Annexure-6

Common Syllabus for the post of Instructor Gr.-I & Technician Gr.-II
Notification Sl. No. **5 & 6**
Qualification – Diploma in Tool & Die Making

Basic Fitting:

Bench work – Metal working, hand tools and devices –Work bench – vices – files – hacksaw – hammer – spanners – screw drivers.
Linear measurements- its units, steel rule dividers, Punch – types and uses.
Description use and care of marking table.
Vernier calliper-its parts, principles, reading, uses and care.
Outside micrometer – its parts, principles, reading, uses and care,
Vernier height gauge-its parts, principles, reading, uses and care.
Marking tools – scriber.
Marking out – Coordinates system, Rectangular – Polar – Rules for marking.
Bevel protractor, combination set- their components, uses and cares.
Pedestal grinder, star wheel dresser, safety precautions, care and maintenance.
Marking media, special application.
Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance.

Drilling:

Drill, Tap, Die-types & application. Determination of tap drill size.
Reamer- material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure.
Drilling machines-types and their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facing tools and nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations.

Inspection:

Dial test indicator-its parts, types, construction and uses. Interchangeability: Necessity in Engineering field, Limit-Definition, types, terminology of limits and fits-basic size, actualsize, deviation, high and low limit, zero-line, tolerance zone, allowances. Different standard systems of fits and limits.
Geometrical tolerance. British standard system, BIS system.
Vernier Bevel Protractor–parts, reading and uses.
Sine Bar–description & uses
Slip gauge–description and uses.

CNC Machines:

Introduction to CNC machining center- CNC system- Elements of CNC machine- Hardware & Software- Safety feature – Axes designation- offset measurement. Types of Co-ordinate System-Preparatory codes (G-Codes and M –codes) –

Cutting part program (Main & Sub) – Do"s and Don"t – routine maintenance – Trouble shooting.

Electric discharge machining:

Principles of EDM - Advantages and applications of EDM – Spark erosion terminology – machine tool operating system – dielectric fluid – dielectric system – methods of flushing, Electrode – material - application - manufacturing methods – methods of holding electrodes and alignment – determining electrode size and spark gap, Work preparation and setting EDM parameters, Trouble shooting and maintenance. Principles of CNC Wire cut EDM - Advantages and applications. Machine tool, power supply, dielectric supply and part programming. Work preparation, work material, wire electrode, job mounting, and job reference point, Water Dielectric- characteristics, dielectric strength and flushing.

Material Technology:

Introduction about metals, difference between Metal and Non-Metal, properties of metal, Classification of metals and its applications, pig– iron, cast iron, wrought iron, steel-plain carbon steel (Low carbon steel, medium and high carbon steels, high speed steel, stainless steel, carbides etc.)

Heat Treatment:

Heat treatment of metals, process-such as annealing, nitriding, hardening, tempering, casehardening, carburizing, cyaniding ,flame hardening, Induction hardening, purposes and its effects on the properties of steel.

Lathe:

Getting to know the lathe with its main components, lever positions and various lubrication points as well. Definition of machine & machine tool and its classification.

Introduction to lathe. Centre lathe construction, detail function of parts, specification. Safety points to be observed while working on a lathe.

Different types of Lathe operations-facing, turning, parting-off, grooving, chamfering, boring etc. Lathe cutting tool-different types, shapes and different angles (clearance, rake etc.), specification of lathe tools. Types of chips, chip breaker. Tool life, factors affecting tool life.

Driving mechanism, speed and feed mechanism of Lathe. Concept of Orthogonal and Oblique Cutting.

Work holding on lathe-Chucks & different types of job holding devices on lathe and advantages of each type.

Mounting and dismounting of chucks.
Knurling-types, grade & its necessity.
Various material for single pointcutting tools, tip tools- their brazing and
Single point tool sharpening process.
Calculations of taper turning by off-setting tailstock.

Milling Machine:

Importance, types, construction and specification.
Driving and feed mechanism of Milling Machine
Different milling cutter angles, Milling cutter materials.
Jobholding devices-vice, clamps, V-block, parallel block etc. Milling cutter holding devices,
Milling process –Up milling and Down milling.
Calculation of cutting speed, feed, machining time for milling machine. Milling machine operations. Milling machine attachments –vertical milling attachment,
Introduction to coolant & lubricant-difference between them, types and uses of each.
Dividing head – Introduction, construction, types. Simple and universal dividing head.
Indexing methods–direct indexing, simple indexing, angular indexing, its calculations.

