Kammavari Sangham (R)-1952

# K.S.GROUP OF INSTITUTIONS

# K.S. INSTITUTE OF TECHNOLOGY

(Approved by AICTE & Affiliated to VTU)

KANAKAPURA ROAD, BANGALORE - 560109


"Tell me and I'll forget; Show me and I may remember; Involve me and I'll understand"

## PRACTICAL RECORD

NAME : Sreekara K B

SEM/ BRANCH : 7th Sem Mechanical

SUBJECT & CODE : CIM LAB

USN : 1 K S 1 6 M E 0 8 5

# K.S. INSTITUTE OF TECHNOLOGY

## VISION

"To impart quality technical education with ethical values, employable skills and research to achieve excellence"

## MISSION

* To attract and retain highly qualified, experienced & committed faculty.
* To create relevant infrastructure
* Network with industry & premier institutions to encourage emergence of new ideas by providing research & development facilities to strive for academic excellence
* To inculcate the professional & ethical values among young students with employable skills & knowledge acquired to transform the society

# K.S.INSTITUTE OF TECHNOLOGY, BANGALORE

#14, Raghuvanahalli, Kanakapura Main Road, Bengaluru-560109

## DEPARTMENT OF MECHANICAL ENGINEERING

### Vision of the Department

"To groom incumbents to compete with their professional peers in mechanical engineering that brings recognition"

### Mission of the Department

- To impart sound fundamentals in mechanical engineering
- To expose students to new frontiers
- To achieve engineering excellence through experiential learning and team work.

### PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

- **PEO1:** To produce graduates who would have developed a strong background in basic science and mathematics and ability to use these tools in Mechanical Engineering.
- **PEO2:** To prepare graduates who have the ability to demonstrate technical competence in their fields of Mechanical Engineering and develop solutions to the problems.
- **PEO3:** To equip graduates to function effectively in a multi-disciplinary environment individually, within a global, societal, and environmental context.

### PROGRAM SPECIFIC OUTCOMES (PSO's)

- It is expected that a student in mechanical engineering will possess an:
- **PSO1:** Ability to apply concept of mechanical engineering to design a system, a component or a process/system to address a real world challenges
- **PSO2:** Ability to develop effective communication, team work, entrepreneurial and computational skills

### COURSE LEARNING OUTCOMES:

| After completing the course, students will be able to | | |
|---|---|---|
| **15MEL77.1** | **Explain** the concepts of Computer Integrated manufacturing and Classify NC, CNC and DNC systems. | Understanding (K2) |
| **15MEL77.2** | **Develop** manual part programs to perform milling, drilling and turning operations in design, simulation and manufacturing. | Applying (K3) |
| **15MEL77.3** | **Analyze** the Simulation of Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine. | Analyzing (K4) |
| **15MEL77.4** | **Identify** the concepts of flexible manufacturing systems like Automatic storage and Retrieval system and utilize Robot programming language for simple operations such as pick and place, stacking objects using teach pendent and off line programming. | Applying (K3) |
| **15MEL77.5** | **Apply** the knowledge of pneumatics and hydraulics to demonstrate the related experiments | Applying (K3) |

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K.S.GROUP OF INSTITUTIONS

# K.S. INSTITUTE OF TECHNOLOGY

(Approved by AICTE & Affiliated to VTU)

KANAKAPURA ROAD, BANGALORE - 560 062

## Laboratory Certificate

This is to certify that Mr./Ms. ...SREEKARA. K.B..... has satisfactorily completed the course of experiments in ....CIM.....laboratory, Code.15MEL77 prescribed by Visvesvaraya Technological University, Belgaum for the.....7.....Semester B.E.....MECHANKAL.....Branch in this College during the academic year 20.19... - 20.20..

Name of the Candidate :.....SREEKARA. K.B.....

USN :1KS16ME085....Subject (with code)CIM LAB 15MEL77

Internal assessment marks awarded : $\frac{10}{10} + \frac{10}{10} = \frac{20}{20}$

Signature of Staff Incharge

Date: 26/11/19

Signature of Head of Department

Head of the Department
Dept. of Mechanical Engg.
K.S. Institute of Technology
Bengaluru - 560 109.

# INSTRUCTIONS FOR MAINTAINING THE PRACTICAL RECORD

1. Record should be written neatly in ink on the right side page only, left side pages being reserved for diagrams and graphs in pencil.

2. Record should contain
   - Number and name of the Experiment
   - The date
   - Principle
   - Procedure
   - Observation calculation (to be entered on the left hand side pages in neat tabular forms wherever applicable)
   - Results

# CONTENTS AND EVALUATION

| Sl.No. | Date of Conducting Experiment | Date of Submission | Page No. | Title of the Experiment | Assessment Marks | | | Signature of Staff with Date |
|---|---|---|---|---|---|---|---|---|
| | | | | | Experiment 10 Marks | Record 5 Marks | Total | |
| 1 | 22/08/19 | 29/08/19 | 1-8 | Introduction | 10 | 20 | 30 | |
| 2 | 29/08/19 | 12/09/19 | 9-10 | Simple facing | 10 | 20 | 30 | |
| 3 | 29/08/19 | 12/09/19 | 11-12 | Simple facing cycle | 10 | 19 | 29 | |
| 4 | 29/08/19 | 12/09/19 | 13-14 | Simple turning | 10 | 19 | 29 | |
| 5 | 29/08/19 | 12/09/19 | 15 | Simple turning cycle | 10 | 20 | 30 | |
| 6 | 12/09/19 | 19/09/19 | 16 | Step turning | 10 | 20 | 30 | |
| 7 | 12/09/19 | 19/09/19 | 17-19 | Taper turning | 10 | 20 | 30 | |
| 8 | 19/09/19 | 26/09/19 | 20 | Contouring | 10 | 20 | 30 | |
| 9 | 19/09/19 | 26/09/19 | 21 | Multiple turning | 10 | 20 | 30 | |
| 10 | 26/09/19 | 03/10/19 | 22-23 | External grooving | 10 | 20 | 30 | |
| 11 | ~~03~~/10/19 | 10/10/19 | ~~24~~-25 | Subprogram | 10 | 20 | 30 | |
| 12 | 10/10/19 | 17/10/19 | 26-27 ~~28-29~~ | Multiple threading | 10 | 20 | 30 | |
| | | | | | | | | |

# CONTENTS AND EVALUATION

| Sl.No. | Date of Conducting Experiment | Date of Submission | Page No. | Title of the Experiment | Assessment Marks | | | Signature of Staff with Date |
|---|---|---|---|---|---|---|---|---|
| | | | | | Experiment 10 Marks | Record 5 Marks | Total | |
| 13 | 17/10/19 | 24/10/19 | 28 | Peck Drilling | 10 | 19 | 29 | |
| 14 | 17/10/19 | 24/10/19 | 29-30 ~~28-29~~ | Step Boring | 10 | 20 | 30 | |
| 15 | 17/10/19 | 24/10/19 | 31-32 ~~30-31~~ | Internal Multiple Turning | 10 | 20 | 30 | |
| 16 | 24/10/19 | 31/10/19 | 33-34 | Internal threading | 10 | 20 | 30 | |
| 17 | 31/10/19 | 14/11/19 | 35-37 | Introduction to milling | 10 | 20 | 30 | |
| 18 | 14/11/19 | 27/11/19 | 32-39 | Linear interpolation | 10 | 20 | 30 | |
| 19 | 14/11/19 | 27/11/19 | 40 | Circular interpolation | 10 | 20 | 30 | |
| 20 | 14/11/19 | 27/11/19 | 41-42 | Linear & circular interpolation | 10 | 20 | 30 | |
| 21 | 14/11/19 | 27/11/19 | 43-44 | Mirroring | 10 | 19 | 29 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Rec + obs + viva → Avg → Test

30/30 = 10/10

10/10 =

Total → 29/30

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DATE 22/08/19 | EXPT. TITLE INTRODUCTION | PAGE NO 1

EXP. NO 1

## Numerical control (NC):

It can be defined as form of programmable automation in which the process is controlled by numbers, letters and symbols in NC the numbers forms a program of instructions designed for a particular work part or job.

When the job changes the program of instruction is changed. This capability will change program for each new job is what giver NC flexibility.

