# 061 – MECHANICAL ENGINEERING CRAFT PRACTICE

**EXAMINATION STRUCTURE**

The examination for this syllabus wills cover the underlisted two major areas of groupings and 193 Building/Engineering Drawing as the related course

– Fitting, Drilling and Grinding (CME 13, 17 and 18)

– Turning, Milling, Shaping and Slotting (CME 14, 15 & 16)

In each of this paper, candidates will be examined in Objectives, Essay and Practical.

**EXAMINATION SCHEME**

**61 – Mechanical Engineering Craft Practice**

This subject consists of two papers:

61-1 – PAPER I : This will consists of two sections, viz:

SECTION A: OBJECTIVE: this will be forty (40) multiple choice questions. Candidates will be required to answer all in 40 minutes. This section carries forty (40) marks.

SECTION B: ESSAY: this will be a written paper of seven questions. Candidates are to answer five questions in 2 hours. This Section carries sixty marks.

61-2 PAPER II: PRACTICAL: Candidates will be required to answer two question for 100 marks. This paper will be released to the candidates TWO WEEKS in advance.

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# FITTING, DRILLING AND GRINDING

| S/N | TOPICS/OBJECTIVE | CONTENT | ACTIVITIES/REMARK |
|---|---|---|---|
| 1. | **Shaping Metals to Size**<br>State method of shaping metals to size by hand. | Methods of shaping metals to size using hand tools e.g. sawing, shearing, filling etc. | Carry out various shaping operations |
| 2. | **Sawing**<br>1. Explain principles of cutting metals and differences between hacksaw and power saw.<br>2. Select, install and cut metal to specifications using hack saw or power saw. | 1. Basic principles of cutting metals by sawing.<br>2. Difference between hacksaw and power saw.<br>3. Installation of saw blades in hack and power saw.<br>4. Cutting metals to specification using hack or power saw. | Cut metal to specification using a hacksaw or power saw. |
| 3. | **Shearing**<br>Explain principles of shearing metals to size and select correct tools for cutting exercises | 1. Basic principles of shearing metals to size.<br>2. Selection of correct shearing tools for the thickness of materials to be sheared e.g. supper/hand shear, bench shear, power shear.<br>3. Cutting metals size by any of the shears mentioned above. | Shearing metals to size using hand and power saw. |
| 4. | **Filing**<br>1. Classify files used in metal work and explain the principle of selection of appropriate ones for job application.<br>2. With appropriate files carry out filing exercise on flat and curved surface of materials.<br>3. Identify types, working principles and purpose of scraper in metal work.<br>4. Select and chisel metal of given specification to shape. | 1. Classification of files used in metal work e.g. fitters/machinist files, swiss files etc.<br>2. Principles of filing and application to various metals.<br>3. Selection of appropriate files for job.<br>4. Filing of metals to given specification for different grade of finish and hardness of materials.<br>5. Filing of flat and curved surface.<br>6. Scraper and its working principles.<br>7. Identification of scraper types e.g. flat type, bearing of half round scraper, and three-square scraper.<br>8. Shapening of scrapers.<br>9. Frosting or flaking of scraper surface.<br>10. Chisel types, functions of shipping jobs.<br>11. Using of chisel on metals. | 1. Filling metals to size using appropriate filing methods.<br>2. Carry out scraping operations<br>3. Chiseling and its applications |
| 5. | **Clamping Devices**<br>1. Identify shapes of job and use appropriate clamping device on metal components.<br>2. Control clamping pressure for finish surfaces and check overhand/packing. | 1. Various shapes of job to be clamed e.g. round, flat, irregular etc.<br>2. Appropriate clamping device in metal e.g. strap clamp, angle plate etc.<br>3. The control of clamping device<br>4. Protection of finish surfaces when applying clamps.<br>5. Checking overhand and packing. | Select and use appropriate clamps for a given job. |
| 6. | **Clamping Device**<br>1. Identify, describe type of hand grinder and state characteristics of good grinding stone.<br>2. Choose appropriate grinding wheel for a job and carry out grinding | 1. Types, functions and use of grinder e.g. bench grinder, pedestal grinder, hand grinder.<br>2. Characteristics of good grinding stone e.g. fine, medium, rough.<br>3. Appropriate grinding wheel for a job.<br>4. Safety precautions necessary when performing grinding operations e.g. | Carry out grinding operation. |

