

RRB ALP Heat Engine Syllabus

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Heat Engine Mock Test and Note Available

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◇ Subjects

Mechanical Parts	Electrical Part	Automobile Part
<ul style="list-style-type: none">Internal Combustion EngineHand ForgingBasic fittingWeldingSheet MetalMeasurement	<ul style="list-style-type: none">Basic Electricity	<ul style="list-style-type: none">Transmission System

◇ Subject Wise Marks Distribution (Expected)

Subject	Marks
Internal Combustion Engine (IC)	20
Hand Forging	8
Basic fitting	10
Welding	10
Sheet Metal	10
Measurement	5
Basic Electricity	7
Transmission System	5

◇ Subject Wise Syllabus Details

@ Internal Combustion Engine (IC Engine)

- Introduction of IC engine
- Two stroke and four stroke cycle engines
- Sequence of operations in a cycle
- Advantages and Disadvantages two-stroke cycle over four-stroke cycle engines
- Valve timing diagram for a four-stroke cycle petrol engine
- Valve timing diagram for a four-stroke cycle diesel engine
- Petrol engine and Diesel engine - general description, process, working principal, classification, uses
- Comparison of Petrol engine and Diesel engine
- Types of material used in packings and gaskets
- Types of locking devices, their places use in both engine
- Precautions of starting, running and stopping a Petrol and Diesel engine

- Brief description of engine auxiliaries and functions of various gauges and used with their engine
- Engine cylinder, cylinder head, cylinder liners, their material, wear and causes
- Method of reconditioning worn cylinders, piston, piston rings, types and functions and maintenance
- Brief functions of flywheel and clutch assembly, valve and valve operating systems, camshaft and timing gears and importance of timing mark
- Tappets and Valve Guides, importance of correct tappet clearance
- Ignition system of both engines,
- Purpose of induction coils, distributor and spark plug
- Elementary functions of the carburettor and adjustment
- Importance of correct air fuel mixture on the engine performance
- Scavenging of IC engine
- Supercharging of IC engine
- Lubrication of IC engine
- Governing of IC engine
- Detonation in IC engine
- Rating of SI engine fuel – Octane number
- Rating of CI engine fuels – Cetane number
- Testing of IC engine
- Thermodynamic test for IC engine (indicated mean effective pressure, indication power, brake power, efficiency, mechanical efficiency, overall efficiency, indicated thermal efficiency, brake thermal efficiency, air standard efficiency, relative efficiency, volumetric efficiency)

@ Hand Forging

Introduction

- Definition and importance of forging.
- Types of forging (Hot and Cold Forging).
- Advantages and limitations of forging.

Forging Tools and Equipment

- Description and uses of hammers (Ball-peen, Cross-peen, etc.).
- Types of tongs and their uses.
- Anvils and their components.
- Swage blocks and their applications.
- Chisels, punches, and drifts.
- Forge (Open hearth, closed hearth, and portable forge).
- Fuel types used in forging (coal, coke, and gas).

Forging Techniques

- Heating of metal in a forge.
- Temperature ranges for forging different metals.
- Basic forging processes:

➤ Upsetting

- Drawing out
 - Fullering
 - Edging
 - Bending
 - Twisting
 - Punching and drifting
- Proper handling of tools for precision forging.

Material Science in Forging

- Types of materials used in forging (Mild Steel, Wrought Iron, High Carbon Steel, etc.).
- Properties of forging materials.
- Heat treatment processes (hardening, tempering, annealing, etc.).

Forging Operations

- Straightening and flattening.
- Tapering and reducing.
- Joining metals using forging techniques (forge welding).
- Splitting, cutting, and swaging operations.
- Forging defects and their remedies.

Safety in Forging

- Safety precautions during forging operations.
- Proper use of Personal Protective Equipment (PPE).
- Fire hazards and prevention in the forge shop.

Applications of Forging

- Production of simple tools like chisels, punches, and spanners.
- Forging of components like hooks, clamps, and rings.
- General maintenance and repair work using hand forging techniques.

@ Basic Fitting

Introduction

- Definition of fitting and its importance in engineering.
- Objectives and scope of fitting work.
- Safety precautions and use of PPE in the fitting shop.

Fitting Tools and Equipment

- Types of fitting tools:
 - Marking Tools: Surface plate, scribe, punches, V-blocks, angle plates.