Ex: G00 X0 Y0 Z0

## Computer numerical control (CNC):

Numerical control integrated computer control includes one or more microprocessor, minicomputers. The logic function or program the control comprises a program that is stored in the memory.

## Direct Numerical control (DNC):

It can be defined as a manufacturing system in which a number of machines are controlled by a computer through direct connection and in real time.

## NC motion control system:

In NC there are 3 basic types of machine control system

i) Point to point

ii) Straight cut

iii) Contouring.

### i) Point to Point:

It is also sometimes called positioning system. In point to point the objective of the machine tool control system is to the cutting to predefined location once

the tool reaches the defined location the machining operation is performed at that position.
Ex: NC drill presses.

ii) Straight cut NC:
Straight cut control system is capable of moving the cutting tool, parallel to one of the major axes at controlled rate suitable for machining. It is therefore appropriate for performing milling operation to fabricate work piece of rectangular configurations.

Part programming fundamentals:
The following are the basic steps in NC procedure
Process planning
Part programming
Part programming entry
Proving the part
Program production

Process planning:
The part programmer will often carry out the tasks of process planning. Process planning is the procedure of deciding what operations are to be done on the component, in what order, and with what tooling work holding facilities. Both the process planning and part programming aspects of manufacture occur after the detail drawings of a component have been prepared. The following procedure may be used as a guide to assist the programmer, by describing each step required in preparing the method of production.

- Receive the part drawing, from part drawing information, check suitability of the part to be machined against the machine capacity.
- Determine a method of driving the component (chuck type, chuck size, type of jaw) and the method of machining.
- Determine the tooling required to suit the method of machining and utilize as much as possible the tools which are permanently in the turret set upon the machine
- Determine the order of machining and the tooling station.
- Determine the planned stops for checking dimensional sizes required by operator
- Determine cutting speeds based on
- Component material, method of driving, rigidity of component tooling selected for roughing & finishing.
- Determine the depths of cut and feeds for roughing operations.
- Determine surface finish requirements, the cutter nose radius most suited for finishing operations and determine feed rates. Allocates tool offsets as required complete planning sheet.

Part programming:

After completing the planning sheet, draw the component showing the cutter paths (a simple sketch is sufficient for simple components)

- Select a component datum and carryout the necessary calculations of slopes and arcs
- Prepare tooling layout sheet showing tools to be used in the program and indicate the station number for each tool
- Indicate the ordering code for each tool grade and type of inserts to be used.
- Write the part program according to the sequence of operations.

Part program entry or tape preparation:

The part program is prepared / punched on a 25mm wide paper tape with 8 tracks and is fed to MCU in order to produce a component of interest on machine tool. Other forms of input media include punched cards, magnetic tape, 35mm motion picture film. The input to the NC system can be in two ways

1) Manual data input (MDI): Complete part programs are entered into CNC control unit via the console keyboard. It is suited only for relatively simple jobs. The most common application for MDI is the editing of part programs already resident in controllers memory.

One variation of MDI is a concept called Conversational Programming. CNC machines are programmed via a question and answer technique whereby a resident software program asks the operator a series of questions. In response to the operators input, and accessing a pre-programmed data file, the computer control can

- Select numerical values for use within machining calculations
- Perform calculations to optimize machining conditions
- Identify standard tools and co-ordinates
- Calculate cutter paths and co-ordinates
- Generate the part program to machine the component.

A typical dialogue from the machine would be as follows for the operator to indentify such things as

- Material to be cut
- Surface roughness tolerances
- Machined shape required
- Size of the raw material blank

Machining allowances, cut directions, tools & tool detail etc.

The operator may then examine and prove the program via computer graphics simulation on the console VDU. After this, the program is stored or punched on tape. Although there is some sacrifice in machine utilization, actual programming time is minimal and much tedious production engineering work is eliminated.

2) Direct Numerical control: The process of transferring part programs into memory of a CNC machine tool from a host computer is called Direct numerical control or DNC

Providing part programs:

It is safe practice to check the programmed path for any interference betwe the tool and the work before using the part program for production. The proving part program is done by

- Visual inspection
- Single step execution dry run

Visual inspection: It represents the method of checking visually the program present in the memory of the CNC machine. In this, actual program is run a the programmed movements in all axes are to be checked along with ensuring the tool offset and cutter compensation feature. this method represents the least form of verification and should not be relied upon entirely.

Single step execution: Before auto running the part program it shou be executing in a step module i.e. block by block. During this execution, s speed and feed rate override facilities are to be used so that axes moveme

# M Codes

| | |
|---|---|
| M00 | Program stop |
| M02 | Optional stop |
| M03 | Spindle forward |
| M04 | Spindle reverse |
| M05 | Spindle stop |
| M06 | Tool change |
| M08 | Coolant on |
| M09 | Coolant off |
| M10 | Vice open |
| M11 | Vice close |
| M13 | Spindle forward, coolant on |
| M14 | Spindle reverse, coolant on |
| M30 | Program end |
| M38 | Door open |
| M39 | Door close |
| M98 | Subprogram call |
| M99 | Subprogram exit |

can be exactly monitored. This operation may be carried out with or without mounting the component on the machine.

## Part Programming Geometry :

### 1) Coordinate system for a CNC lathe :

Machining of a workpiece by an NC program requires a coordinate system to be applied to the machine tool. As all machine tools have more than one slide, it is important that each slide is identified individually. There are two planes in which movements can take place.

Longitudinal

Transverse

Each plane is assigned a letter and is referred to as an axis

Axis X

Axis Z

The two axis are identified by upper case X, Z and the direction of movement along each axis + or - The Z axis is always parallel to the main spindle of the machine. The X axis is always parallel to the work holding surface, and always at right angles to the Z axis. The coordinate system for turning operation is shown in fig. below.

### 2) Zero points and Reference points

All CNC machine tool traverses are controlled by coordinating systems. Their accurate position within the machine tool is established by zero points.

Machine zero point (M) : is specified by the manufacturer of the machine. This is the zero point for the coordinate systems and reference points

## G codes

| | |
|---|---|
| G00 | Positioning |
| G01 | Linear interpolation |
| G02 | Circular interpolation (CW) |
| G03 | Circular interpolation (CCW) |
| G04 | Dwell |
| G20 | Inch data input |
| G21 | Metric data input |
| G28 | Reference point return |
| G40 | Tool nose radius compensation cancel |
| G41 | Tool nose radius compensation left |
| G42 | Tool nose radius compensation right |
| G50 | Works coordinate change |
| G70 | Finishing cycle |
| G71 | Multiple turning cycle |
| G72 | Stock removal in facing |
| G73 | Pattern repeating |
| G74 | Peck drilling in Z axis |
| G75 | Grooving in X axis |
| G76 | Thread cutting cycle |
| G90 | Cutting cycle A (Turning) |
| G94 | Cutting cycle B (Facing) |
| G96 | Constant surface speed control |
| G97 | Constant surface speed control cancel |
| G98 | Feed per revolution |
| G99 | Feed per minute. |

in the machine. On turning lathes, the machine zero point is generally at the center of the spindle nose face. The main spindle axis (centre line) represents the Z-axis, the face determines the X axis. The directions of the positive X and Z axes point toward the working area as shown in figure below.

Workpiece zero point (W): This point determines the workpiece coordinate system in relation to the machine zero point. The workpiece zero point is chosen by the programmer and input into the CNC system when setting up the machine. The position of the workpiece zero point can be freely chosen by the programmer within the work piece envelope of the machine. It is however advisable to place the workpiece zero point in such a manner that the dimensions in the workpiece drawing can be conviniently converted into coordinate values and orientation when damping / chucking, setting up and checking, the traverse measuring system can be effected easily.

For turned parts, the workpiece zero point should be placed along the spindle axis (center line), in line with the right hand or left hand end face of the finished contour as shown in fig.

