.
3. **Materials Science** – Electrical Engineering materials; crystal structure & defects; ceramic materials – structures, composites, processing and its uses; Insulating laminates for electronics, structures, properties and its uses; Magnetic materials, basics, classification, ferrites, ferro/para-magnetic materials and components; Nano materials – basics, preparation purification, sintering, nano particles and uses; Nano-optical/magnetic/electronic materials and uses; Superconductivity, uses.
4. **Electronic Measurements 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; Mearurement systems for non-electrical quantities; Basics of telemetry; Different types of transducers and displays; Data acquisition system basics
5. **Network Theory** – Network graphs & matrices; Wye-Delta transformation; Linear constant co-efficient 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 & transfers functions; State equations for networks; Steady state sinusoidal analysis.
6. **Analog and Digital Circuits** – Small signal equivalent circuits of Diodes, BJTS and FETs; Doide circuits for different uses; Blasing and stability of BJT & JFET amplifier circuits; Analysis/design of amplifier – single/multi-stage; feedback & uses; Active filters, timers, multipliers, wave shaping, A/D-D/A converters; Boolean Algebra & uses; Logic gates, Digital IC families, Combinatiorial/sequential circuits; Basics of multiplexes, counters/registers/memories/microprocessors, design and applications.
7. **Analog and Digital Communication Systems** – Random signals, noise, probability theory, information theory, Analog versus Digital communication and applications; Systems – AM, FM, transmitters/receivers, theory/practice/standards, SNR comparision; Digital communication basics: Sampling, quantizing, coding, PCM, DPCM, multiplexing-audiovideo; Digital modulation: ASK, FSK, PSK, Multiples access: TDMA, FDMA,CDMA: Optical communication: fibre optics, theory, practice/standards.

8. **Control System** – classification of signals and systems; Application of signal and system theory; system realization; transforms & their application; Signal flow graphs, Routh-Hurwitz criteria, root loci, Nyquist/Bode plots; Feedback systems – open & close loop types, stability analysis, steady state, transient and frequency response analysis; Design of control system, compensators, elements of lead/lag compensation, PID and Industrial Controller.
9. **Computer Organisation and Architecture** – Basic architecture, CPU, I/O organization, memory organization, pheripheral devices, trends; Hardware/Software issues; Data representations & programming; Operating systems – basics, processes, characteristics, applications; Memory management, virtual memory, file systems, protection & security; Data bases, different types, characteristics and design; Transactions and concurrency control; Elements of programming languages, typical examples.
10. **Electromagnetic** – Elements of vector calculus, Maxwell's equations – basic concepts; Gauss', Stokes' theorems; Wave propagation through different media; Transmission Lines – different types, basics, Smith's chart, impedance matching/transformation, S-parameters, pulse excitation, uses, Waveguides – basics, rectangular types, modes, cut-off frequency, dispersion, dielectric types;Antennas – radiation pattern, monopoles/dipoles,gain,arrays-active/assive,theory uses.
11. **Advanced Electronic Topics** – 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, examples;DSP: Discrete time signals/systems, uses; Digital FIR/IIR types, design, speech/audio/radar signal processing uses; Microprocessors & microcontrollers, basics, interrupts, DMA, instruction sets, interfacing; Controllers & uses; Embedded systems.
12. **Advanced Communication Topics** – Communication networks: Principles/practices/ technologies /uses/ OSI model/Security; Basic packet multiplexed streams/scheduling; Cellular networks tuypes, analysis, protocols (TCP/TCPIP); Microwave & satellite communication; terrestrial/space type LOS systems, block schematics link calculations, system design; Communication satellites, orbits, characteristics, systems, uses; Fibre-optic communication systems, block schematics, link calculations, system design.

