***Final Plan of Written Examination***

*All the aspirants are informed as under with respect to the written test to be conducted for the recruitment of* **Machine Operator** ***(Advt. No. 16 of 2022)*** *:-*

1. *The Exam will be conducted in MCQ (Multiple Choice Questions)format. OMR sheets will be used for answering the questions.*

2. *The Exam would be of 2 hours 30 minutes duration.*

3. *The Exam will consist of two parts (Part A and Part B) as follows:-*

*(a)* ***Part A:-*** *Qualifying test of Punjabi Language equivalent to Matriculation standard as per Notification No. G.S.R.72 / Const. / Art.309/Amd.(22)/2022, dated:28.10.2022.*

| Part | Topic | No. of Questions | Marks (Each Question carries 1 mark) | Type of Questions |
|---|---|---|---|---|
| **A** | Punjabi (Qualifying Nature) (Annexure-1) | 50 | 50 | MCQs (Multiple Choice Questions) |

***Note:- (i)There will be no negative marking in Part-A.***

***(ii) Part 'B' will be evaluated only if a candidate scores minimum 50% marks (i.e 25 marks) in Part 'A'.***

***(b) Part-B:-*** *Part-B will consist of two sub-sections i.e Section (I) and Section (II) as following:-*

| Part | Section | Topic | No. of Questions | Marks (Each Question carries 1 mark) | Type of Questions |
|---|---|---|---|---|---|
| B | (I) | Questions from the Subject (Annexure-2) | 70 | 70 | MCQs (Multiple Choice Questions) |
| | (II) | Questions from General Knowledge, English, Logical Reasoning and Mental ability, Punjabi (Annexure-3) | 30 | 30 | |
| | **Total** | | **100** | **100** | |

*Note:-* ***(i) There will be negative marking in Part-B. Each question carries 1 mark. For every wrong answer, 1/4$^{th}$ mark would be deducted. The question(s) not attempted will receive no credit or discredit.***

***(ii)The merit list of candidates, who will qualify Part-'A', will be prepared on the basis of marks secured by candidate in Part-B.***

4. *Tentative syllabus for the written examination for the recruitment of* **Machine Operator** *is annexed at Annexure-1,2 and 3.*

## Annexure-1 (Punjabi Syllabus)

## Part-A (Punjabi Qualifying Exam)

1. ਜੀਵਨੀ ਅਤੇ ਰਚਨਾਵਾਂ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ:-

   ਸ਼੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਰਾਮਦਾਸ ਜੀ,

   ਸ਼੍ਰੀ ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਜੀ, ਸ਼੍ਰੀ ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ ਜੀ।

2. ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ, ਸਮਾਨਾਰਥਕ ਸ਼ਬਦ।

3. ਮੁਹਾਵਰੇ।

4. ਅਖਾਣ।

5. ਸਬਦ ਦੇ ਭੇਦ।

6. ਅਗੇਤਰ/ਪਿਛੇਤਰ।

7. ਵਚਨ ਬਦਲੋ ਤੇ ਲਿੰਗ ਬਦਲੋ।

8. ਵਿਸ਼ਰਾਮ ਚਿੰਨ੍ਹ।

9. ਸ਼ਬਦਾਂ / ਵਾਕਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਕੇ ਲਿਖੋ।

10. ਅੰਗਰੇਜ਼ੀ ਸ਼ਬਦਾਂ ਦਾ ਪੰਜਾਬੀ ਵਿੱਚ ਸ਼ੁੱਧ ਰੂਪ।

11. ਅੰਕਾਂ, ਮਹੀਨੇ, ਦਿਨਾਂ ਦਾ ਸ਼ੁੱਧ ਪੰਜਾਬੀ ਰੂਪ।

12. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

13. ਪੰਜਾਬ ਦੇ ਇਤਿਹਾਸ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

14. ਪੰਜਾਬ ਦੇ ਸਭਿਆਚਾਰ ਨਾਲ ਸਬੰਧਤ ਪ੍ਰਸ਼ਨ।

## Annexure-2

**Part B (I)-Subject Syllabus(Machine Operator)**

1.Introduction to trade and related industries.