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| | operation observing all precautions. | wearing protective goggles or shield, holding work and tools at correct angle etc.<br>5. Carry out grinding operation with facility.<br>6. Dressing and throw off-hand grinding wheel with a star dresser. | |
| 7. | **Drilling and Drilling Machine**<br>1. Differentiate type of drilling machines and accessories.<br>2. Install accessories on machine and select speed and feed for operation observing all precautions. | 1. Types of drilling machine e.g. pillar drilling machine, radial drilling machine, sensitivity drilling machine etc.<br>2. Materials used for twist drills e.g. high carbon steel, high speed steel etc.<br>3. Correct drill accessories for jobs e.g. use of a drill press.<br>4. Selection of speed and feed for drilling operations.<br>5. Drilling holes with machine to given specification on<br>a. flat work pieces<br>b. round work pieces | Carry out drilling operation to specifications. |
| 8. | **Lapping of Engineering Component**<br>Select appropriate tools and past for lapping and state the composition of paste for correct lapping operation. | 1. Appropriate tools past for lapping:<br>a. flat surface<br>b. curved surface<br>c. diameter (internal and external) e.g. value seating.<br>2. Composition of paste used for lapping various surfaces.<br>3. Correct lapping speed.<br>4. Setting and lapping the surface to required finish and accuracy. | Set and lap a given surface to specification. |
| 9. | **Ream and Reamer**<br>1. Explain and state purpose of reaming and boring with selection of appropriate reamer for a job.<br>2. Adjust reamer to hole size and carry out reaming operations with safety precautions. | 1. Purpose of boring and reamer.<br>2. Purpose of reaming.<br>3. Appropriate reamer for a job e.g. solid adjustable/expansion, tappers reamers etc.<br>4. Adjusting of expansion reamer to correct size of hole.<br>5. Reaming holes using hand and machine tools observing safety precautions. | Carry out reaming operation. |
| 10. | **Mechanical Properties**<br>1. Describe heat treatment, hardening materials and state their composition.<br>2. Carry out various heat treatment process and explain purpose and method of case hardening. | 1. Introduction to heat treatment e.g. carbon on structural changes, relationship between temperature and colour, correct quenching media, techniques of quenching.<br>2. Hardening material and their composition.<br>3. The process of carrying out:<br>a. hardening,<br>b. annealing,<br>c. normalizing<br>d. tempering<br>e. stress relief processes etc.<br>4. Purpose and method of case hardening and case hardening of various metals. | Carry out various heat treatment |