Occasionally the workpiece zero point is also called the program zero point

Reference point (R): This point serves for the calibrating and for controlling the measuring system of the slides and tool traverses. The position of the reference point as shown in fig. below is accurately predetermined in every traverse axis by the trip dogs and limit switches. Therefore, the reference point coordinates always have the same, precisely known numerical value in relation to the machine zero point. After

| | Marks obtained |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |

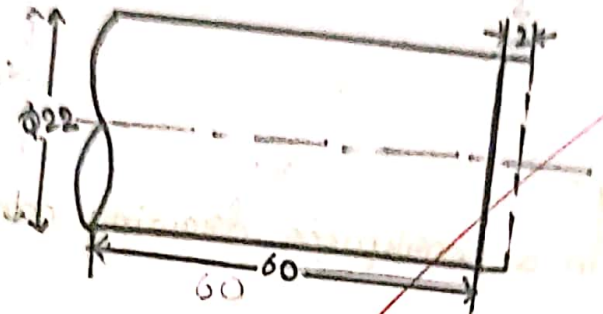
initiating the control system, the reference point must always be approached from all axes to calibrate the traverse measuring system. If current slide and tool position data should be lost in the control system as for example, through an electrical failure, the machine must again be positioned to the reference point to re-establish the proper positioning values.

CNC-related dimensioning :

Dimensional information in a workpiece drawing can be stated in two ways:

1) Absolute Dimension system : Data in absolute dimension system always refer to a fixed reference point in the drawing as shown in figure. A above. This point has the function of a coordinate zero point as in figure B. The dimension lines run parallel to the coordinate axes and always start at the reference point. Absolute dimensions are also called as 'Reference dimensions'.

2) Incremental Dimension system : When using incremental dimension system, every measurement refers to a previously dimensioned position as shown in figure A below. Incremental dimensions are distance between adjacent points. These distances are converted into incremental coordinates by accepting the last dimension point as the coordinate origin for the new point. This may be compared to a small coordinate system i.e shifted consequently from point to point as shown in figure B. Incremental dimensions are also frequently called 'Relative dimensions or Chain dimensions.




Planning and operations sheet

| Billet size : 22X60 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No : 1001 | | | | DWG No : 1 | | | |
| Sl. no. | Operation | Tool Holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| | Simple facing | SDJCR1212H11 | DCMT11T304 | 1 | 1 | 1200 | 45 |

DATE 29/08/19 EXPT. TITLE : SIMPLE FACING PAGE NO. 9

EXP. NO. 2

Write a manual part program for simple facing operation for the component shown in figure below.

~~O1001~~

G21 G98

G28 U0 W0

M06 T0101

M03 S1200

G00 X22 Z1

F0.5

G01 X0

G01 Z0

G01 Z1

G00 X22

G01 Z-0.5

G01 X0

G01 Z1

G00 X22

G01 Z-1

G01 X0

G01 Z1

G00 X22

G01 Z-1.5

G01 X0

G01 Z1

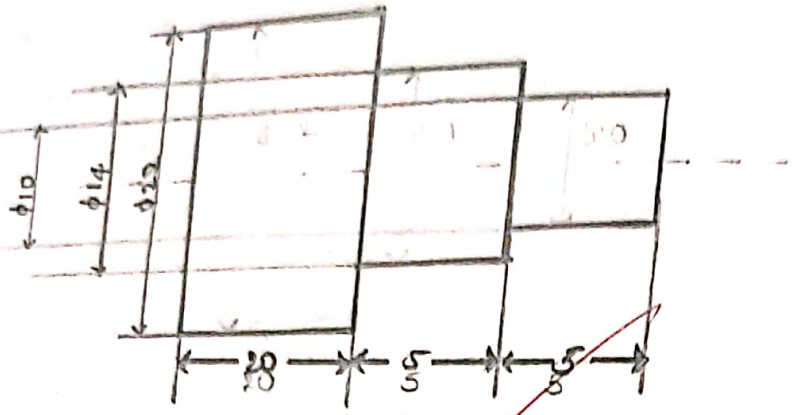
G00 X22

G01 Z-2

G01 X0
G01 Z1
G00 X22
G28 U0 W0
M05
M30

19/20

| | Marks Allotted |
|---|---|
| Record | 19 |
| Observation | 5 |
| Viva | 5 |
| Total | 29 |
| Signature of Faculty with date | |




Planning and operations sheet:

| Billet size: 22×30 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No: 1004 | | | | DWG No: 2 | | | |
| Sl. no. | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| 1 | Facing | SDJCR1212H11 | DCMT11T304 | 1 | 1 | 1200 | 45 |

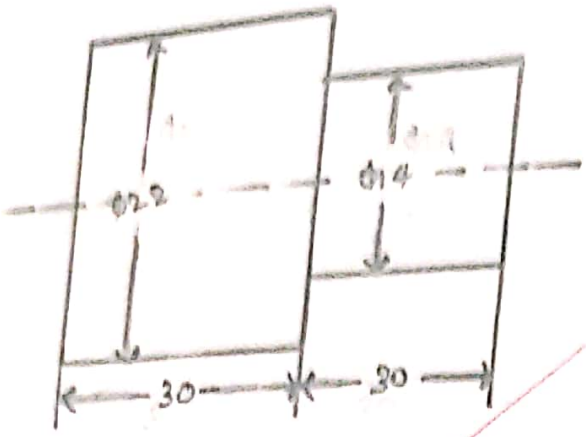
DATE 29/08/19 | EXPT. TITLE : SIMPLE FACING CYCLE | PAGE NO. 11

EXP. NO. 3

Write a manual part program for facing operation for the component shown in figure below

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X22 Z1
F35
G01 Z0
G94 X10 Z-0.5
 Z-1
Z-1.5
Z-2
Z-2.5
Z-3
Z-3.5
Z-4
Z-5
G00 X22 Z-5
G94 X14 Z-5.5
Z-6
Z-6.5
Z-7
Z-7.5
Z-8
Z-8.5
```

| | Marks Allotted |
|---|---|
| Record | 19 |
| Observation | 5 |
| Viva | 5 |
| Total | 29 |
| Signature of Faculty with date | |




Planning & operation sheet

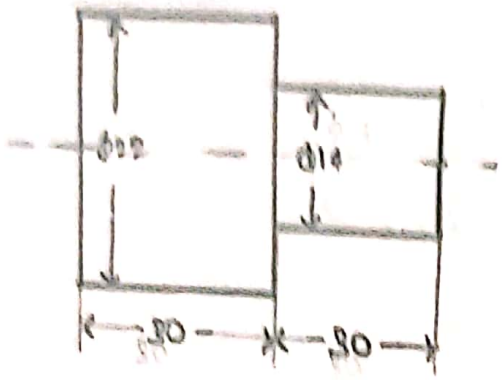
| Billet size: 22X60 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No: 1002 | | | | DWG No: 3 | | | |
| Sl. no. | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/rev |
| 1 | Simple turning | SDJCR1212H11 | DCMT11T304 | 1 | 1 | 1200 | 45 |

DATE 29/08/2019 EXPT. NO. 4 EXPT. TITLE: SIMPLE TURNING PAGE NO. 13

Write a manual part program for simple turning operation for the component shown in the figure below.

G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X22 Z1
F45
G01 X21
G01 Z-30
G00 X22
G00 Z1
G01 X20
G01 Z-30
G00 X22
G00 Z1
G01 X19
G01 Z-30
G00 X22
G00 Z1
G01 X18
G01 Z-30
G00 X22
G00 Z1
G01 X107
G01 Z-30

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | Nd |




Planning and operation sheet

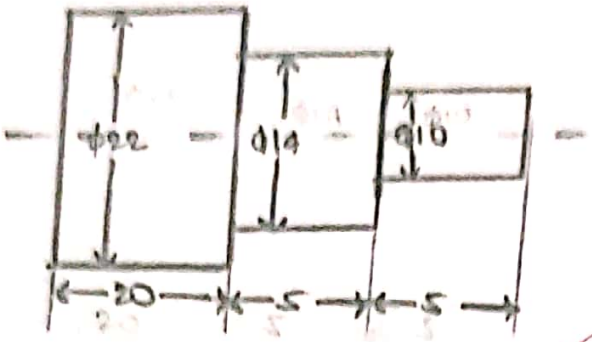
| Billet size: 22 x 60 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No.: 1002 | | | | DWG No.: 4 | | | |
| Sl. no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| 1 | Simple turning | SDSCR 1212H11 | DCMT11T304 | 1 | 1 | 1200 | 45 |

Write a manual part program for simple turning operation for the component shown in figure below.

G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X22 Z1
F45
G01 Z0
G90 X21 Z-30
X20
X19
X18
X17
X16
X15
X14
G28 U0 W0
M05
M30

19/20

| | Marks Allotted |
|---|---|
| Record | 19 |
| Observation | 5 |
| Viva | 5 |
| Total | 29 |
| Signature of Faculty with date | |




Planning & operation sheet

| Billet size : ϕ22×30 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No. : 1007 | | | | DWG No : 5 | | | |
| Sl. no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed rate |
| 1 | step turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 30 |

DATE 12/09/19 EXPT. NO. 6 EXPT. TITLE : STEP TURNING PAGE NO. 16

Write a manual part program for step turning operation with G90 cycle for the component shown in figure below.

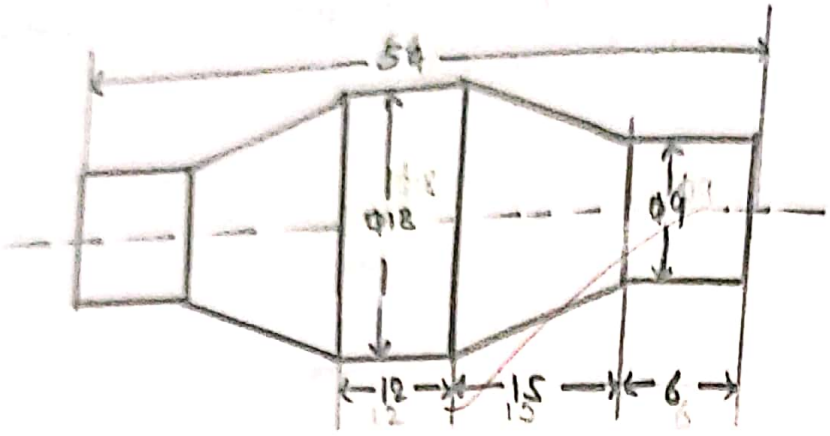