General safety precautions and first aids, firefighting equipment and electrical safety.History of Refrigeration and Air conditioning.Function, use andspecifications of refrigerationtools, instruments and equipment.

2. Fitting .

Different types of Fitting hand tools, power tools, - their use. Function, construction, Specification & theirapplication. Machineries and equipment used in fittingslike drillingmachines, grinding machines – types, specifications and care and maintenance, measuring instruments.

3. Sheet Metal

Function, construction,working, use, and application,specification of Sheet metaltools, instruments andequipment. Care andmaintenance of tools.Types of sheet metal joints (cold andhot) and their use. Rivet &riveting- their types and use.Solder and its composition.

4.Electrical

Electrical terms such as AC and DC supply, Voltage, Current, Resistance, Power, Energy, Frequency etc. Conductors and Insulators, Materials used as conductors. Series and parallelcircuit, open circuit, shortcircuit, etc. Measuring Instruments such as voltmeter, ammeter, ohm meter, watt meter, energy meter and frequency meter.Earthing and its importance.Earth resistance. Insulation and continuity test. Inductors and capacitors.Effects of inductor and capacitors in an AC circuit.Inductive reactance, capacitivereactance, Impedance and power factor. Lagging and leading power factors. Singlephase and Three phase supply system. Star and Deltaconnection and theircomparison. Line voltage, Line current, Phase voltage and Phase current. Methods of improving power factor.

5.Electronics

Introduction to Electronics.Basic Principles of semiconductors, Principles and application of Diodes. Solder – its composition andpaste. Rectification, Zener diode as voltage regulator – transistors parameters- CB, CE, CC, configuration, amplification.SCR Photo diodes, phototransistors, multi – vibrator, CR & LR circuit.SCRs, UJTs, ICs.

6.Welding

Introduction to basicprinciples of commonly used Welding processes, oxy fuel gas welding / cutting, brazing & soldering, nozzles, basemetal and filler metal. Use of flux. Method of gas welding, gas used and flames adjustment and pressure setting of O2 and DA. Difference between solderingand Brazing in terms of temperatures, filler materials, joint strengths andapplication.Use of Oxy Acetylene, OxyLPG, Air LPG and two stage regulators for brazing/ soldering. Descriptionof back fire arrester.

7. Basic Refrigeration

Basic principle of refrigeration,working, use, specifications of refrigeration tools, instruments and equipment.Fundamentals of Refrigeration, units and measurements, Pressure & its Measurements. Thermodynamics law. Science related torefrigeration, work, power,energy, force, Heat and Temperature, Different Temperature scales,Thermometers, Units of heat, sensible heat, latent heat, super heating and sub-cooling,saturation temperature, pressure, types, units. sub cooling and super heating.

8.Refrigerator ( Direct cool)

Function, construction,working of single door directcool refrigerator,specifications,troubleshooting,careandmaintenance.Require ment of Vacuum and level of vacuum.

9.Frost Free Refrigerator

Study the construction and working of Frost Free (2 or 3 door) Refrigerator parts particularly, the forced draft cooling, Air Duct circuit,temperature control inFreezer & cabinet of Refrigerator, air

flapper/ louver used in refrigeratorsection, automatic defrostsystem. Study of Electrical accessories & their functions (Timer, Heater, Bimetal, Relay, OLP, T/S etc.)Refrigerator cabinet volume calculation.

10.Refrigerator (InverterTechnology)

Study the construction and its workingof two and three door frost free refrigerator Care and maintenance, installationmethod.