Grinding machine:

Introduction, types, Surface & Cylindrical grinding Machine- their parts, functions, specification, and uses. Safety points to beobserved while working on a Grinding machine.
Grinding wheel shapes and sizes. Standard marking system. Selection of grinding wheel.
Procedure for mounting of grinding wheels, balancing of grinding wheels.
Dressing, types of dresser. Glazing and Loading of wheels –its Causes and remedies.
Roughness values and their symbols.
Importance and necessity of quality.
Abrasives - its types, Bond, Grade, Grit, structure.
Tool & cutter grinder-construction, use and specification.

ENGINEERING DRAWING:

Introduction to Engineering Drawing and Drawing Instruments–
Conventions
Sizes and layout of drawing sheets

Title Block, its position and content
Drawing Instrument
Lines-Types and applications in drawing, Free hand drawing of Geometrical figures and blocks with dimension
Transferring measurement from the given object to the free hand sketches.
Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures:
Angle, Triangle, Circle, Rectangle, Square, Parallelogram.
Lettering & Numbering–Single Stroke. Dimensioning
Types of arrow head
Leader line with text
Position of dimensioning (Uni directional, Aligned), Symbolic representation–
Different symbols used in there lated trades. Concept and reading of Drawing in
Concept of axes plane and quadrant
Concept of Orthographic and Isometric projections
Method of first angle and third angle projections (definition and difference)
Reading of Job drawing of related trades.
Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc.
Reading of foundation drawing
Reading of Rivets and rivetted joints, welded joints
Reading of drawing of pipes and pipe joints
Reading of Job Drawing, Sectional View & Assembly view

WORKSHOP CALCULATION & SCIENCE:

Unit, Fractions
Classification of unit system
Fundamental and Derived units F.P.S,C.G.S, M.K.S and SI units
Measurement units and conversion
Factors, HCF, LCM and problems
Fractions-Addition, subtraction, multiplication & division
Decimal fractions-Addition, subtraction, multiplication & division
Solving problems by using calculator
Square root, Ratio and Proportions, Percentage
Square and square root
Simple problems using calculator
Applications of Pythagoras theorem and related problems
Ratioandproportion

Ratio and proportion-Direct and indirect proportions
Percentage
Percentage-Changing percentage to decimal and fraction
MaterialScience
Types metals, types of ferrous and nonferrous metals
Physical and mechanical properties of metals
Introduction of iron and cast iron
Difference between iron & steel, alloy steel and carbon steel
Properties of insulating materials
Mass, Weight, Volume and Density
Mass, volume, density, weight and specific gravity
Speed and Velocity, Work, Power and Energy
Work, power, energy, HP,I HP, BHP and efficiency
Heat & Temperature and Pressure
Concept of heat and temperature, effects of heat, difference
Between heat and temperature, boiling point & melting point of different metals and non-metals
Transmission of heat-Conduction, convection and radiation
Co-efficient of linear expansion
Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction
Friction-Lubrication
Friction-Co-efficient of friction, application and effects of friction in workshop practice
Centre of gravity-Centre of gravity and its practical application
Area of cut out regular surfaces-circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle
Area of irregular surfaces and application related to shop problems
Elasticity-Elastic, plastic materials, stress, strain and their units and young's modulus
Elasticity-Ultimate stress and working stress
Heat treatment and advantages (Only over view required).
Heat treatment-Different heat treatment process –Hardening, tempering, annealing, normalizing and case hardening (Only over view required)

Basic Electricity

Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC their comparison, voltage, resistance and their units

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Mensuration

Area and perimeter of square, rectangle and parallelogram
Area and perimeter of Triangles
Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse
Surface area and volume of solids -cube, cuboid, cylinder, sphere and hollow cylinder
Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels
Levers and Simple machines
Lever & Simple machines-Lever and its types
Trigonometry
Measurement of angles
Trigonometrical ratios
Trigonometrical tables

Jigs and fixtures:

Definition, basic elements, advantages and applications in batch production and mass production.

Design features of jigs and fixtures. Economy and cost of jig and fixture. Planes and movements and arresting degrees of freedom. Locating principle and types of locators. Clamping principles and types of clamps. Drill bushes- types, size, accuracy and material. Types of drill jigs, parts and functions, Types of Milling fixtures, parts and functions. Welding fixtures – Construction principles, parts and function.

Press tools:

Shearing theory – cutting and non-cutting operations, Cutting-clearance, Land and angular clearance, Calculation of cutting force,

Introduction on Quality control, Inspection of tool and gauges, Product inspection, awareness on ISO and importance in different tooling and applications, methods of Press tool & Press tool nomenclature.