```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X22 Z1
G01F30
G01 Z0
G90 X21 Z-10
X20
X19
X18
X17
X16
X15
X14
G00 X14 Z1
G90 X13 Z-5
X12
X11
X10
G28 U0 W0
M05
M30
```

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |

20/20

KSIT




Planning & operations sheet

| Billet size : 22 x 54 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No : 1008 | | | | DWG No : 9 | | | |
| Sl. no. | Operations | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed |
| 1 | Taper turning | SDJCR 1212H11 | DCMT11T304 | 1 | 1 | 1200 | 35 |

DATE 12/09/19 | EXPT. TITLE TAPER TURNING CYCLE | PAGE NO. 17

EXP NO 7

Write a manual part program for taper turning operation for the component shown in figure below.

G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X22 Z1
G01 Z0 F35
G90 X21 Z-54
X20
X19
X18
X17 Z-6
X16
X15
X14
X13
X12
X11
X10
X9
G00 X18 Z-6
G90 X18 Z-21 R0
X18 R-0.5
X18 R-1
X18 R-1.5

X18 R-2
X18 R-2.5
X18 R-3
X18 R-3.5
X18 R-4
X18 R-4.5
G01 X18 Z-33
G90 X18 Z-48 R0
X17 R0.5
X16 R1
X15 R1.5
X14 R2
X13 R2.5
X12 R3
X11 R3.5
X10 R4
X9 R4.5
G00 X18 Z-48
G90 X18 Z-54
X17
X16
X15
X14
X13
X12
X11
X10

DATE .....
EXP. NO. .....

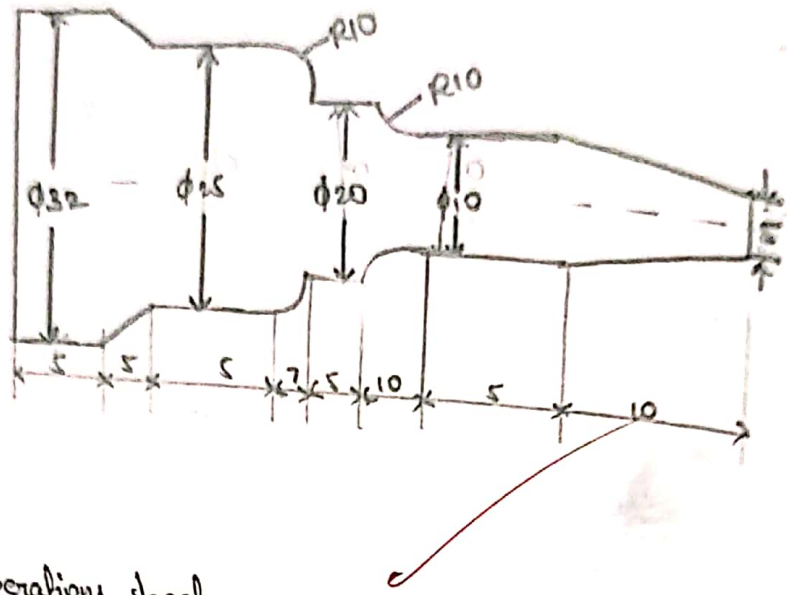
EXPT. TITLE :

PAGE NO. 19

x9
G28 U0 W0 -
M05
M30

20/20

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet

| Billet size: 32×52 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no.: 1003 | | | | DWG No: 8 | | | |
| Sl. no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Fe... |
| 1 | Turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 15 |

DATE 19/09/19 | EXPT. TITLE : CONTOURING | PAGE NO. 10

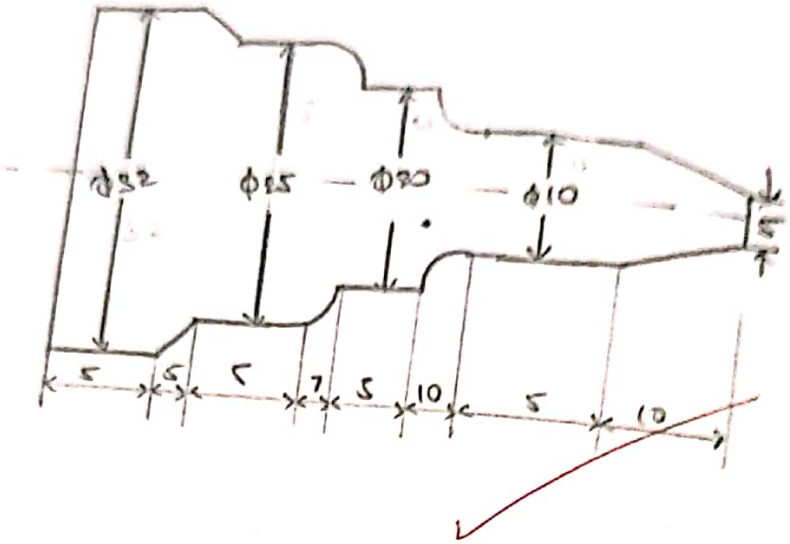
EXP. NO. 3

Write a manual part program for Linear and circular contour operation for the component shown in fig. below

O1003
BILLET X32 Z52
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X32 Z1
G01 Z0 F30
G00 X5
G01 X10 Z-10 F45
G01 X10 Z-15
G02 X20 Z-25 R10 F25
G01 Z-30 F45
G03 X25 Z-37 R10 F25
G01 Z-42 F45
G01 X32 Z-47
G01 Z-52
G28 U0 W0
M05
M30

20/20

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet

| Billet size: 32x52 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no. 1009 | | | | DWG NO. 09 | | | |
| Sl no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | |
| 1 | Rough turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 35 |
| 2 | Finishing | SDJCR 1212H11 | DCMT 11T302 | 2 | 2 | 1200 | 25 |

DATE 11/9/19 | PART NAME: Multiple Turning Cycle | PAGE NO. 01

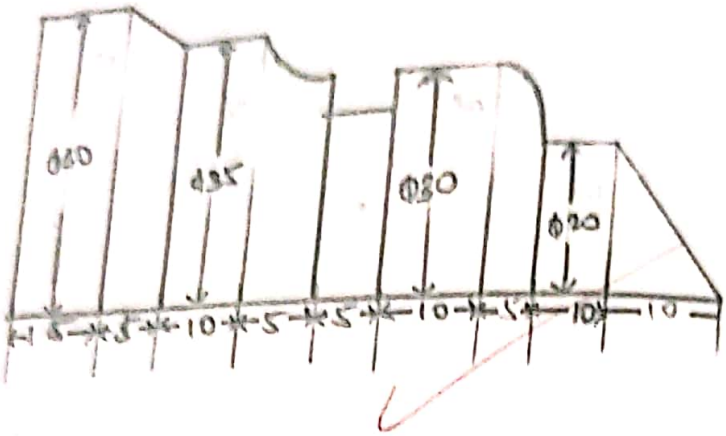
Write a manual part program for multiple turning operation for the component shown in figure below

G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X32 Z1
G71 U0.5 R1
G71 P10 Q20 U0.1 W0.1 F85
N10 G01 X5
G01 Z0
G01 X10 Z-10
G01 Z-15
G02 X20 Z-25 R10
G01 Z-30
G03 X25 Z-37 R10
G01 Z-42
G01 X30 Z-47
N20 G01 Z-52
G28 U0 W0
M06 T0202
M03 S1450
G00 X32 Z1
G70 P10 Q20 U0 W0 S2500 F30
G28 U0 W0
M05 M30

20/20 md

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | md |

KSIT




Planning & operation sheet

| Billet size: 40×75 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no 1012 | | | | DWG no: 12 | | | |
| Sl no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed |
| 1 | Rough turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 45 |
| 2 | Finishing | SDJCR 1212H11 | DCMT 11T302 | 2 | 2 | 1450 | 25 |
| 3 | Grooving | HSS | 3mm width | 5 | 5 | 750 | 15 |

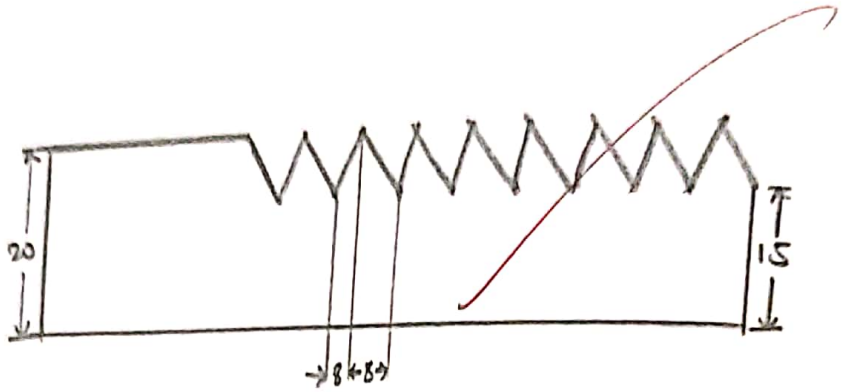
Write a manual part program for external grooving operation for the component shown in figure below.

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X40 Z1
G01 Z0 F35
G71 U0.5 R1
G71 P20 Q40 U0.1 W0.1 F30
N20 G01 X0
G01 X20 Z-10
G01 X20 Z-20
G03 X30 Z-25 R5
G01 Z-40
G02 X35 Z-45 R5
G01 X35 Z-55
G01 X40 Z-60
N40 G00 X40 Z1
G28 U0 W0
G70 P20 Q40 U0 W0 S2500 F30
G28 U0 W0
M06 T0202
M03 S2000
G00 X32 Z-37
G01 X30
G
```

```
G75 R1
G75 X20 Z-40 P500 Q1000 F20
G28 U0 W0
M05
M30
```

