GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

MACHINE TOOL DESIGN (3161921)

Unit 1: Introduction to Machine Tool Drives

Repeated Questions:

1. **Explain the general requirements of machine tool design.**
   - (W24 - Q1a, 03 marks)
   - (S24 - Q1a, 03 marks) [in PDF (2)]
   - (W22 - Q1c, 07 marks) [in PDF (4)]
   - (Base PDF - Q1a, 03 marks) [Likely S22]
2. **State the functions of the spindle unit with their application in machine tool.**
   - (S25 - Q1a, 03 marks)
   - (W24 - Q3a, 03 marks)
   - (S24 - Q3a, 03 marks) [in PDF (5)]
3. **Differentiate between hydraulic transmission and mechanical transmission.**
   - (Base PDF - Q1a, 03 marks)
   - (S24 - Q1b, 04 marks) [in PDF (2)]
4. **Explain the procedure for selection of electrical motor in machine tool that works under variable loading condition.**
   - (W24 - Q1b, 04 marks)
   - (S24 - Q1b, 04 marks) [in PDF (5)]

Other Important Questions (Newest to Oldest):

1. **Explain hydraulic transmission system in brief.** (S23 - Q1a, 03 marks)
2. **What are different progression ratios?** (S24 - Q1a, 03 marks) [in PDF (2)]
3. **Compare arithmetic and geometrical progression ratio for speed selection.** (S23 - Q1a, 03 marks)
4. **Differentiate between rotary and translator hydraulic drive.** (S24 - Q1b, 04 marks) [in PDF (2)]
5. **Give the drive and feed motions for the following machines: (1) Lathe (2) Boring (3) Drilling (4) Shaping.** (S23 - Q1b, 04 marks)
6. **Explain various laws of stepped regulation with its applications.** (S23 - Q1c, 07 marks)
7. **Explain about the "working and auxiliary motions" in machine tools.** (S24 - Q1c, 07 marks) [in PDF (2)]
8. **Name the Devices used for intermittent motion. Explain anyone in detail.** (W22 - Q1a, 03 marks) [in PDF (4)]
9. **Why feed box with gear cone with sliding key is not suitable for heavy duty lathe machine?** (W22 - Q1b, 03 marks) [in PDF (4)]
10. **Discuss general requirements of machine tool design.** (W22 - Q1c, 07 marks) [in PDF (4)]
11. **Enlist the hydraulic and mechanical transmission and its elements used in machine tools.** (W24 - Q5a, 03 marks)
12. **What are the primary motions in machine tools?** (S25 - Q4a OR, 03 marks)
13. **Define the concept of feed rate in the context of machine tools.** (S25 - Q5a, 03 marks)
14. **State the functions of the spindle unit with their application in machine tool.** (Base PDF - Q1a, 03 marks)
15. **Explain the basic types of machine tools and their constructional features.** (S25 - Q1b, 04 marks)

Unit 2: Regulation of Speed and Feed Rates

Repeated Questions:

1. **Design a 9-speed gear box to give a minimum speed of 100 rpm and maximum speed of 630 rpm. The power is supplied by an electric motor of 10kW capacity, running at 1000 rpm, and driving the input shaft through a V-belt drive, having a speed reduction of 2:1. Draw the speed chart and calculate number of teeth on each gear.**
    - (W24 - Q1c, 07 marks)
    - (S24 - Q1c, 07 marks) [in PDF (5)]
2. **Describe step by step procedure for the design of 8 speed gearbox for a lathe, giving governing design equations.**
    - (W24 - Q2c, 07 marks)
    - (S25 - Q3c OR, 07 marks)
3. **Explain the step by step procedure for constructing structure diagram for speed box.**
    - (Base PDF - Q2c, 07 marks)
    - (S25 - Q2b, 04 marks)
4. **Draw the speed diagram and layout for a six speed gear box having the following structural formulae: (i) 2(3)3(1) (ii) 2(1)3(2) The output speeds are 160 rpm minimum and 1000 rpm maximum. The motor shaft speed is 1440 rpm.** (Base PDF - Q2c OR, 07 marks)

Other Important Questions (Newest to Oldest):