ANNEXURE-I

Proposed Syllabus for **Project Manager (Glass & Ceramics)** Examination

1. **Introduction to Glass & Ceramics Engineering** – Glass, Enamel, Pottery, Refractory, Cements
2. **Industrial Operations** – Concept and rule of unit operation in process industries and house keeping; size reduction, handling of solids and slurry, mechanical operations.
3. **Pottery & Refractory** – raw materials of pottery, body preparation, mould preparation, firing, quality control checks, refractory raw materials, making of refractory bricks, manufacturing of crucible and saggers, quality control checks.
4. **Glass and Enamels** – raw materials, batch calculations, typical commercial glasses, melting and refining, decoration, quality and control test; history of enameling, raw materials for enamels, metal and metal preparation, preparation of enamel frit milling and mill addition, application and control, firing, decoration, defects, their causes and remedies, quality control and testing.
5. **Glass & Ceramic engineering drawing** – detailed use of abbreviations in electrical drawing symbols; simple domestic wiring circuit diagram, wiring diagram of simple switch board (lab); types of pulleys, bush bearing , footstep bearing, plumber block, wall brackets; sectional views of cotter-joint, knuckle joint, jib and cotter joint, flange coupling; pictorial views of Ball Mill, Edge runner Mill, Jaw Crusher, Filter Press; Computer Aided Design.
6. **Industrial Calculation and Environmental Pollution** – material and energy balance; dimensions, units and their conversion factors; stoichiometric and composition relationship; humidity and saturation, material balance; combustion process, environmental pollution.
7. **Fuels, Furnaces and Pyrometry –** solid fuels, liquid fuels, gasesous fuels; furnaces, continuous kilns, tank furnaces, other equipments, pyrometry.
8. **Elements of Geology** – utility of geology specially for ceramic industries; general idea of rocks and minerals, classification of rocks, industrial minerals; ceramic raw materials in India and distribution of ceramic industry in India; petrological microscope; study of physical and optical properties .
9. **Pottery and Porcelain** – various ceramic fabrication process, high and low tension insulators, ceramic glaze, ceramic stains, ceramic transfer, lithography, mechanization in pottery works, quality control and testing
10. **Refractory Technology** – manufacture of refractory materials; properties – physical, thermal, mechanical, thermal mechanical, thermochemical; refractoriness; application of refractories, testing and quality control; crucibles, muffles, saggers and glass pots; refractory cement and mortars, monolithic refractories
11. **Glass Technology** – storage of raw materials, batch house, melting furnace, fabrication-machines, annealing lehr, sorting and packaging section, warehouse; properties of glass; viscosity, variation with temperature and composition, transformation range; defects in glass, their causes and remedies; colourising and decolourising; refining; manufacture of glass bottles and other hollow wares, sheets, different types of glasses; optical glass.
12. **Glass Technology (II)** – glass ceramics, ornamental glass, float glass, opthelmic glass, glass and refractory technology, glass decoration, grain size determination.

ANNEXURE-I

Proposed Syllabus for Assistant Mining Engineer Recruitment Examination

1. **Drilling and Blasting** – Exploration Drilling, Explosives and Initiating Systems, Drilling and Blasting in Surface Mines, Drilling and Blasting in Underground Mines
2. **Mine Surveying** – Surveying, Linear Measurement, Angular Measurement, Leveling, Total Station, Plane Table Surveying, Contours, Computation of Areas and Volumes, Mine Plans and Sections, Control Surveys, Gyro-North Determination, Correlation, Development Surveys, Stope Surveying, Slope Monitoring in Opencast Mines, Subsidence Monitoring, GPS, Application of Automation & IT in surveying, Introduction to Surveying Softwares, Application of Remote Sensing and GIS in Surveying.
3. **Mine Development** – Opening-up of Deposits, Vertical and Inclined Shafts, Shaft Sinking Operations, Insets, Mechanised Sinking, Shaft Boring, Specialised Attributes, Main Haulage Drifts and Tunnels, High Speed Drifting/Tunneling, Recent Developments, Layouts.
4. **Geology for Engineers** – Structural Geology, Economic Geology and Exploration Geology, Coal and Petroleum Geology.
5. **Rock Mechanics** – Concept of Stress and Strain in Rock, Physico-mechanical properties of Rock, Dynamic properties of Rock and rockmass, Time dependent properties of Rock, Strength and Deformability of rockmass, failure criteria for rock and rockmass, pre-mining state of stress, physico-mechanical properties of soil, groundwater, engineering classification of rock and rockmasses.
6. **Underground Mining** – Bord and Pillar Mining, Pillar extraction, longwall mining, Roof Supports
7. **Mine Ventilation** – Composition of mine atmosphere, heat and humidity, air flow through mine openings, natural ventilation, mechanical ventilation, ventilation planning.
8. **Surface Mine Planning and Design** – ore reserve estimation, stripping ratio, geometrical considerations, pit planning, production planning, analysis and design of highwall slopes and waste dumps, design of haul roads, design of drainage system in surface mines, selection of mining system vis-à-vis equipment system, closure of surface mines, feasibility report.
9. **Mine Environmental Engineering** – Mine fires, mine explosions, inundation, rescue and recovery, airborne respirable dusts, illumination.
10. **Mining Machinery** - Design, construction and operation of blast hole drills, rippers, shovels, hydraulic excavators, scraper, dragline, dumpers, wheel loaders, dozers, graders, surface miners, BWE, spreader, stacker & reclaimer, high capacity belt conveyors –constructional detail and selection procedures; Aerial rope ways; Classification, application and constructional features of crushers, breakers and feeders.
11. **Computer Aided Mine Planning**
    (i) Rock Excavation Engineering
    (ii) Open Pit Slope Analysis and Design
    (iii) Dimensional Stone Mining
    (iv) Numerical Modeling
12. **Mine Legislation and Safety**
13. **Industrial Management**
    (i) Innovative Mining System