- Measuring Tools: Steel rule, vernier calipers, micrometers, dial gauge.
- Holding Tools: Bench vice, clamps, and fixtures.
- Cutting Tools: Hacksaw, files, chisels, reamers.
- Tool maintenance and sharpening techniques.

Basic Fitting Processes

- Marking and Measuring:
 - Principles of marking and layout.
 - Use of marking media and layout tools.
- Cutting and Shaping:
 - Sawing and types of hacksaw blades.
 - Filing techniques (cross-filing, draw-filing) and types of files.
 - Chiseling operations and types of chisels.
- Drilling:
 - Types of drills and drill bits.
 - Drilling operations and safety.
 - Use of drilling machines.
- Tapping and Threading:
 - Internal and external threading.
 - Use of taps, dies, and tap wrenches.
- Reaming and Boring:
 - Types of reamers.
 - Reaming techniques.
- Grinding:
 - Use of grinding stones.
 - Bench grinders and safety precautions.
- Scraping:
 - Use of scrapers and their applications.

Material Handling and Properties

- Introduction to engineering materials (metals and non-metals).
- Properties of materials used in fitting (ductility, malleability, hardness, etc.).
- Identification of materials by colour codes or physical properties.

Assembly Work

- Basic assembly of components using fitting techniques.
- Introduction to limits, fits, and tolerances.
- Alignment and assembly checks.

@ Welding

Introduction to Welding

- Definition and importance of welding.
- Types of welding processes.
- Applications of welding in industries.

Welding Tools and Equipment

- Hand tools used in welding.
- Power sources for welding:
 - AC and DC welding machines.
 - Transformers, rectifiers, and generators.
- Welding cables, clamps, and electrodes.
- Personal Protective Equipment (PPE) for welders.

Types of Welding Processes

- Gas Welding (Oxy-Acetylene Welding):
 - Principles of gas welding.
 - Gas cylinders, regulators, hoses, and nozzles.
 - Types of flames and their applications.
 - Gas welding techniques.
- Arc Welding (SMAW):
 - Principles of arc welding.
 - Types of arc welding machines.
 - Types of electrodes and their selection.
 - Techniques of bead formation.
- MIG/MAG Welding (GMAW):
 - Working principles.
 - Gas mixtures used in MIG welding.
 - Advantages and limitations.
- TIG Welding (GTAW):
 - Principles of TIG welding.
 - Use of tungsten electrodes.
 - Shielding gases and their applications.
- Resistance Welding:
 - Spot welding.
 - Seam welding.
 - Projection welding.
- Submerged Arc Welding (SAW):
 - Principles and applications.
 - Flux materials used.
- Plasma Arc Welding (PAW):
 - High-precision welding process.
- Other Advanced Welding Techniques:
 - Laser Welding.
 - Ultrasonic Welding.
 - Friction Welding.
 - Electron Beam Welding.

Welding Materials

- Types of metals used in welding (mild steel, stainless steel, cast iron, aluminum).
- Non-ferrous metals and their weldability.
- Welding consumables like electrodes, filler rods, and fluxes.

Welding Techniques

- Welding Positions:
 - Flat, horizontal, vertical, and overhead positions.
- Joint design and preparation:
 - Butt joints, lap joints, T-joints, corner joints.
- Edge preparation methods.

Welding Defects

- Common welding defects (cracks, porosity, undercut, spatter, etc.).
- Causes and remedies for defects.

Welding Symbols

- Interpretation of welding symbols and blueprints.

Inspection and Testing of Welds

- Visual inspection techniques.
- Non-destructive testing (NDT):
 - Radiographic testing.
 - Ultrasonic testing.
 - Dye-penetrant testing.
 - Magnetic particle testing.
- Destructive testing:
 - Tensile testing.
 - Bend testing.

Safety in Welding

- Fire hazards in welding.
- Ventilation and fume extraction.
- Handling gases and cylinders safely.
- Electrical safety in arc welding.

Heat Treatment and Welding Metallurgy

- Effects of welding heat on materials.
- Pre-heating and post-heating techniques.
- Distortion and its control.

Welding Automation

- Introduction to robotic welding.
- CNC welding applications.

Welding Applications and Projects

- Fabrication of simple components like frames, grills, and tanks.
- Repair and maintenance of metal parts.
- Pipe welding and structural welding.

@ Sheet Metal

Introduction

- Definition and importance of sheet metal work.
- Applications of sheet metal in industries.
- Overview of sheet metal properties and types.