20
30

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet:

| Billet size: 20×60 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no.: 1009 | | | | DWG No: 7 | | | |
| Sl no. | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| 1 | Taper turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 35 |

DATE 23/10/19

EXP. NO 11

EXPT. TITLE : Subprogram 1

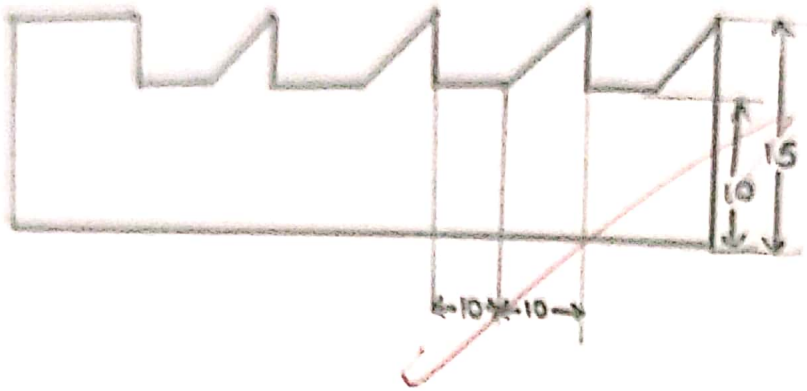
PAGE NO 64

Write a manual part program by using subprograms for the workpiece shown in figure below

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X20 Z1
G01 Z0 F35
M98 P0037777
G28U0 W0
M05
M30

O7777
G90 X20 W-8 R-0.5 F50
X20 R-1
X20 R-1.5
X20 R-2
X20 R-2.5
G00 X20 W-8
G90 X19 W-8 R0.5
X18 R1
X17 R1.5
X16 R2
X15 R2.5
G00 X20 W-8
M99
```

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |



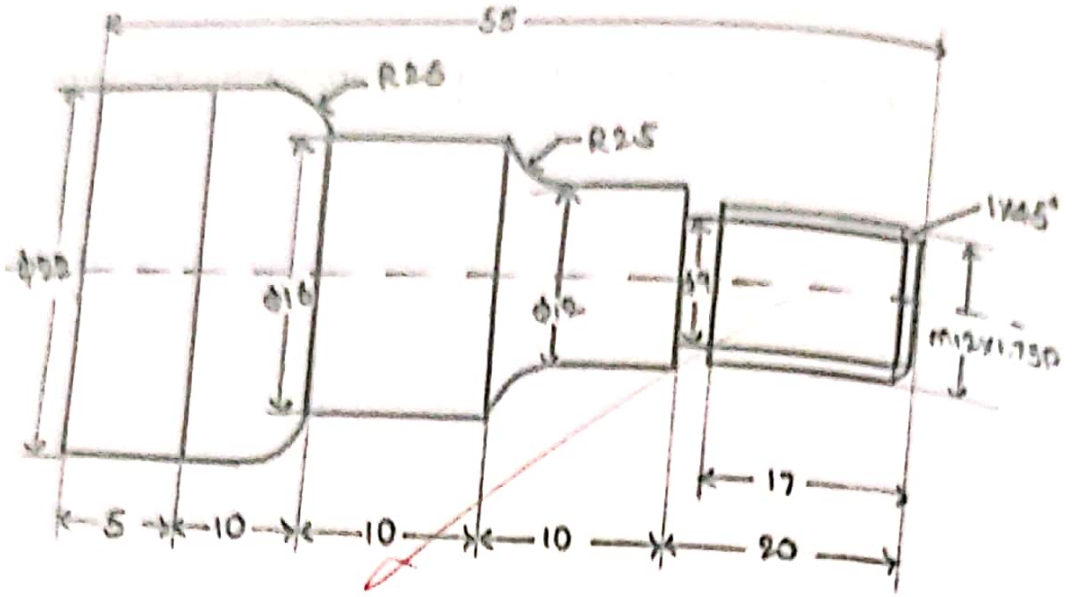

| Billet size: 15 x 70 | | | | Material: Aluminum | | | |
|---|---|---|---|---|---|---|---|
| Program no.: 1009 | | | | DWG No. 8 | | | |
| Sl no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| 1 | Taper turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 35 |

Write a manual part program by using subprograms for the component shown in figure below

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X15 Z1
G01 Z0
M98 P0038888
G28 U0 W0
M05
M30

O8888
G90 X14 W-10 R0.5 F50
X13 R1
X12 R1.5
X11 R2
X10 R2.5
G00 X15 W-10
G90 X14 W-10
X13
X12
X11
X10
G00 X15 W-10
M99
```

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




| Billet size: Φ22X55 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no.: 1011 | | | | DWG No. 11 | | | |
| Sl. no. | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| 1 | Multiple rough turning | SDJCR 1212H11 | DCMT 11T304 | 1 | 1 | 1200 | 35 |
| 2 | Finishing | SDJCR 1212H11 | DCMT 11T302 | 2 | 2 | 1050 | 25 |
| 3 | Grooving | HSS | 3 mm width | 5 | 5 | 750 | 25 |
| 4 | Threading | HSS | | 7 | 7 | 500 | 25 |