1. **What is a Ray Diagram in gearbox design, and how is it used?** (S25 - Q3a, 03 marks)
2. **What is a speed gearbox, and why is it important in machine tools?** (S25 - Q3a OR, 03 marks)
3. **What are the principles behind speed and feed regulation in machine tools? How do these impact the overall performance of the machine?** (S25 - Q2c OR, 07 marks)
4. **What is the role of adaptive control systems in modern machine tools?** (S25 - Q2a, 03 marks)
5. **Justify the statement: The difference between number teeth of successive gears in change of gearbox must be greater than 4.** (W24 - Q2a, 03 marks)
6. **Explain its significance "The geometric progression ratio in a multispeed gearbox is selected in a range of 1 and 2."** (W24 - Q2b, 04 marks)
7. **Explain following speed gear boxes with respect to method of changing speed. 1) Speed boxes with change gears 2) Speed boxes with friction clutches.** (W24 - Q2c OR, 07 marks)
8. **What are structure diagrams? Which information can be obtained from structure diagrams?** (S23 - Q2b, 04 marks)
9. **Explain Harmonic Progression?** (S24 - Q2a, 03 marks) [in PDF (2)]
10. **What are the information required to design a speed Box.** (S24 - Q2b, 04 marks) [in PDF (2)]
11. **List types of feed boxes and explain any one with neat sketch.** (S24 - Q3c, 07 marks) [in PDF (2)] *[Also appears in Base PDF Q1b, 04 marks]*
12. **Draw the structure diagram for following formulae. (i) 3(2)2(1) (ii) 2(3)3(1)** (S24 - Q3c OR, 07 marks) [in PDF (2)]
13. **Draw the structure diagram and gear box arrangement for the following structural formulae: (i) 2(1) 3(2) (ii) 2(3) 3(1) (iii) 3(1) 2(3) (iv) 3(2)2(1)** (S23 - Q2c OR, 07 marks)
14. **Why it is important to adjust the clearance in slide ways?** (W22 - Q2a, 03 marks) [in PDF (4)]
15. **With neat sketch explain following gear box: (1) Feed box with tumbler gear (2) Feed box with sliding gear.** (W22 - Q2c, 07 marks) [in PDF (4)]
16. **Prove that the loss of economic cutting speed is constant over the whole range of spindle speed in GP series.** (Base PDF - Q1c, 07 marks) *[Also appears in S25 Q1c, 07 marks]*
17. **Write advantages of geometrical progression.** (Base PDF - Q2a, 03 marks)
18. **Explain hydraulic step less regulation of speed and feed rates.** (Base PDF - Q2b, 04

marks) *[Also appears in S25 Q2c, 07 marks]*

19. **List types of feed boxes and explain any one with neat sketch.** (Base PDF - Q1b, 04 marks)
20. **Enlist different control system for speed changing.** (S24 - Q5a OR, 03 marks) [in PDF (2)]
21. **Explain simple centralized control system for speed changing.** (Base PDF - Q5a OR, 03 marks) *[Also appears in S25 Q5b OR, 03 marks]*
22. **Explain selective control system for speed changing.** (S23 - Q5c OR, 07 marks)

Unit 3: Design of Machine Tool Structures

Repeated Questions:

1. **Explain the factors affecting stiffness of machine tool structure and methods of improving it.**
    - (S25 - Q3c, 07 marks)
    - (Base PDF - Q3b, 04 marks)
    - (S24 - Q4c, 07 marks) [in PDF (4)]
    - (S25 - Q4c OR, 07 marks)
2. **State the materials and its applications for machine tool structures.**
    - (W24 - Q4a, 03 marks)
    - (S24 - Q3b, 04 marks) [in PDF (2)] *[Paraphrased: "Write a short note on materials of machine tool structure."]*
    - (W22 - Q3b, 04 marks) [in PDF (4)] *[Paraphrased: "Write a short note on materials of machine tool structure."]*
3. **Describe the basic design procedure for machine tool structure.**
    - (W24 - Q4c, 07 marks)
    - (W22 - Q3b OR, 04 marks) [in PDF (4)] *[Paraphrased: "Explain basic design procedure for machine tool structure."]*
4. **Explain static and dynamic stiffness for machine tool structures.**
    - (Base PDF - Q3c, 07 marks)
    - (W24 - Q5b, 04 marks) *[Paraphrased: "Differentiate static and dynamic stiffness for the design of machine tools."]*