Stock material, strip lay out and Economic factor Cutting force calculation punch and die–Types and materials Strippers types and functions Constructions of progressive tool

Stoppers types and functions Pilot locations and sizes, Side cutters Working principle of Ejector and shedder

Compound tool and combination tool- Function, Construction, Side cam tool –

function-advantages-working Principles
Deep draw tool function and calculation
Introduction to Press parts, functions, Classification of presses, and specification
Selection of press- Shut height and daylight clearance Safety precaution on press work Strip feeding, Die cushion
Fine blanking–Application, working principle, clearance.
Tool life, punch and die radius.
Tool estimation.
Introduction of TPM and TQM.
Basic machine tool maintenance and its importance

PLASTIC MOULDING:

Introduction to plastic material: Types of plastics, differentiation of plastics, Properties, application, fillers and additives and rein forced plastics.
Mould terminology : Core, cavity, impression, runner, gate, spruebush, mould base etc.
Parting line: Types of parting line, mould matching (Bedding down),vent and relief.
Requirement for ejection: Types of ejector grids, ejector elements and ejector system.
Feed System : Sprue, runner, gate, types, design and calculations, vent design,
balancing, etc.
Shrinkage: Introduction mould life, cavity/core dimensions, and various shrink age values for different plastic materials.
Temperature controlling of moulds: Introduction, factors effecting the cooling of moulds, layout and sizing of cooling channel, cooling integer type mould plate (core cavity, Bolster),cooling core and cavity inserts and sub inserts, mould cooling requirements and calculations.
Injection moulding machines: Introduction, clamping system/injection system terminologies and specifications, screw terminology construction of screw, Types of moulding machines, and sequence in the moulding cycle. Selection of mould base, material and no. of cavities: Introduction, Selection of mould base and material, advantages and disadvantages of single/ multi-cavity mould, calculation of no. of cavities.
Splits: External under cut components, methods of operation, split locking methods, splits safety arrangements.

Side cores and Side cavities: Introduction, moulding embedded side holes/recess/slots, Design requirements for side core/side cavities, internal side core/side cavities.
Moulding internal under cuts/threads: Definition, form pin/split core/ side core, stripping internal under cuts purpose of threads in plastics, moulding internal threads, power and transmission system layout of impression, and moulding of external threads.
Moulding of thermos set materials: Introduction, processing method, compression moulding, definition, pellet, compression moulding types, advantages and disadvantages of semi positive and fully positive mould, automatic compression mould, mould heaters and Thermo couples, etc., Transfer moulding, types of transfer moulding, advantages and disadvantages of transfer moulding.
Injection moulding of Thermoset material, Advantages and disadvantages of injection moulding of Thermoset material, Compression/ transfer moulding defects.
Surface finish: Mould polishing, different types and appearance required after finishing, over view of the process, standard specification of finish, mechanical equipment of mould polishing, finishing process, problems in mould polishing and solutions, surface treatment method.
Multi day light mould: Introduction, under feet mould with reverse tapered sprue, floating runner plate, working system for floating cavity plate, other standard designs, some non-standard latch/locks, some sample multi-day light design.
Introduction of blow moulding, types of blow moulding advantage and disadvantage of blow moulding. Material used in blow moulding, blow moulding fault& remedy.
Hot runner mould: Definition, runner less mould, advantages and disadvantages of hot runner moulding system, type of hot runner system, valve system, selecting a hot runner system,advantages and disadvantages of insulated runner mould and modified insulated runner mould, starting/ restarting nozzles in a manifold application.
Injection moulding defects: Introduction, common faults, possible problems and remedies, analysis of moulding problems and solutions.
Other moulding processes: Blow moulding, Extrusion moulding, rotational moulding, thermo forming, sheet and film forming. Multi-color moulding:

Introduction, multi-color moulding, multi-material moulding and multi-process moulding.
Maintenance of mould: Introduction, upkeep and maintenance, types of maintenance of idle moulds, maintenance control, and frequency of maintenance.
Die cast mould: Introduction toDie casting, Die casting, gating system design, force calculation, defects and remedies.
Die and mould economics: Estimation and casting of mould raw material, machining hour rate, business transactions, cost of components, activity-based costing, estimation of moulds and standard items.

Hydraulics & Pneumatics:

Basic principles of hydraulics/ pneumatics system, advantages and disadvantages of hydraulics and pneumatics systems, theory of Pascal's law, Brahma's press, Pressure and flow, types of valves used in hydraulics and pneumatics system.
Lubricating system-types and importance Maintenance: Definition, types and its necessity.
System of symbol and colour coding. Possible causes for failure and remedies.

Estimation and Costing:

Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade
Estimation and costing - Problems on estimation and costing.