ANNEXURE-I

(ii) Map Projection & GIS
(iii) Caol Bed Methane
(iv) Mineral Economics

ANNEXURE-I

Proposed Syllabus for Supervisor (Technical) Examination

Optional-1 (Electrical Engineering)

1. **EngineeringMathematics** - Matrix theory, Eigen values & Eigen vectors, system of linear equations, Numerical methods for solution of non-linear algebraic equations and differential equations, integral calculus, partial derivatives, maxima and minima, Line, Surface and Volume Integrals. Fourier series, linear, non-linear and partial differential equations, initial and boundary value problems, complex variables, Taylor's and Laurent's series, residue theorem, probability and statistics fundamentals, Sampling theorem, random variables, Normal and Poisson distributions, correlation and regression analysis.
2. **Electrical Materials -** Electrical Engineering Materials, crystal structures and defects, ceramic materials, insulating materials, magnetic materials– basics, properties and applications; ferrities, ferro-magnetic materials and components; basics of solid state physics, conductors; Photo-conductivity; Basics of Nano materials and Superconductors.
3. **Electric Circuits and Fields** - Circuit elements, network graph, KCL, KVL, Node and Mesh analysis, ideal current and voltage sources, Thevenin's, Norton's, Superposition and Maximum Power Transfer theorems, transient response of DC and AC networks, Sinusoidal steady state analysis, basic filter concepts, two-port networks, three phase circuits, Magnetically coupled circuits, Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions, Ampere's and Biot-Savart's laws; inductance, dielectrics, capacitance; Maxwell's equations.
4. **Electrical and Electronic Measurements** - Principles of measurement, accuracy, precision and standards; Bridges and potentiometers; moving coil, moving iron, dynamometer and induction type instruments, measurement of voltage, current, power, energy and power factor, instrument transformers, digital voltmeters and multi-meters, phase, time and frequency measurement, Q-meters, oscilloscopes, potentiometric recorders, error analysis, Basics of sensors, Transducers, basics of data acquisition systems
5. **Computer Fundamentals -** Number systems, Boolean algebra, arithmetic functions, Basic Architecture, Central Processing Unit, I/O and Memory Organisation; peripheral devices, data represenation and programming, basics of Operating system and networking, virtual memory, file systems; Elements of programming languages, typical examples.
6. **Basic Electronics Engineering** - Basics of Semiconductor diodes and transistors and characteristics, Junction and field effect transistors (BJT, FET and MOSFETS), different types of transistor amplifiers, equivalent circuits and frequency response; oscillators and other circuits, feedback amplifiers.
7. **Analog and Digital Electronics** - Operational amplifiers – characteristics and applications, combinational and sequential logic circuits, multiplexers, multi- vibrators, sample and hold circuits, A/D and D/A converters, basics of filter circuits and applications, simple active filters; Microprocessor basics- interfaces and applications, basics of linear integrated circuits; Analog communication basics, Modulation and de-modulation, noise and bandwidth, transmitters and

receivers, signal to noise ratio, digital communication basics, sampling, quantizing, coding, frequency and time domain multiplexing, power line carrier communication systems.