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| 11. | **Measurement**<br>1. Outline history of measurement and explain English and Metric systems.<br>2. Identify types of micrometer and describe functions, working principles/measurements.<br>3. Identify and explain functions of the following measuring tools:<br>a. Caliper,<br>b. Combination set,<br>c. Electric gauge,<br>d. A sine bar and plate<br>e. Go and no-go gauge<br>f. Vernier gauge micrometer.<br>4. Inspect finished component equipment and select gauges for particular inspections and set, use and state limit and accuracies of each gauge. | 1. Brief history of measurement.<br>2. Systems of measurement (English and Metric).<br>3. Types, size and parts of micrometers e.g. outside micrometer, inside micrometer, depth micrometer, screw-thread micrometer etc.<br>4. Functions of parts of micrometer.<br>5. The working principles of micrometer.<br>6. Measurement of micrometer.<br>7. Calipers.<br>8. Coughing and measuring difference<br>9. Electric gauge<br>10. Parts of combination set<br>11. Difference between 25-division vernier caliper and 50-division vernier caliper.<br>12. Common length of a sine-bar.<br>13. Difference between a fine bar and sine plate.<br>14. Difference between go and no-go gauge.<br>15. The principles of vernier gauge micrometer<br>16. Accurate measurement of:<br>a. vernier gauges,<br>b. vernier protector,<br>c. dial indicators,<br>d. optical instrument, micrometer and dial indicator micrometer.<br>17. Inspections of finished components and equipment using gauges.<br>18. Choosing of gauge for particular inspections.<br>19. Mentioning of limits and accuracies of gauges.<br>20. Setting and using of gauges. | 1. The application of measuring tools in measurement.<br>2. Emphasize the use of the calipers and the other tools.<br>3. Make accurate measurement using the various measuring tools. |
| 12. | **Alignment of Components**<br>1. Check and state purpose of alignment in engineering using steel test bar and dial indicator.<br>2. Check alignment after machining using dowels.<br>3. Select appropriate tools, align centre of lathe and test carryout alignment. | 1. Purpose of alignment in engineering.<br>2. Methods of checking alignment.<br>3. Locating and aligning components using dowel or with steel test or dial indicator.<br>4. Checking alignment after machining and measuring with a micrometer.<br>5. Locating and aligning components by using dowel e.g. mark out dowel position, 'Box' the hole, drill hole with correct reaming allowance, ream holes, select correct dowel size for job, insert dowel in position.<br>6. Appropriate tools and aligning centres of the lathe.<br>7. Appropriate tools and aligning centre.<br>8. Test for straightness, roundness, surface finish, and centre distance.<br>9. Carrying out alignment for shaft, pulley, couplings, belts, chains, sprockets, and horizontal vertical or regular planes. | 1. The dial indicator must stay at zero as the carriage is moved back and forth.<br>2. Carrying out alignment for shaft, pulley, couplings, belts etc. |

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| 13. | **Solder and Soldering**<br>1. Explain principles of soldering and jobs to be so soldered and solder composition.<br>2. Differentiate melting point of solder and metal and solder/test joints. | 1. Principles of soldering and factors that determines job to be soldered.<br>2. Composition of solder<br>3. Difference between melting points of solder and metal.<br>4. Soldering of joints<br>5. Testing of soldered joints for rigidity and leakage. | Solder joints using given metals |
| 14. | **Assembly of Component**<br>1. Read machine blue print, working drawings and identify components with their functions.<br>2. Select appropriate devices for assembling and test efficiency of assembled machine. | 1. Machine blue print, working drawings with components.<br>2. Functions of component.<br>3. Appropriate devices for assembling<br>4. Testing for efficiency of assembled machine. | Test assembled machine for correctness. |
| 15. | **Drilling Machine**<br>1. Identify types, constructional details and describe application of each drill and accessories of a drilling machine.<br>2. Identify types of drill and carry out drilling operation considering tool lubrication and safety.<br>3. Explain different cutting angles and grind drills to different angles | 1. Types and application of drilling machines and accessories – constructional details and functions.<br>2. Types and features of drills (drill bits):<br>a. drilling to specification<br>b. grinding of drills to correct angle. | 1. Emphasize safety and lubrication.<br>2. Observe safety precaution.<br>3. Compare and contrasts.<br>4. Identify and use each. |
| 16. | **Seating**<br>Differentiate counter boring, counter-sinking and spot facing tools and carry out various operations for production. | 1. Types of seating e.g. Counter-boring, Counter-Sinking etc, Spot –facing.<br>2. Seating operation. | Carry out various seating operations. |
| 17. | **Reamers and Reaming**<br>1. Identify and describe types of reamer and explain purpose of reaming a hole.<br>2. Select and mount reamer on drill check to ream a hole observing safety precautions. | 1. Types and use of reamers e.g. Jobber's Reamer, Steel Reamer, Fluted Chucking Reamer, Rose Chucking Reamer, Expansion Types Step Types, Morse Taper Types,<br>2. Purposes of Reaming<br>3. Reaming Operations | Observe safety precautions during reaming operations. |
| 18. | **Pillar Drilling Machine**<br>1. Describe construction of pillar drilling machine and explain drilling techniques for different holes.<br>2. Set and carry out drilling operation with necessary safety maintenance. | 1. Features of a pillar drilling machine.<br>2. Use of Pillar and radial Drilling machine.<br>3. Drilling operations. | Emphasize the observation of safety precautions. |

