

જા.ક. ૪૯/૨૦૧૮-૧૯

જગ્યાનું નામ : મદદનીશ ઇજનેર (યાંત્રિક), વર્ગ-૨

ભાગ-૧ અને ભાગ-૨ ના ૧૮૦ મિનિટના સંયુક્ત પ્રશ્નપત્રની પ્રાથમિક કસોટીનો અભ્યાસક્રમ

પ્રાથમિક કસોટીનો અભ્યાસક્રમ	
પ્રશ્નપત્ર-૧	
માધ્યમ: ગુજરાતી	કુલ ગુણ : ૧૦૦
૧	ભારતની ભૂગોળ- ભૌગોલિક, આર્થિક, સામાજિક, કુદરતી સંસાધન અને વસ્તી અંગેની બાબતો- ગુજરાતના ખાસ સંદર્ભ સાથે
૨	ભારતનો સાંસ્કૃતિક વારસો- સાહિત્ય, કલા, ધર્મ અને સ્થાપત્યો- ગુજરાતના ખાસ સંદર્ભ સાથે
૩	ભારતનો ઇતિહાસ- ગુજરાતના ખાસ સંદર્ભ સાથે
૪	ભારતની અર્થવ્યવસ્થા અને આયોજન
૫	<u>ભારતીય રાજનીતિ અને ભારતનું બંધારણ:</u> (૧) આમુખ (૨) મૂળભૂત અધિકારો અને ફરજો (૩) રાજ્યનીતિના માર્ગદર્શક સિદ્ધાંતો (૪) સંસદની રચના (૫) રાષ્ટ્રપતિની સત્તા (૬) રાજ્યપાલની સત્તા (૭) ન્યાયતંત્ર (૮) અનુસૂચિત જાતિ, અનુસૂચિત જનજાતિ અને સમાજના પછાત વર્ગો માટેની જોગવાઈઓ (૯) એટર્ની જનરલ (૧૦) નીતિ આયોગ (૧૧) પંચાયતી રાજ (૧૨) નાણા પંચ (૧૩) બંધારણીય તથા વૈધનિક સંસ્થાઓ- ભારતનું ચૂંટણી પંચ, સંઘ લોક સેવા આયોગ, રાજ્ય લોક સેવા આયોગ, કોમ્પ્ટ્રોલર એન્ડ ઓડિટર જનરલ; કેન્દ્રીયસતર્કતા આયોગ, લોકપાલ તથા લોકાયુક્ત અને કેન્દ્રીય માહિતી આયોગ
૬	સામાન્ય બૌદ્ધિક ક્ષમતા કસોટી
૭	સામાન્ય વિજ્ઞાન, પર્યાવરણ અને ઈન્ફર્મેશન એન્ડ કોમ્યુનિકેશન ટેકનોલોજી
૮	ખેલ જગત સહિત રોજબરોજના પ્રાદેશિક, રાષ્ટ્રીય અને આંતરરાષ્ટ્રીય મહત્વના બનાવો

Syllabus of Preliminary Test	
Paper-1	
Medium: Gujarati	Total Marks- 100
1	Geography of India-Physical, Economic, Social, Natural Resources and population related topics- with special reference to Gujarat
2	Cultural heritage of India-Literature, Art, Religion and Architecture- with special reference to Gujarat
3	History of India with special reference to Gujarat
4	Indian Economy and Planning
5	<u>Indian Polity and the Constitution of India:</u> (1) Preamble (2) Fundamental Rights and Fundamental Duties (3) Directive Principles of State Policy (4) Composition of Parliament (5) Powers of the President of India (6) Powers of Governor (7) Judiciary (8) Provisions for Scheduled Castes, Scheduled Tribes and backward classes of the society (9) Attorney General (10) NITIAayog (11) Panchayati Raj Institutions (12) Finance Commission (13) Constitutional and Statutory Bodies: Election Commission of India, Union Public Service Commission, State Public Service Commission, Comptroller and Auditor General; Central Vigilance Commission, Lokpal and Lokayukta, Central Information Commission
6	General Mental Ability
7	General Science, Environment and Information & Communication Technology
8	Daily events of Regional, National and International Importance including Sports