8. **Systems and Signal Processing** - Representation of continuous and discrete-time signals, shifting and scaling operations, linear, time-invariant and causal systems, Fourier series representation of continuous periodic signals, sampling theorem, Fourier and Laplace transforms, Z transforms, Discrete Fourier transform, FFT, linear convolution, discrete cosine transform, FIR filter, IIR filter, bilinear transformation.
9. **Control Systems** - Principles of feedback, transfer function, block diagrams and signal flow graphs, steady-state errors, transforms and their applications; Routh-hurwitz criterion, Nyquist techniques, Bode plots, root loci, lag, lead and lead-lag compensation, stability analysis, transient and frequency response analysis, state space model, state transition matrix, controllability and observability, linear state variable feedback, PID and industrial controllers.
10. **Electrical Machines** - Single phase transformers, three phase transformers - connections, parallel operation, auto-transformer, energy conversion principles, DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors, Induction motors - principles, types, performance characteristics, starting and speed control, Synchronous machines - performance, regulation, parallel operation of generators, motor starting, characteristics and applications, servo and stepper motors.
11. **Power Systems** - Basic power generation concepts, steam, gas and water turbines, transmission line models and performance, cable performance, insulation, corona and radio interference, power factor correction, symmetrical components, fault analysis, principles of protection systems, basics of solid state relays and digital protection; Circuit breakers, Radial and ring-main distribution systems, Matrix representation of power systems, load flow analysis, voltage control and economic operation, System stability concepts, Swing curves and equal area criterion. HVDC transmission and FACTS concepts, Concepts of power system dynamics, distributed generation, solar and wind power, smart grid concepts, environmental implications, fundamentals of power economics.
12. **Power Electronics and Drives** - Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation, triggering circuits, phase control rectifiers, bridge converters - fully controlled and half controlled, principles of choppers and inverters, basis concepts of adjustable speed DC and AC drives, DC-DC switched mode converters, DC-AC switched mode converters, resonant converters, high frequency inductors and transformers, power supplies.

ANNEXURE-I

Optional-2 (Mechanical Engineering)

1) **Fluid Mechanics** – basic concepts and properties of fluids, manometry, fluid statics, buoyancy, equations of motion, Bernoulli's equation and applications, viscous flow of incompressible fluids, laminar and turbulent flows, flow through pipes and head losses in pipes.
2) **Thermodynamics and Heat Transfer** – Thermodynamics systems and processes; properties of pure substance; Zeroth, First and Second Laws of Thermodynamics; Entropy, Irreversibility and availability; analysis of thermodynamic cycles related to energy conversion; Rankine, Otto, Diesel and Dual Cycles; ideal and real gases; compressibility factor; Gas mixtures.

   Modes of heat transfer, Steady and Unsteady heat conduction, Thermal resistance, fins, Free and forced convection, Radiative heat transfer – Radiation heat transfer co-efficient; boiling and condensation, Heat exchanger performance analysis.
3) **IC Engines, Refrigeration and Air Conditioning** – SI and CI engines, Engine systems and Components, Performance characteristics and testing of IC engines; Fuels, Emission and Emission control. Vapour compression refrigeration, Refrigerants and working cycles, Compressors, Condensers, Evaporators and Expansion devices, other types of refrigeration systems like Vapour Absorption, Vapour jet, thermo electric and vortex tube refrigeration. Psychometric properties and processes, Comfort chart, Comfort and Industrial air conditioning, Load calculations and heat pumps.
4) **Turbo Machinery** – Reciprocating and rotary pumps, Pelton whells, Kaplan and Francis Turbines, velocity diagrams, Impulse and Reaction principles, Steam and Gas Turbines, Theory of Jet Propulsion – Pulse jet and Ram Jet engines, Reciprocating and Rotary Compressors – Theory and applications.
5) **Power Plant Engineering** – Rankine and Brayton cycles with regeneration and reheat, Fuels and their properties, Flue gas analysis, Boilers, steam turbines and other power plant components like condensers, air ejectors, electrostatic precipitators and cooling towers – their theory and design, types and applications;
6) **Renewable Sources of Energy** – solar radiation, Solar Thermal Energy Collection – Flat Plate and focusing collectors their materials and performance. Solar thermal energy storage, Application – heating cooling and Power generation; solar Photovoltaic Conversion; Harnessing of Wind Energy, Bio-mass and Tidal Energy – Methods and Applications, Working principles of Fuel Cells.
7) **Engineering Mechanics** – Analysis of System of Forces, Friction, Centroid and Centre of Gravity, Dynamics; Stresses and Strains – Compound Stresses and Strain, Bending Moment and Shear Force Diagrams, Theory of Bending Stresses – Slope and defection – Torsion, Thin and thick cylinders, spheres
8) **Engineering Materials** – Basic Cyrstallography, Alloys and Phase diagrams, Heat Treatment, Ferrous and Non-Ferrous Metals, Non metallic materials, Basics of Nano-materials, Mechanical Properties and Testing, Corrosion prevention and control
9) **Mechanisms and Machines** – Types of Kinematics Pair, Mobility, Inversions, Kinematic Analysis, Velocity and Acceleration Analysis of Planar Mechanisms, CAMs with uniform acceleration and retardation, cycloideal motion, oscillating followers; Vibration – Free and