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| 19. | **Speeds and Feeds**<br>Calculate surface speed of a pillar drilling machine. | 1. Calculations of<br>a. Surface speed<br>b. Spindle speed<br>c. Revolution required and<br>d. Time taken<br>$S = \frac{\pi DN}{1000}$ where S = Surface Speed (cutting speed) M/Min<br>D = Drill diameter (mm) $\prod = 3.142$<br>N = Number of revolution per minute = spindle speed rev/min)<br>The spindle speed $N = \frac{1000S}{\prod D}$<br>Revolution required = $\frac{\text{length of hole}}{\text{Feed (mm/rev.)}}$<br>Time Taken = $\frac{\text{Revolution Required}}{\text{Spindle Speed (rev/min)}}$ | |
| 20. | **Grinding Machine**<br>Explain principles, parts and describe various components of a grinding machine. | Principle and uses – parts and their uses. | |
| 21. | **Grinding Operation**<br>1. Identify types and state importance of grinding operations.<br>2. Describe features function of various grinding machines and difference between off hand and precision grinding. | Importance of grinding operations – types and constructional details of grinding machines:<br>a. Hand Grinder<br>b. Surface Grinder<br>c. Portable Grinder<br>d. Cylindrical Grinder<br>e. Centerless Grinder<br>f. Tool and Cutter Grinder<br>g. Universal Grinder<br>h. Internal Grinder<br>i. Off Hand and Precision Grinder | Carry out grinding operations and observe safety precautions. |
| 22. | **Grinding Machines and their Accessories**<br>1. Explain working details of all grinding machines and select appropriate table for calculating wheel speed.<br>2. State reasons for choice of grinding speed and describe how lost of temper in metal due to overheating is maintenance of grinding machines. | 1. Working principles of each type of grinding machine e.g. hand grinder, portable grinder, surface grinder etc. – cutting action of grinding wheel.<br>2. Factors governing – selection of grinding speeds.<br>3. Calculation of wheel speed with formula e.g.<br>$S = \frac{\pi DN}{1000}$ where D = Diameter of wheel in mm.<br>N = Number of revolution per minute<br>S = Speed of machine<br>$\prod = 3.142$<br>4. Prevention of lost of temper in metal during grinding.<br>5. Maintenance of grinding machines:<br>a. regular cleaning of machine<br>b. top up oil level | |