Materials in Sheet Metal Work

- Types of sheet metal materials:
 - Ferrous metals (mild steel, galvanized iron, stainless steel).
 - Non-ferrous metals (aluminum, copper, brass, tin).
- Properties of sheet metal materials (ductility, malleability, corrosion resistance).
- Standard sizes and gauges of sheet metals.
- Methods of identifying sheet metal materials.

Sheet Metal Tools and Equipment

- Hand tools:
 - Marking tools (scriber, divider, punches, trammel).
 - Cutting tools (snips, shears, hacksaws, chisels).
 - Bending tools (pliers, seamers, stakes).
 - Holding tools (bench vice, clamps).
- Measuring tools:
 - Steel rule, tape measure, calipers.
 - Vernier calipers and micrometers.
- Machines used in sheet metal:
 - Guillotine shears.
 - Folding machines.
 - Rolling machines.
 - Press brakes.
 - Power hammers.

Marking and Layout

- Marking out methods using templates and patterns.
- Development of surfaces:

- Parallel line method.
- Radial line method.
- Triangulation method.
- Pattern drafting for various shapes:
 - Cylindrical shapes.
 - Conical shapes.
 - Transition pieces (square to round, round to oval).

Cutting and Shaping

- Types of cutting methods:
 - Straight cutting.
 - Circular cutting.
 - Notching.
 - Slitting.
- Filing and grinding techniques.
- Bending and forming:
 - Hand bending.
 - Machine bending.
 - Rolling and crimping.

Joining Techniques

- Temporary joining:
 - Screwing.
 - Riveting.
- Permanent joining:
 - Soldering.
 - Brazing.
 - Welding (TIG/MIG and spot welding for sheet metal).
- Adhesive bonding for sheet metal.

Assembly Work

- Joint design and types:
 - Lap joints.
 - Butt joints.
 - Corner joints.
 - Grooved and hemmed joints.
- Assembly of components like ducts, boxes, and containers.

Sheet Metal Operations

- Edge treatment:
 - Hemming.
 - Seaming.
- Beading and swaging operations.
- Flanging and wiring techniques.

- Embossing and stamping.

Development of Sheet Metal Jobs

- Layout and development of:
 - Cylindrical jobs (pipes, hoppers).
 - Conical jobs (funnels).
 - Transition jobs (square to round, etc.).
- Making articles like trays, ducts, tanks, and cabinets.

Inspection and Quality Control

- Checking dimensions and tolerances.
- Common defects in sheet metal work and their remedies.
- Use of measuring instruments for inspection.

Safety in Sheet Metal Work

- Safety precautions while cutting, bending, and joining.
- Handling sharp edges and hazardous tools.
- Fire safety during soldering and welding.

Advanced Sheet Metal Techniques

- CNC machines for sheet metal fabrication.
- Laser cutting and plasma cutting.
- Metal spinning and hydroforming.
- Introduction to composite materials in sheet metal.

Practical Applications and Projects

- Fabrication of simple components (trays, funnels, cans).
- Designing and making HVAC ducts.
- Repairing and maintaining sheet metal products.

@ Measurement

Introduction

- Importance of measurement in industries.
- Units of measurement:
 - SI units and their conversions.
 - Imperial and metric systems.

Measuring Tools and Instruments

- Linear Measurement Tools:
 - Steel rule.
 - Measuring tape.
 - Vernier caliper.
 - Micrometer.
- Angular Measurement Tools:
 - Protractor.
 - Bevel gauge.
 - Sine bar.
 - Angle plates.
- Depth and Height Measuring Tools:
 - Depth gauge.
 - Height gauge.
- Dial Indicators:
 - Plunger-type and lever-type indicators.
 - Applications in alignment and concentricity.
- Surface Measurement Tools:
 - Surface plates.
 - Straight edges.
- Thread Measuring Tools:
 - Screw pitch gauge.
 - Thread micrometer.
- Hole Measuring Tools:
 - Inside calipers.
 - Bore gauge.
- Radius and Profile Measuring Tools:
 - Radius gauge.
 - Profile projector.

Precision Measuring Instruments

- Vernier Instruments:
 - Vernier caliper.
 - Vernier height gauge.
 - Vernier depth gauge.
- Micrometers:
 - Outside micrometer.
 - Inside micrometer.
 - Depth micrometer.
- Dial Vernier and Digital Micrometers.
- Coordinate Measuring Machine (CMM):
 - Introduction and applications.
- Slip Gauges:
 - Sets, wringing process, and applications.