11.Compressor

Function, construction,working,application of compressor,(Fixed speed and variable speed compressor) like Reciprocating, rotary, scroll and inverter type. AC motors and their types. Advantages of AC motor over DC motor. Revolving field theory. Phase splitting theory. Capacitor method and inductor method used to split the single phase. Torque – starting torque and running torque. Split phase induction motors, working principle and construction. Starting winding and runningwinding. Starting current and running current. Method of changing thedirection of rotation(DOR). Capacitor startsinduction run motor, working principle and construction.Centrifugal switch and its function.Starter and its necessity.DOL starter and the safety devices incorporated in it. Description of hermetic compressor Motor. Capacitor starts capacitor run motor, working principle andconstruction. Starting capacitor and running capacitor Shaded pole motors, working principle and construction.Torquecomparison among various single-phase AC motors.Common faults, causes and remedies in motors.

12.Motors

Motors used in refrigeration And Air conditioning system, types, construction, working & their starting methods.Function of Starting relay, Capacitors, OLP's. Working principle of inverter technology, advantages ofvariable speed technology over fixed speed. Working principle of control system for inverter Air Conditioners (ACs). Printed circuit board (PCB), including power PCB, filter PCB, heat sink and reactor. Wiring diagram.

13.Condenser

Function of condenser, types, Construction of air-cooled condenser. Effect of chockedcondenser. Advantages, descaling of air-cooled condenser. Effects of air fouling and bypass air in condenser. Types of water-cooled condenser, application, and advantages. Liquid receiver, pump down, application,types, function and working. Description of water-cooled condenser.

14.Drier

Function of drier, types,application and its advantage. Description of desicants.

15. ExpansionValve

Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic andThermostatic Ex. Valves, and electronic expansionvalves.

16.Evaporator

Working principle, Function,types of evaporators used in refrigerator, water coolers, bottle coolers, window andsplit A.C, Super heating in evaporators, Function of accumulator and types. Methods of defrosting.Safe handling of flammable refrigerants. Refrigerant leak detectionmethods, evacuation andchargingof refrigerant,temperature glides ofrefrigerant blends, procedureof charging of refrigerantblends especially the zeotropicblends, hydrocarbon blends,HFC blends (R-404A, R-407C, R-410A) and blends ofHFC/HFO.

17. Retrofitting

Changes of components & practices while retrofitting CFC appliances with HC Refrigerants. Properties of HCs

18.Thermal Insulation

Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems. Introduction of polyols and foam blowing agents (HCFC- 141b, cyclopentane, water, C02, methyl formate, HFO- 1233zd (E), HFO-1336mzz (Z)).

19. Window Air Conditioner

Study of constructionandworking principle of window AC and its components;electrical controls and wiring.Installation, troubleshootingand servicing. Energy Efficiency Ratio (EER) - Energy-efficiency labeling on ACs.

20.Split AC

Construction and workingprinciple, types, Troubleshooting & care and maintenance. Energy Efficiency Ratio (EER) - Energy-efficiency labelingonACs. Advantages of proper installation with emphasis on proper functioning and avoidance of leakage of refrigerant. Selection of location of indoor and outdoorunits ensuring minimumdistance between the units, away from flammablematerials, if any, good air flow within the cooling space as well as over the condenser. Locate power supply point considering safety and exclusiveness. Step by step procedure forinstallation both for indoor and outdoor unit. Ensure convenient access for drainage of condensate from the cooling coil.

21. SPLIT A.C (floor, Ceiling /Cassette mounted Split A.C) Construction and working principle, types, trouble shooting. Description ofelectrical components used in split A.C. Study the wiring circuit.

22.SPLIT A.C ( Ducted )

Study of the Duct able split AC, its Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.

23.INVERTER SPLIT A.C.

Study of construction andworking principle of inverter AC and its components, electrical circuit and controls, installation, servicing, trouble shooting, fault detection, leak testing and gas charging.Concept of Indian SeasonalEnergy Efficiency Ratio ISEER).Energy Efficiency leveling on inverter AC.