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| | | c. grease and machine<br>d. adjust slide at the end of day<br>e. cleaning the machines at regular intervals during use and at the end of day.<br>f. Top oil level<br>g. Grease the machine<br>h. Adjust slide at the end of the day. | |
| 23. | **Grinding Wheel Composition and Classification**<br>1. Describe composition of grinding wheels and explain types of abrasives and bonds.<br>2. State and describe classifications, characteristics and shape of grinding wheels.<br>3. State factors for selecting grinding wheels for a job and test for soundness before mounting. | 1. Composition of grinding wheel e.g. Abrasive and bond.<br>2. Types of abrasives:<br>a. Selicon Carbide – grinding of materials with low tensils strength such as aluminium, ceramics, copper and cast iron;<br>b. Aluminium Oxide-grinding materials with high tensile strength such as heat treated parts, steels and alloys steel etc.<br>3. Bond and types of adhesives.<br>4. Classification of grinding wheel e.g.<br>a. Coarse - abrasive grain size of 6 – 14<br>b. Medium - abrasive grain size of 30 – 40<br>c. Fine – abrasive grain size of 70 – 180.<br>d. Very-fine - abrasive grain size of 200 – 260.<br>5. Shapes and characteristics of grinding wheels e.g.<br>a. Type of abrasive.<br>b. Proper bonding of abrasive grains.<br>c. Size and grade (coarseness of abrasive grains).<br>d. Structure (abrasive grain spacing/distribution).<br>6. Factors affecting selection of grinding wheel e.g.<br>a. Materials to be ground especially its hardness.<br>b. Wet or dry operation.<br>c. Speed of the wheel and the area grinding contact.<br>d. The size of machine (horse power).<br>7. Testing of a wheel before use.<br>8. Selection of appropriate grinding wheel. | Selection and testing of grinding wheel for safety. |
| 24. | **Safety**<br>Explain various safety rules observed when using grinding machine. | 1. Basic safety rules and protection wears e.g.<br>a. Glasses<br>b. A watch should not be worn when operating any machine where a magnetic chuck is used.<br>c. Avoid loose clothing. | Emphasize the observation of safety precautions. |

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| | | d. Always cover the bed weap and the cross slide during grinding.<br>e. Keep away from grinding wheel in motion. The wheel can eat up your skin if it is in contact with it.<br>f. Work should not be forced against a wheel.<br>g. Do not measure work near a revolving wheels.<br>h. Keep your fingers away from turning wheels.<br>i. Hold work piece securely. | |
| 25. | **Surface Grinder**<br>1. Explain use of surface grinder and describe its functions and all the parts.<br>2. Explain the machine feeds and select appropriate work holding device to carry out operation. | 1. Uses of surface grinder in machine shop.<br>2. Selection of work holding devices.<br>3. Surface grinding operations.<br>4. Appropriate devices for surface grinder e.g. electro-magnetic check.<br>5. Explanation of various feeds e.g. table speed, craft feeds, infeeds, coolants, wheel speeds (as abrasive). | Emphasize the observation of safety precautions. |
| 26. | **Cylindrical Grinders**<br>Explain use and select appropriate work holding devices to carry out operation in cylindrical grinding machine. | 1. Uses of cylindrical grinders.<br>2. Selection of work holding devices for cylindrical grinders<br>3. Cylindrical grinding operation | Using centres of chucks when carrying out cylindrical grinding. |
| 27. | **Centreless Grinder**<br>1. Explain the use, advantages and disadvantages of centreless grinder and describe that parts.<br>2. Explain types, the grinding process and carry out centreless operation observing necessary safety precautions. | 1. Features and uses of centreless grinder – advantages and disadvantages of centreless grinder over cylindrical grinder.<br>2. Types of feeds.<br>3. Centreless grinding operations.<br>4. Emphasize safety precautions. | Carry out grinding operations on centreless grinder. |

**TURNING AND MILLING**

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| 28. | **Lathe Work**<br>1. Identify types working principles and describe functions and construction details of lathe machines.<br>2. Set lathe machine for operation, identify tools and machine on a given job.<br>3. State problems associated with machining plastics and perform safely various operation on | 1. Types of lathe e.g. centre lathe, screw lathe etc. Functions and working principles of lathe, parts and accessories – in the operations e.g. drilling reaming, tapping parallel and tape turning etc. Grinding of lathe tools cutters to suit different work materials.<br>2. Machining of plastic materials.<br>3. Maintenance of the lathe machines.<br>4. Emphasize the use of the operation manual.<br>Simple calculations of:<br>a. Cutting speed e.g. $S = \frac{\pi ND}{}$ | Carry out various shaping operations, while observing safety procedures.<br>a. Drilling<br>b. Reaming<br>c. Tapping<br>d. Cutting screw-thread<br>e. Taper turning<br>f. Knurling |