DATE 19/10/19

EXP. NO. 13

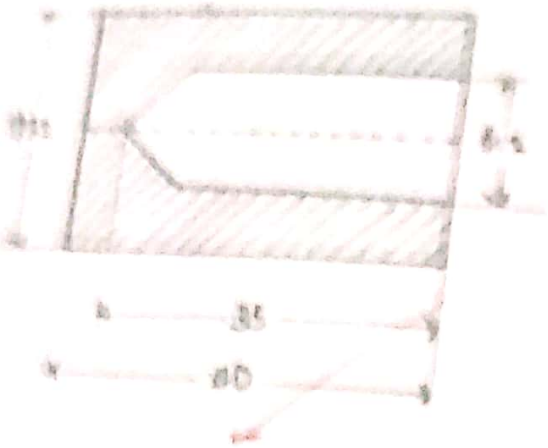
EXPT. TITLE : EXTERNAL MULTIPLE THREADING



Write a manual part program for external threading operation for the component

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X22 Z1
G01 Z0
G71 U0.5 R1
G71 P10 Q20 U0.1 W0.1 F35
N10 G01 X10
G01 Z0
X12 Z-1
Z-20
G02 X16 Z-30 R25
G01 Z-40
G03 X22 Z-50 R25
N20 G01 Z-55
G28 U0 W0
M06 T0202
M03 S1450
G00 X22 Z1
G70 P10 Q20 F25
G28 U0 W0
M06 T0505
M03 S650
```

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet

| Billet size 32×30 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Program No : 1015 | | | | Material : Aluminium | | | |
| | | | | DWG No 15 | | | |
| Sl no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed |
| 1 | Center drill | 6mm | - | 6 | 6 | 1800 | 40 |
| 2 | Drilling | 12mm | - | 8 | 8 | 800 | 40 |

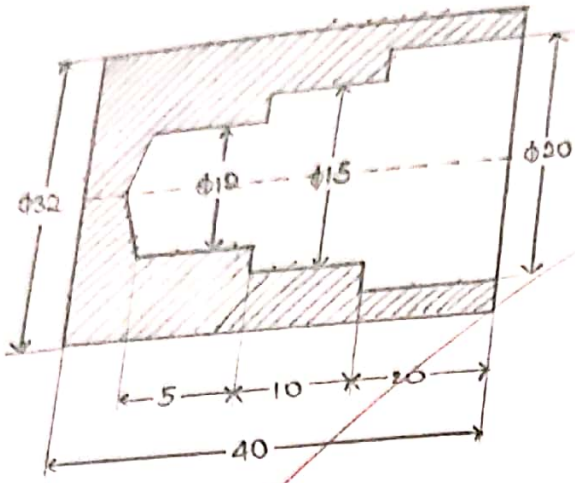
DATE 17/10/19 EXPT. NO. 14 EXPT. TITLE: PECK DRILLING PAGE NO. 32

Write a manual part program for peck drilling operation for the component shown in figure below.

```
G21 G98
G28 U0 W0
M06 T0606
M03 S1200
G00 X0 Z2
G01 Z0 F20
G74 R1
G74 X0 Z-5 Q500 F20
G28 U0 W0
M06 T0808
M03 S800
G00 X0 Z2
G74 R1
G74 X0 Z-35 Q500 F20
G28 U0 W0
M05
M30
```

19/20

| | Marks Allotted |
|---|---|
| Record | 19 |
| Observation | 5 |
| Viva | 5 |
| Total | 29 |
| Signature of Faculty with date | |




Planning & operations sheet

| Billet size: 32×40 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No: 1016 | | | | DWG No: 16 | | | |
| Sl. no. | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/min |
| 1 | Center drill | 6mm | - | 1 | 1 | 1200 | 20 |
| 2 | Drilling | 12 mm drill | - | 8 | 8 | 800 | 15 |
| 3 | Boring | 100mm boring | - | 2 | 2 | 1200 | 20 |

DATE 17/10/19 | EXPT. TITLE : STEP BORING | PAGE NO. 21

EXP. NO 15

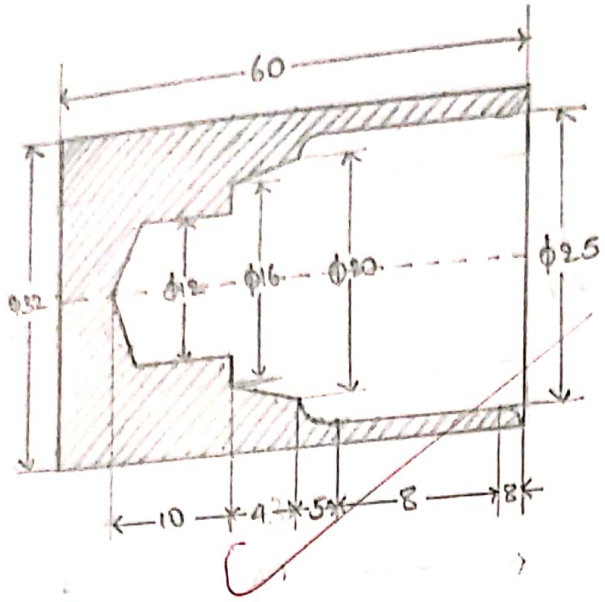
Write a manual part program for step boring operation for the component shown in figure below

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X0 Z2
G01 Z0 F20
G71 R1
G71 X0 Z-5 Q500 F20
G28 U0 W0
M06 T0808
M03 S800
G00 X0 Z0
G71 R1
G71 X0 Z-35 Q500 F15
G28 U0 W0
M06 T0202
M03 S1200
G00 X12 Z1
G01 Z0
G90 X13 Z-30 F20
X14
X15
X16 Z-20
X17
```

X18
X19
X20
G28 U0 W0
M05
M30

90
30

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet

| Billet size : 32 x 40 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program No. : 1017 | | | | DWG No. : 17 | | | |
| Sl. no. | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed mm/r |
| 1 | Center drill | 6mm | - | 1 | 1 | 1200 | 15 |
| 2 | Drilling | 12mm drill | - | 2 | 2 | 700 | 15 |
| 3 | Boring | 10mm | - | 3 | 3 | 800 | 20 |

DATE 17/10/19

EXP. NO. 16

EXPT. TITLE: INTERNAL MULTIPLE TURNING

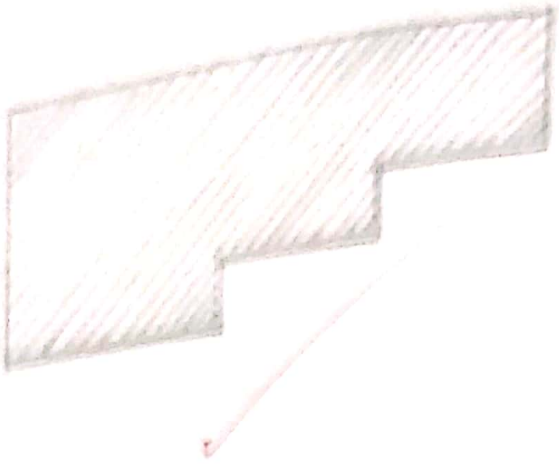


write a manual part program for internal multiple turning operation for the component shown in figure below

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X0 Z2
G01 Z0
G74 R1
G74 X0 Z-5 Q500 F15
G28 U0 W0
M06 T0202
M03 S1000
G00 X0 Z1
G01 Z0
G74 R1
G74 X0 Z-35 Q500 F15
G28 U0 W0
M06 T0303
M03 S800
G00 X12 Z1
G01 Z0
G71 U0.2 R1
G71 P10 Q20 U0.1 W0.1 F20
N10 G01 X30
G02 X25 Z-8 R8 F15
```

G01 Z-16 F20
G03 X20 Z-21 R5 F15
G01 X16 Z-31 F20
N20 G01 X12
G70 P10 Q20 U0 W0 S1000 F20
G28 U0 W0
M05
M30

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |



Planning & operations sheet

Billet size : 25 x 70

Material: Aluminium

Program no : 1011

DWG No : 11

| Sl no | Operation | Tool holder | Tool tip | Tool station | Tool offset | Spindle speed | Feed rate |
|---|---|---|---|---|---|---|---|
| 1 | Center drill | 6mm | - | 1 | 1 | 800 | 10 |
| 2 | Drilling | 12 mm drill | - | 2 | 2 | 1200 | 15 |
| 3 | Boring | 10 mm boring bar | - | 3 | 3 | 900 | 20 |
| 4 | Threading | HSS | - | 4 | 4 | 1000 | 25 |

EXPT. TITLE : INTERNAL THREADING

PAGE NO. 33

Write a manual part program for internal threading operation for the component shown in figure below.