24. CAR AIR CONDITIONING

Study various components, electrical circuits and wiring diagram, testing components, fault detection, leak testing, Study of good service practice, evacuation, gascharging, Installation, troubleshooting, Magnetic

clutchoperation, free movement of flywheel (nonfunctioning of clutch), care and maintenance.

25.COMMERCIAL COMPRESSOR (Fixed & Variable)

Function, types, Construction & working, applications of compressors used in commercial refrigeration. Volumetric efficiency, Capacity control, factor influencing volumetricefficiency. Compressor lubricant oil, types, properties, types of lubrication methods such as splash, forced feed.

26.WATER COOLEDCONDENSER

Study the water-cooledCondenser, its type and capacity, construction and working, de scaling, application. Evaporative condenser-Types and their function, construction and application.Liquid receiver, function.Drier, types and application.

27. COOLING TOWER

Cooling tower, types,Construction, capacity, advantage & disadvantages of different types of cooling tower. Efficiency, approach and Cooling tower range.

28.WATER TREATMENT

Necessary, Causes of watercontamination control of scale deposit, corrosion and algae, Water softening and De-scaling method, pump and fan used. Regenerate and backwash.

29. EXPANSION VALVE

Types and function, construction, working principle, & their advantage &disadvantages. Thermostatic ExpansionValves (TXV), Automatic Expansion Valves (AXV), Float valves, fixed and modulating orifice controls & electronic Expansion Valves, LMC(level master control).

30. EVAPORATOR

Function, types, Plate & Tube forced air DX evaporators. Types of Defrost system.Water/ Brinechillers. Types of brine used as secondary refrigerant. Accumulator, its function.Liquid-suction-liquid Heat-exchanger, their function, construction, application & advantages.Study of Accumulator and Oilseparator.

31.ICE CUBE MACHINE

Description, Construction, working, reverse cycle functioning & Circuit diagram, installationmethod

32. ICE CANDY PLANT

Function, construction,working principle, Circuit diagram, capacity& types of compressor used. Brinecomposition to maintainrequiredtemperature.Operation, maintenance, retrofit.

33.COLD STORAGE

Study of cold storage plant, parts, construction,applications, controls &electrical diagram used incold storage plant. Foodpreservation spoiling agents-controlling of spoiling agents, preservation byrefrigeration system, maintaining temperature in different places.Types of cold storage and its details.Properties of commonly used refrigerantslike ammonia and its safe handling.Cold storage-type construction, capacity and specification.Use of vibration eliminator and shock absorber, Study the lay out and electric wiring of the storage plant.Mobile refrigeration in transport vehicles.Method of pressure testing, evacuation & charging to the system and testing efficiency.Cold storage plant operation, its common trouble & remedies. Deep freezing, freezing tunnel, blast freezer its function and working, its application.

34.HVAC (Plant)

Introduction to HVAC, Fundamentals of Central AirConditioning / HVAC plant, requirements of comfort A.C,study of psychometric terms, DBT, WBT, RH, enthalpy,dew point and specific humidity.

35.DUCT

Function, types, materials,duct designing, ductinsulation, properties of insulating materials 'K'factors, Acoustic insulation,air distribution methods, air flow, AHU, FCU, fan, blower.

36. AIR FILTERS

Function of air filters, types, construction, maintenance,effect of chocked Air filter, Hepa filters.

37.PACKAGE AC (with AirCooled Condenser)

Study the Package AC (with Air Cooled Condensers), its Construction and working principle, types, trouble shooting.

38. PACKAGE A.C WITH WATER COOLED CONDENSER

Study Package AC, types, construction and workingprinciple, trouble shooting, and various applications.Duct system, AHU.Care andmaintenance, installationmethod.

39.CENTRALISED/INDUSTRIALAIRCONDITIONING.