Specialized Measurement Tools

- Electrical Measuring Instruments:

- Multimeter.
- Ammeter.
- Voltmeter.
- Wattmeter.
- Frequency meter.
- Temperature Measuring Instruments:
 - Thermometers.
 - Pyrometers.
 - Thermocouples.
- Pressure Measuring Instruments:
 - Pressure gauges.
 - Manometers.

Measuring Techniques

- Types of Measurement:
 - Direct and indirect measurement.
 - Comparative measurement.
- Alignment and Centering Techniques.
- Measurement on Different Surfaces:
 - Flat surfaces.
 - Cylindrical surfaces.
- Use of Templates and Gauges:
 - Limit gauges (go and no-go gauges).
 - Plug and ring gauges.

Limits, Fits, and Tolerances

- Definition and types of limits (upper and lower).
- Types of fits (clearance, interference, and transition).
- Understanding tolerances:
 - Unilateral and bilateral tolerances.
 - Geometrical tolerances.

Surface Roughness Measurement

- Surface roughness parameters.
- Tools for roughness measurement (roughness comparator, profilometer).

Calibration

- Importance of calibration in measurement.
- Standards of calibration (ISO, BIS).
- Calibration of tools like micrometers, calipers, and gauges.

Inspection and Quality Control

- Role of measurement in inspection.

- Dimensional inspection.
- Use of measuring instruments in quality control.
- Identifying and correcting measurement errors.

Error in Measurement

- Types of errors:
 - Systematic error.
 - Random error.
 - Parallax error.
- Methods to minimize measurement errors.

Advanced Measurement Techniques

- Optical instruments (optical flats, autocollimators).
- Non-destructive testing (NDT) measurement techniques:
 - Radiographic.
 - Ultrasonic.
 - Magnetic particle.
- Introduction to laser-based measurement.

Safety in Measurement

- Handling of precision measuring instruments.
- Proper storage and maintenance of tools.
- Safety precautions during inspection and measurement.

Applications of Measurement

- Measuring and checking machine components.
- Dimensional analysis in fabrication and assembly.
- Measuring tools for electrical and electronic components.

@ Basic Electricity

Introduction

- Definition and importance of electricity.
- Sources of electricity:
 - Primary sources (battery, solar cells).
 - Secondary sources (AC mains, generators).
- Applications of electricity in daily life and industries.

Electrical Fundamentals

- Electric Charge and Current:
 - Concepts of charge, current, and electron flow.

- Unit of current (ampere).
- Voltage and Potential Difference:
 - Definition and unit (volt).
 - Measurement of voltage.
- Resistance:
 - Definition, unit (ohm), and symbols.
 - Factors affecting resistance (material, length, area, temperature).
 - Concept of resistivity and conductivity.
- Ohm's Law:
 - Relation between voltage, current, and resistance.
 - Applications of Ohm's Law.
- Power and Energy:
 - Electrical power (watt) and energy (kilowatt-hour).
 - Efficiency of electrical devices.

Electrical Components and Materials

- Conductors and insulators.
- Semiconductors (basic introduction).
- Types of wires and cables.
- Soldering materials and techniques.
- Electrical switches, fuses, and circuit breakers.

Electrical Circuits

- Types of circuits:
 - Series circuits.
 - Parallel circuits.
- Combination circuits and their applications.
- Circuit diagrams and symbols.

Electromagnetism

- Magnetic fields and their properties.
- Magnetic effects of electric current.
- Electromagnetic induction:
 - Faraday's laws of electromagnetic induction.
 - Lenz's Law.
- Self-inductance and mutual inductance.
- Applications of electromagnetism (motors, generators, relays).

DC Circuits

- Sources of DC supply (battery, rectifiers).
- Kirchhoff's laws:
 - Kirchhoff's Current Law (KCL).
 - Kirchhoff's Voltage Law (KVL).
- Analysis of simple DC circuits.

AC Circuits

- Basics of alternating current (AC):
 - AC waveform (sine wave).
 - Frequency, amplitude, and phase.
- RMS and average values of AC.
- Concept of reactance and impedance.
- Power factor and its significance.

Electrical Measuring Instruments

- Types of instruments:
 - Ammeter.
 - Voltmeter.
 - Multimeter.
- Wattmeter and energy meter.
- Use of megger for insulation testing.
- Cathode Ray Oscilloscope (CRO) basics.