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| | lathe. | 1000<br>where ∏ = 3.142,<br>D = Diameter of work<br>N = Revolution per minute and<br>S = surface speed M/min<br>b. Simple and compound gear trains.<br>Where<br>Driver (Gear) = Pitch of Cut<br>Driver (Gear) Pitch of lead | |
| 29. | **Screw Cutting**<br>Calculate cutting speed of lathe with that of simple and compound gear train screw cutting using appropriate formulae. | Simple calculations of<br>a. Cutting speed e.g.<br>S = ∏ND<br>1000<br>where ∏ = 3.142,<br>D = Diameter of work<br>N = Revolution per minute and<br>S = surface speed M/min<br>b. Simple and compound gear trains.<br>Where:<br>Driver (Gear) = Pitch of Cut<br>Driver (Gear) Pitch of lead | Calculate cutting speeds for given job and gear arrangement. |
| 30. | **Taper Turning**<br>1. Identify methods of taper turning and explain various operation on machine.<br>2. Calculate angle for taper turning and angular error derived from tool setting. | 1. Methods of taper turning e.g. trial stock set over, compound slide etc.<br>2. Simple calculations of:<br>a. angle<br>b. angular error | Carry out various tapper turning |
| 31. | **Automatic and Special Purpose Lathe**<br>1. Explain principles, function and mount jobs using appropriate tools/accessories for lathe operations.<br>2. Grind tools to correct angles observing necessary safety precautions and carry out screw threads and other turning operations on lathe.<br>3. Carry out relative turning and turn taper considering all faults and necessary preventions. | 1. Working principles and main functions of the lathe capstan, turret and automatic.<br>2. Work plan for a turning job e.g. interpret working drawings, select work holding devices etc.<br>3. Use of accessories e.g. angle plates, chukes etc.<br>4. Methods of cutting screw threads e.g. chasers, diehead etc.<br>5. Form turning operation e.g. copying, attachment and form tools.<br>6. Boring and recesses.<br>7. Grinding on the lathe.<br>8. Relieve turning.<br>9. Taper turning.<br>10. Common turning faults.<br>11. Preventive maintenance. | Observe all necessary safety precautions. |
| 32. | **Work Holding Method**<br>Describe the various types of work holding equipment used.<br>a. The centre lathe<br>b. Turret lathe or Automatic | 1. Types and uses of work holding devices e.g. Chuck, collect, three jaw, four jaw and face plate etc. | |

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| | type. | | |
| 33. | **Principles of Milling Machine**<br>1. Identify types, working principles and functions of milling machine with component details.<br>2. Select appropriate cutrter and set machine for various milling operations.<br>3. Sharpen milling cutters and mill different surfaces to the required angles.<br>4. Explain and calculate indexing with selection of indexing plate applied to milling operations.<br>5. Set sector arm and mount/align cutters for various milling operations.<br>6. Mill two surface parallel at one setting to produce multiple surfaces at one passage of cutter and explain working principles of straddle.<br>7. Mount cutters to produce required profile and calculate speed of cutters and maintain milling machine. | 1. Types of milling machine:<br>a. Working principles<br>b. Function and constructional details of each milling machine.<br>c. Mounting and use of milling machine<br>d. Types of milling operations.<br>e. Safety precautions e.g. use of guard, application of cutting fluid etc.<br>2. The use of dividing head – indexing: its calculation, and selection; meaning of indexing.<br>3. Straddle and gang milling processes:<br>a. Indexing plate e.g. hexagonal and pentagonal;<br>b. Sector arm and production;<br>c. Mounting and aligning cutters;]<br>d. Seat for flat surfaces<br>e. Milling two surfaces parallel at one setting;<br>f. Working principles of straddle.<br>4. Calculation of speed, feed and table movement:<br>a. $S = \frac{\prod ND}{1000}$<br>b. $N = \frac{1000S}{\prod D}$<br>5. Maintenance of milling machine. | |
| 34. | **Work Holding Devices**<br>1. Identify, select and use appropriate work hold devices on milling machine.<br>2. Mount and set machine for various operations. | 1. Types and used of work holding devices e.g. Vice, Plain and Universal, Auxiliary Tables, Soft-jaws, Dividing head, Rotary Tables, Clamps, Chuck and collects, Fixtures etc.<br>2. Milling operations using special work, holding devices.<br>3. Production of job using all accessories to specifications e.g. Dog teeth, cerration, spliner, profile milling etc.<br>Dove tail and teestat helical spur gears worm wheel bevel helical milling. Rotary table differential indexing milling cam. | |
| 35. | **Plano milling Machine**<br>1. Identify types, working principles and explain functions of plano milling machine.<br>2. Identify and mount appropriate attachment and tools on machine four | 1. Types of working principles of plano milling machine.<br>2. Functions of parts and accessories.<br>3. Attachment for milling operation, e.g. vertical head, milling cam, slotting attachment.<br>4. Plano milling operations.<br>5. Maintenance of plano milling machine. | |