Construction and workingprinciple, types, maintenance of Industrial Airconditioning plant.Humidification anddehumidification methods. AHU, description of FCU Temperature and pressure controls used in AC plant, its construction, working, safetydevices, cooling towers, piping lines.

40. DIRECT EXPANSION SYSTEM

Study Direct expansion system. Operation & Preventive MaintenanceSchedule of central AC plant.Maintain log book for dailyoperation. VRF / VRV system – description and function of different parts. Details of piping have and controls system, Common reason for error code, types of ODU and IDU.

41.INDIRECT/CHILLER SYSTEM

Study central station AHU and FCU, Air washers used in chilled water system, understanding lay out,modulating valves for temperature control.Expansion valves & other related control – description and function. Study of Humidification &De-humidification. Humidifiers & De-humidifier's. Humiditycontrol.Use of hygrometer.

42.MOBILE AC (Bus, train)

Study the refrigeration cyclein automobile AC, its Construction, working of busAC, Magnetic clutchoperation, freewheeling (de engaging clutch).Refrigerants used HCFC-22,HFC-134a, HFOs, blends ofHFCs and HFOs.

## Annexure-3

**Part B(II)--General Knowledge, Logical Reasoning and Mental Ability, English, Punjabi.**

| *Sr. No.* | *Indicative Contents of Syllabus* | *Weightage (Approx.)* |
|---|---|---|
| 1 | ***General Knowledge and Current affairs of National and International importance including:***<br>*(i) Political issues,*<br>*(ii) Environment issues,*<br>*(iii) Current Affairs,*<br>*(iv) Science and Technology,*<br>*(v) Economic issues,*<br>(vi) History of Punjab-14th century onwards<br>*(vii) History of India with special reference to Indian freedom struggle movement.*<br>*(viii) Sports,*<br>*(ix) Cinema and Literature.* | *10* |
| 2 | ***Logical Reasoning & Mental Ability:***<br>*Verbal reasoning: Coding, Decoding, Analogy, Classification, Series, Direction sense test, relations, mathematical operations, time test, odd man out problems.*<br>*Non Verbal reasoning: Series, Analogy and Classification.*<br>*Basic numerical skills, Percentage, Number system, LCM and HCF, Ratio and Proportion, Number series, Average, Problems based on Ages, Profit & Loss, Partnership and Mixture, Simple and Compound Interest, Work and Time, Time and Distance. Mensuration and Data Interpretation.* | *10* |
| 3 | ***English:-***<br>*Basic Grammar, Subject and Verb, Adjectives and Adverbs, Synonyms, Antonyms, One Word Substitution, Fill in the Blanks, Correction in Sentences, Idioms and their meanings, Spell Checks, Adjectives, Articles, Prepositions, Direct and Indirect Speech, Active and Passive Voice, Correction in Sentences, etc.* | *5* |
| 4. | ***ਪੰਜਾਬੀ:-***<br>ਸ਼ੁੱਧ-ਅਸ਼ੁੱਧ, ਸ਼ਬਦਜੋੜ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ, ਸਮਾਨਾਰਥਕ/ਵਿਰੋਧੀਸ਼ਬਦ, ਨਾਂਵ, ਪੜਨਾਂਵ ਅਤੇ ਕਿਰਿਆ ਦੀਆਂ ਕਿਸਮਾਂ ਤੇ ਸਹੀ ਵਰਤੋਂ, ਲਿੰਗ ਅਤੇ ਵਚਨ, ਪੰਜਾਬੀ ਅਖਾਣ ਤੇ ਮੁਹਾਵਰੇ, ਅੰਗਰੇਜੀ ਤੋਂ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਅਤੇ ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੀ ਥਾਂ ਇੱਕ ਸ਼ਬਦ ਆਦਿ। | *5* |
| | **Maximum Marks** | 30 |

Note:-a) The distribution of marks/question in each section is indicative. It may vary slightly.

b) The syllabus is broadly classified as above but may vary to some extent.