Electrical Machines (Basic Concepts)

- Transformers:
 - Construction and working principle.
 - Types and applications.
- Electric motors:
 - Types (AC and DC motors).
 - Basic construction and working.
- Generators and alternators:
 - Construction and working principles.

Electrical Safety

- Importance of electrical safety.
- Shock hazards and prevention.
- Earthing and its necessity.
- Protective devices (MCB, RCCB, ELCB).
- First aid in case of electrical accidents.

Battery and Energy Storage

- Construction and working of batteries.
- Types of batteries (lead-acid, lithium-ion).
- Charging and discharging of batteries.
- Maintenance of batteries.

Basic Electrical Wiring

- Types of wiring systems:

- Surface wiring.
- Conduit wiring.
- Wiring accessories (switches, sockets, holders).
- Preparation of wiring layouts.

Basics of Renewable Energy

- Solar energy systems.
- Wind energy systems.
- Introduction to smart grids.

Troubleshooting and Maintenance

- Fault detection in electrical circuits.
- Repair and maintenance of electrical equipment.
- Testing electrical installations.

Advanced Topics (Introduction)

- Basics of electrical control systems.
- PLC and automation basics.
- Overview of IoT in electrical systems.

@ Transmission System

Introduction

- Definition and importance of transmission systems.
- Types of transmission systems:
 - Mechanical transmission.
 - Hydraulic transmission.
 - Electrical transmission.
- Applications of transmission systems in industries and vehicles.

Mechanical Transmission Systems

- Belt Drives:
 - Types of belts (flat, V-belts, timing belts).
 - Belt materials and their properties.
 - Pulley systems and their applications.
- Chain Drives:
 - Types of chains (roller chains, silent chains).
 - Chain drive components (sprockets, links).
 - Advantages and limitations of chain drives.
- Gear Drives:
 - Types of gears (spur, helical, bevel, worm, rack, and pinion).

- Gear terminology (pitch, module, teeth).
- Gear train systems (simple, compound, and planetary).
- Friction Drives:
 - Concept of friction in transmission.
 - Applications of friction drives.
- Rope Drives:
 - Types of ropes used in transmission.
 - Applications in lifts and hoists.

Couplings and Clutches

- Couplings:
 - Types of couplings (rigid, flexible, universal).
 - Applications of couplings in power transmission.
- Clutches:
 - Types of clutches (friction clutch, centrifugal clutch, fluid clutch).
 - Applications in vehicles and machinery.

Hydraulic Transmission Systems

- Hydraulic Principles:
 - Pascal's law.
 - Basic components of hydraulic systems.
- Hydraulic Pumps:
 - Types of pumps (gear pump, vane pump, piston pump).
- Hydraulic Motors:
 - Types and applications.
- Hydraulic Couplings and Torque Converters:
 - Working principles.
 - Applications in vehicles and machines.

Electrical Transmission Systems

- Basics of Electric Transmission:
 - Transmission of power using electricity.
- Electric Motors:
 - Types of motors (AC motors, DC motors).
 - Applications in power transmission.
- Linear Motion Systems:
 - Ball screws.
 - Actuators.

Automotive Transmission Systems

- Manual Transmission:
 - Components (gearbox, shafts, gears).
 - Working of manual gearboxes.
- Automatic Transmission:

- Components and working principle.
- Types (AMT, CVT, DCT).
- Drive Systems in Vehicles:
 - Front-wheel drive (FWD).
 - Rear-wheel drive (RWD).
 - All-wheel drive (AWD) and four-wheel drive (4WD).
- Differential Mechanism:
 - Purpose and working.
 - Types of differentials (open, limited-slip).
- Propeller Shaft and Universal Joints:
 - Functions and applications.

Special Transmission Systems

- Overhead Transmission:
 - Ropeways and cable cars.
- Conveyor Systems:
 - Types of conveyors (belt, chain, roller).
- Cranes and Hoists:
 - Power transmission in cranes.

Lubrication and Maintenance of Transmission Systems

- Importance of lubrication in transmission systems.
- Types of lubricants used.
- Troubleshooting and maintenance of transmission systems.

Common Transmission Mechanisms

- Cam and Follower Mechanism:
 - Types of cams and followers.
 - Applications.
- Rack and Pinion:
 - Working principle.
 - Applications in steering systems.

Advanced Transmission Systems (Introduction)

- Mechatronic Transmission:
 - Integration of electronics and mechanics.
 - Applications in modern vehicles.
- Hybrid Transmission Systems:
 - Working principles.
 - Applications in hybrid and electric vehicles.