```
G21 G98
G28 U0 W0
M06 T0101
M03 S800
G00 X0 Z1
G01 Z0
G74 R1
G74 X0 Z-5 Q500 F50
M06 T0202
M03 S1200
G00 X0 Z1
G01 Z0
G74 R1
G74 X0 Z-30 Q500 F50
G00 X0 Z1
G28 U0 W0
M06 T0303
M03 S800
G00 X12 Z1
G01 Z0
G90 X13 Z-20
X14
X15
X16
```

```
X17
X18
X18.774
G28 U0 W0
M06 T0404
M03 S1000
G00 X16 Z1
G01 Z0
G76 P031560 Q50 R0.1
G76 X10 Z-20 P0613 Q100 F1
G28 U0 W0
M05
M30
```

20/20

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |

M CODES:

| | |
|---|---|
| M00 | Program stop |
| M01 | Optional stop |
| M02 | Program end |
| M03 | Spindle forward |
| M04 | Spindle reverse |
| M05 | Spindle stop |
| M06 | Tool change |
| M08 | Coolant on |
| M09 | Coolant off |
| M10 | Vice open |
| M11 | Vice close |
| M13 | Coolant, spindle forward |
| M14 | Coolant, spindle reverse |
| M30 | Program stop and rewind |
| M70 | X mirror on |
| M71 | Y mirror on |
| M80 | X mirror off |
| M81 | Y mirror off |
| M98 | Subprogram call |
| M99 | Subprogram exit |

G CODES :

| | |
|---|---|
| G00 | Positioning (Rapid transverse) |
| G01 | Linear interpolation (Feed) |
| G02 | Circular interpolation (cw) |
| G03 | Circular interpolation (ccw) |
| G04 | Dwell |
| G20 | Inch data input |
| G21 | Metric data input |
| G28 | Reference point return |
| G40 | Tool nose radius compensation cancel |
| G41 | Tool nose radius compensation left |
| G42 | Tool nose radius compensation right |
| G43 | Tool length compensation + direction |
| G44 | Tool length compensation - direction |
| G73 | Peck drilling cycle |
| G74 | Counter tapping cycle |
| G76 | Fine boring |
| G80 | Canned cycle cancel |
| G81 | Drilling cycle, spot boring |
| G82 | Drilling cycle, counter boring |
| G83 | Peck drilling cycle |
| G84 | Tapping cycle |
| G85 | Boring cycle |
| G86 | Boring cycle |
| G87 | Back boring cycle |
| G88 | Boring cycle |
| G89 | Boring cycle |

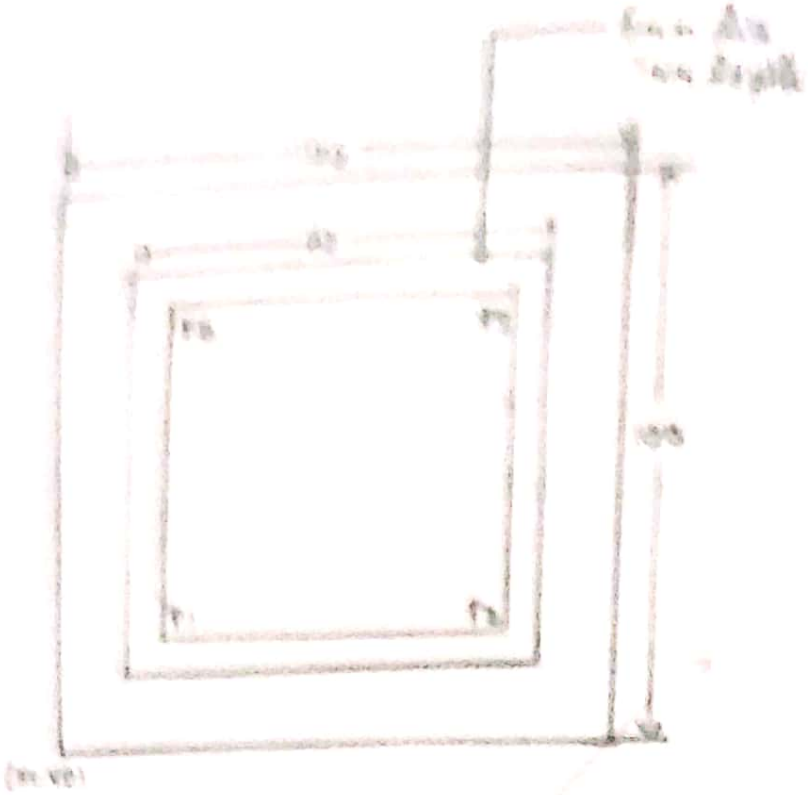
DATE .....
EXP. NO. .....

EXPT. TITLE :



| | |
|---|---|
| G90 | Absolute command |
| G91 | Incremental command |
| G92 | Programming of absolute zero point |
| G94 | Feed per minute |
| G95 | Feed per revolution |
| G98 | Return to initial point in canned cycle |
| G99 | Return to R point in canned cycle |

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |



Planning & operations sheet

| Billet size : 100 x 100 x 10 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no. : 1080 | | | | DWG No : 20 | | | |
| Sl no | Operation | Tool type | Tool dia | Tool station | Tool length offset | Spindle speed | Feed |
| 1 | Linear | slot cutter | 6 mm | 1 | 1 | 2000 | 30-50 |

DATE ..... EXPT NO. 19

EXPT. TITLE : LINEAR INTERPOLATION

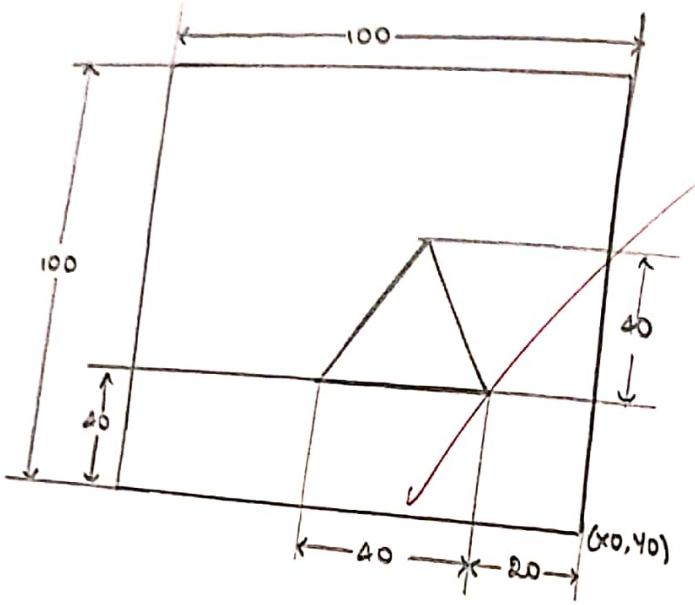
PAGE NO. 38

Write a manual part program for linear interpolation for the component shown in figure below.