forced vibration of undamped and damped SDOF systems, Transmissibility Ratio, Vibration Isolation, Critical Speed

ANNEXURE-I

of Shafts. Gears – Geometry of tooth profiles, Law of gearing, involute profile, Interference, Helical, Spiral and Worm Gears, Gear Trains – Simple, Compound and Epicyclic; Dynamic Analysis – Slider – crank mechanism, turning moment computations, balancing of Revolving and Recriprocating masses, Gyroscopes – Effect of Gyroscopic couple on automobiles, ships and aircrafts, Governors

10) **Design of Machine Elements** – Design for static and dynamic loading; failure theories; fatique strength and the S-N diagram; principles of the design of machine elements such as riveted, welded and bolted joints. Shafts, Spur gears, rolling and sliding contact bearings, Brakes and clutches, flywheels.
11) **Manufacturing, Industrial and Maintenance Engineering** – Metal casting – Metal forming, Metal Joining, Machining and machine tool operations, Limits, fits and tolerances, Metrology and inspection, computer integrated manufacturing, FMS, Production planning and Control, Inventory control and operations research – CPM-PERT. Failure concepts and characteristics – Reliability, Failure analysis, Machine Vibration, Data acquisition, Fault Detection, Vibration Monitoring, Field Balancing of Rotors, Noise Monitoring, Wear and Tear Debris Analysis, Signature Analysis, NDT Techniques in Condition Monitoring.
12) **Mechatronics and Robotics** – Microprocessors and Microcontrollers, Architecture, programming, I/O, Computer interfacing, Programmable logic controller, Sensors and actuators, Piezoelectric accelerometer, Hall effect sensor, Optical Encoder, Resolver, Inductosyn, Pneumatic and Hydraulic actuators, stepper motor, Control Systems – Mathematical modeling of Physical systems, control signals, controllability and observability, Robotics, Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics; Homogenous Coordinates and Arm Equation of four Axis SCARA Robot.

ANNEXURE-B

Proposed Scheme of Examination and Syllabus for DO(DIC)/Asst. Director (Plg)/Asst Director(SSI)/Extension Officer (IND)/Inspector(SSI)/Supervisor(Credit)/ Supervisor(KVI)/Supervisor(MKT)

Part-A

There shall be a written examination consisting of 100 Multiple Choice Questions each carrying 1(one) marks with 2 (two) hours duration on the following areas:-

1. General Mental Ability including basic numeracy, data interpretation, logical reasoning, analytical ability, problem solving (30 questions) – 30 marks
2. General Studies (70 questions) – 70 marks

The questions on General Studies will cover the following topics:

vii. General Science
viii. Current Events of National and International Importance
ix. History of India
x. Indian National Movement
xi. Indian Polity and Economy
xii. World Geography and Population

Questions on General Science will cover general appreciation and understanding of Science, including matters of everyday observation and experience, as may be expected of a well-educated persons who has not made a special study of any scientific discipline. In History of India, emphasis should be on a broad understanding of economic, social, cultural and political aspects of Indian History. In Indian National Movement, the candidates are expected to have a synoptic view of the nature and character of the Indian freedom movement, growth of nationalism and attainment of Independence. In Indian Polity and Economy, questions will test knowledge of the candidate pertaining to Indian Polity including the Indian Constitution, Panchayati Raj and Community Development, broad features of Indian economy and planning. In world geography and population, only general understanding of the subject will be expected with emphasis on physical/ecological, economic and socio-demographic aspects of Geography of India.

Part-B

The Interview/Personality Test carrying 15 marks will be conducted for the candidates who qualify in the written examination.