Syllabus for the preliminary test for the recruitment on the post of Assistant Engineer (Mechanical), Class-II in the Gujarat Engineering Services

Marks – 200

Questions – 200

Medium - English

1. THERMODYNAMICS:

- Fundamentals- thermodynamic systems and control Volume; Thermodynamic Properties, Process and state; Exact and Inexact differentials; Work-Thermodynamic definition; Temperature, Definition of thermal equilibrium and Zeroth law; Definition of heat; Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Properties of pure substances, behavior of ideal and real gases; Definitions of saturated states; Identification of states & determination of properties, Mollier's chart.
- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Various modes of energy, Internal energy and Enthalpy.
- Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.
- Clausius inequality; Definition of entropy S ; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Principle of increase of entropy; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.
- Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

2. HEAT-TRANSFER:

- Introduction to three modes of heat transfer, heat balance equation- Steady one dimensional solution for conduction heat transfer, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer, Heissler charts.
- Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.
- Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Wien's displacement law
- Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and NTU methods,
- Introduction mass transfer, Similarity between heat and mass transfer.

3. Fluid Mechanics:

Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; Euler's equation – theory of Rotodynamic machines viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings. Classification of

water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines.

4. Power Engineering:

Air and gas compressors; vapor and gas power cycles, concepts of regeneration and reheat.

5. I.C. Engines:

- Combustion in SI and CI engines, Combustion stages, Combustion chambers and abnormal combustion. Fuel supply systems in SI and CI engines, carburetors, Port fuel injection, direct injection and Common rail injection. Ignition system, Lubrication system and Cooling system. Testing of IC engines. Engine emissions and control. Advanced IC Engine concepts Air-standard Otto, Diesel and dual cycles.
- Engine Management, Engine System, Engine Mapping, Open Loop Engine Control Systems, lean burn engine control. Complete Vehicle Control System, Artificial intelligence and Engine management. Maintenance and fault diagnostics of engine management system, Engine diagnostics, Troubles and Tune-up, Engine service. Vehicle performance-performance parameters.
- Heavy Earth Movers, Types of Excavators, Dumpers, Draggers, Cranes

6. Refrigeration and air-conditioning:

Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes.

7. Engineering Mechanics:

Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion;

impulse and momentum (linear and angular) and energy formulations, collisions.

8. Mechanics of Materials:

Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

9. Kinematics and Theory of Machines:

Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility- Grashof's law, Universal Joint-Rocker mechanisms Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

10. Engineering Materials:

Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials. Young's modulus, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. Static failure theories: Ductile and brittle failure mechanisms, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects

of mean stress using the Modified Goodman diagram; Introduction to non-destructive testing (NDT).

11. Manufacturing Processes:

- Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.
- Heat treatment process-Annealing, tempering, normalizing and spheroidising,
- Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminum and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys.
- Welding and weld Testing, Classifying Welding process, Fusion versus non-fusion, Pressure versus non-pressure, Energy source of welding, Other basis for classification and sub-classification.
- Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters (5)Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.
- Types of Pumps, Pump viscosity, Centrifugal, NPSH, Pump curves, Progressive cavity, Screw pumps, Rope Pump, Submersible, Vertical

turbine, Coupling section, Motor section, Well Section, Hydraulic Principles, General pumping fundamental.

- Spillways-Types of spillway based on most prominent features, Spillway Crest Gates
- Flood Management

12. Metrology and Inspection:

Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

13. Computer Integrated Manufacturing:

Basic concepts of CAD/CAM and their integration tools. NC/CNC Technology and Part programming.

14. Operations Research:

Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM

15. Current Trends and Recent Advancements in the field of Mechanical Engineering.