```
G21 G94
G91 G28 Z0
G28 X0 Y0
M06 T0101
M03 S1500
G90 G00 X30 Y30 Z5
G01 Z-1 F30
G01 X70 Y30 F60
G01 X70 Y70
G01 X30 Y70
G01 X30 Y30
G00 Z5
G91 G28 Z0
G28 X0 Y0
M05
M30
```

20/20

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operation sheet:

| Billet size : 100×100×10 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no. : 10201 | | | | DWG No. : 21 | | | |
| Sl. no. | Operation | Tool type | Tool dia | Tool station | Tool length offset | Spindle speed | Feed mm/min |
| 1 | Linear | Slot cutter | 6mm | 1 | 1 | 2000 | 30-50 |

EXPT. TITLE : LINEAR INTERPOLATION

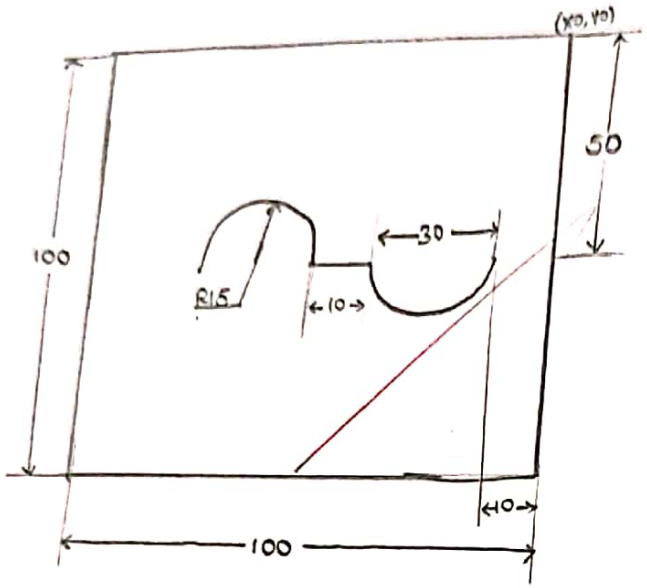
PAGE NO. 39

Write a manual part program for linear interpolation for the component shown in figure below

G21 G94
G91 G28 Z0
G28 X0 Y0
M06 T0101
M03 S1500
G90 G00 X-20 Y40 Z5
G01 Z-1 F30
G01 X-60 Y40 F30
G01 X-40 Y80
G01 X-20 Y40
G00 Z5
G91 G28 Z0
G28 X0 Y0
M05
M30

20/20

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operation sheet

| Billet size : 100x100x10 | | | | Material : Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no. : 1022 | | | | DWG No : 22 | | | |
| Sl no. | Operation | Tool type | Tool dia | Tool station | Tool length offset | Spindle speed | Feed mm/min |
| 1 | Linear | slot cutter | 6 mm | 1 | 1 | 2000 | 30-50 |

DATE .....
EXP. NO. 21

EXPT. TITLE : CIRCULAR INTERPOLATION

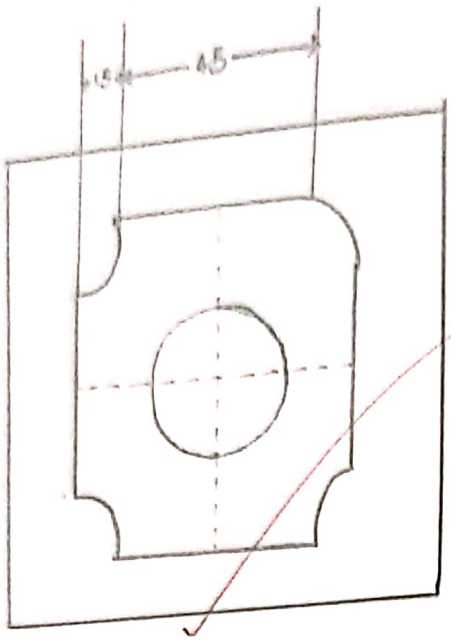
PAGE NO. 40

Write a manual part program for circular interpolation for the component shown in figure below.

```
G21 G94
G91 G28 Z0
G28 X0 Y0
M06 T0101
M03 S1500
G90 G00 X-10 Y-50 Z5
G01 Z-1 F30
G02 X-40 Y-50 R15
G01 X-50 Y-50
G03 X-80 Y-50 R15
G00 Z5
G91 G28 Z0
G28 X0 Y0
M05
M30
```

20/20

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet

| Billet size : 100x100x10 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no. : 1023 | | | | DWG No: 23 | | | |
| Sl. no. | Operation | Tool type | Tool dia | Tool station | Tool length offset | Spindle speed | Feed mm/min |
| 1 | Contouring | Slot cutter | 6mm | 1 | 1 | 2000 | 30-50 |

Write a manual part program for contouring operation for the component shown in figure below

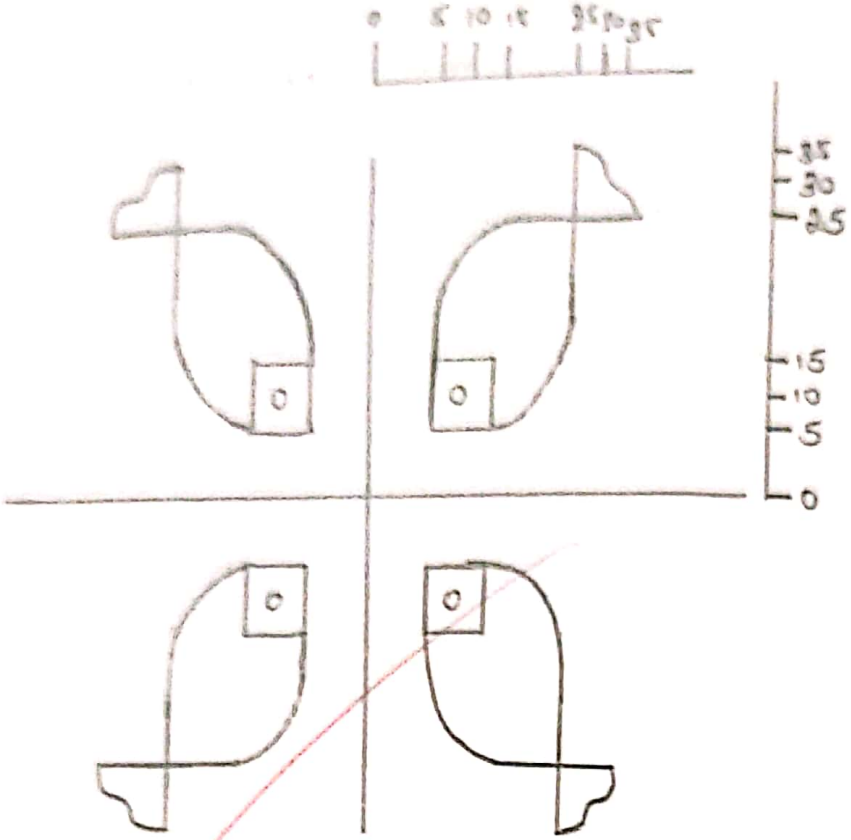
G21 G94
G91 G28 Z0
G28 X0 Y0
M06 T1
M03 S2000
G90 G00 X0 Y-37.5 Z5
G01 Z-1 F50
G01 X-22.5 Y-37.5
G03 X-37.5 Y-22.5 R15
G01 X-37.5 Y22.5
G01 X-37.5 Y22.5
G03 X-22.5 Y37.5 R15
G01 X22.5 Y37.5
G02 X37.5 Y22.5 R15
G01 X37.5 Y-22.5
G03 X22.5 Y-37.5 R15
G01 X0 Y-37.5
G00 Z5
G00 X-15 Y0
G01 Z-1 F50
G02 X15 Y0 R15
G02 X-15 Y0 R15
G91 G28 Z0
G28 X0 Y0

EXPT. TITLE :

PAGE NO. 44

m0.5
m30

| | Marks Allotted |
|---|---|
| Record | 20 |
| Observation | 5 |
| Viva | 5 |
| Total | 30 |
| Signature of Faculty with date | |




Planning & operations sheet:

| Billet size: 100x100x10 | | | | Material: Aluminium | | | |
|---|---|---|---|---|---|---|---|
| Program no.: 1008 | | | | DWG No: 24 | | | |
| Sl. no. | Operation | Tool type | Tool dia | Tool station | Tool length offset | Spindle speed | Feed mm/min |
| 1 | Contouring | Slot cutter | 6mm | 1 | 1 | 2000 | 35-50 |

Write a manual part program for mirroring operation for the component shown in figure.

G21 G94
G91 G28 Z0
G28 X0 Y0
M06 T1
M03 S2000
G90 G00 X0 Y0 Z5
G00 Z0
M98 P0015000
M70
M98 P0015000
M80
M98 P0015000
M70
M71
M98 P0015000
M80
M81
M71
M98 P0015000
G00 Z5
G91 G28 Z0
G28 X0 Y0
M05
M30

O5000
G00 X5 Y5 Z5
G01 Z-1 F50
X15 Y5
X15 Y15
X5 Y15
X5 Y5
G00 Z5
X10 Y10
G10 Z-1 F50
G00 Z5
X15 Y5
G01 Z-1 F50
G03 X25 Y15 R15
G01 X25 Y35
G02 X30 Y30 R5
G02 X35 Y25 R5
G01 X15 Y25
G03 X5 Y15 R15
G00 Z5
G00 X0 Y0
M99

Ahmed

| | Marks Allotted |
|---|---|
| Record | 19 |
| Observation | 5 |
| Viva | 5 |
| Total | 29 |
| Signature of Faculty with date | Ahmed |