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| | various operations.<br>3. Perform requirement milling operation and maintain the machine. | 6. Adjusting slide of plano machine. | |

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**SHAPING, PLANNING AND SLOTHING (CME 16)**

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| 36. | **Shaping Machine**<br>1. Identify types with functions of shaping machine and describe its components and accessories.<br>2. Explain shaper principles of operation, set and carry out operation to produce various components.<br>3. Apply necessary safety precautions, maintain machines and adjust slides. | 1. Types of shaping machine:<br>a. uses of components and accessories<br>b. operating principles<br>c. shaping process<br>d. components production<br>2. Maintenance of shaping machine. | Observe safety precautions of a shaper to produce components and maintain the machine. |
| 37. | **Cutting Speed and Feed**<br>Explain geometry of quick return motion and calculate the working speed of a shaper. | 1. Geometry of quick return motion.<br>2. Calculation of cutting speed and double stroke cutting speed = Length of stroke in meter<br>Time in minutes taken by<br>Cutting speed<br>Or<br>stroke cutting speed = $\frac{S}{2 \times \text{length of job}}$.<br>Where S = surface speed<br>Feed = distance table moves after each cutting stroke. | Carry out simple calculations of<br>a. Cutting speed<br>b. Double stroke |
| 38. | **Planing Machine**<br>1. Identify types, functions and explain working principles of a planning machine.<br>2. List tools/accessories and mount work correctly on planning machine. | 1. Types and sizes of planning machines<br>a. working principles<br>b. functions of parts and accessories<br>c. speed and feed selection to suit different machines.<br>2. Maintenance of planning machine. | 1. Carry out proper operation of the planning machine.<br>2. Observe safety precautions. |
| 39. | **Special Feed**<br>1. Calculate working speed of planning machine.<br>2. Identify components functions and explain working principles of slotting machine.<br>3. Prepare machine ready for production<br>4. Explain geometry of quick return motion and calculate speed of slotting machine to determine feed rate. | Calculation of working speed = $\frac{\text{Length of stroke in meters}}{\text{Time in minutes taken by cutting stroke}}$.<br>Or<br>$\frac{S}{LL}$.<br>Where S = surface speed<br>L = Length of stroke in meters | Student are to be taught how to calculate feed rate. |
| 40. | **Slotting Machine**<br>Carry out slotting operations and maintain machines | 1. Types and uses of slotting machine.<br>2. Geometry of quick return motion<br>3. Calculation of cutting speed, double stroke and feed rate. | Emphasize safety precautions |

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| | | Length of stroke in meters .<br>Time in minutes taken by cutting stroke<br>Average cutting speed<br>Or<br>S = Double stroke/mm<br>2 x length of job<br>Determine feed rate<br>F = f x T x N<br>Where F = Feed rate<br>f = Feed per tooth<br>T = Number of teeth and<br>N = rpm of cutter<br>4. Production of engineering components.<br>5. Maintenance of slotting machine | |

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