Other Important Questions (Newest to Oldest):

1. **What are the different design criteria for design of machine tool structure?** (S23 - Q3a, 03 marks)
2. **On which basis you will select the Cast Iron and Steel as the material of machine tool structure?** (S23 - Q3b, 04 marks)
3. **Explain the design procedure of machine tool structure on the basis of strength.** (S23 - Q3c, 07 marks)
4. **Enlist profiles of machine tool structures.** (S24 - Q3a, 03 marks) [in PDF (2)]
5. **Evaluate the applicability of cast Iron and Mild steel as a material of Machine tool.** (S24 - Q3b, 04 marks) [in PDF (2)]
6. **Enlist commonly used column sections and its applications.** (S24 - Q3a OR, 03 marks) [in PDF (2)]
7. **Discuss various types of Bed structure.** (S24 - Q3b OR, 04 marks) [in PDF (2)]
8. **Give functions of machine tool structures and their requirements.** (Base PDF - Q3a, 03 marks)
9. **Explain the function of machine tool structures.** (S23 - Q2c, 07 marks)
10. **Discuss various types of Bed structure and wall arrangements and their applications with neat sketch.** (W22 - Q2b, 04 marks) [in PDF (4)]
11. **Explain various functions and types of guideways.** (W22 - Q3a OR, 03 marks) [in PDF (4)]
12. **Explain the design procedure of Slideways for wear resistance.** (W22 - Q3c OR, 07 marks) [in PDF (4)]
13. **Discuss various methods to improve dynamic stiffness of machine tools.** (W22 - Q4a OR, 03 marks) [in PDF (4)]
14. **Explain the factors affecting on design of sliding- friction power screws.** (Base PDF - Q4b OR, 04 marks)
15. **During the turning operation on a workpiece held between centres, the tangential cutting force component was 150 kgf and the radial cutting force component was 80 kgf. If the workpiece is 500 mm long and has diameter = 80 mm, determine the deflection when the tool is 200 mm from the headstock. The headstock and tailstock stiffness are 35,000 and 15,000 kgf/cm, respectively.** (W24 - Q4b, 04 marks) *[Numerical Problem]*
16. **Derive the equation of (l^2/h) for simple machine tool bed with two side walls with**

considering as simply supported beam loaded by concentrated load (P) acting at centre. (W24 - Q4c, 07 marks)

17. **Describe the basic design procedure for machine tool structure with respect to the role of cutting force, friction force, forces of reactions, forces due to mass of structure and inertial forces due to vibration.** (W24 - Q4c OR, 07 marks)
18. **Derive the equation for forces acting on the mating surfaces in a combination of V and Flat slideways under orthogonal cutting condition for lathe machine with schematic loading diagram.** (W24 - Q3c OR, 07 marks)

Unit 4: Design of Guideways and Power Screws

Repeated Questions:

1. **Explain Anti friction guideways.**
   - (Base PDF - Q3b OR, 04 marks)
   - (S25 - Q3b OR, 03 marks) *[Paraphrased: "Illustrate anti friction guideways."]*
   - (S24 - Q4b OR, 04 marks) [in PDF (2)]
2. **Discuss various shapes of slide ways and justify their application for machine tools.**
   - (W22 - Q2c OR, 07 marks) [in PDF (4)]
   - (S25 - Q3b, 04 marks)
3. **Explain the design of rolling friction power screws.**
   - (Base PDF - Q4c, 07 marks)
   - (S25 - Q4c, 07 marks)

Other Important Questions (Newest to Oldest):

1. **State the different applications of guideways in machine tool design.**
   - (S25 - Q4a, 03 marks)
   - (W24 - Q4a, 03 marks)
2. **What are the commonly used bed sections and wall arrangements. Also state its applications.** (Base PDF - Q4a OR, 03 marks)
3. **Enlist the major requirements that the guide ways must satisfy.** (S23 - Q3a OR, 03 marks)
4. **Illustrate with sketch the symmetrical V, dovetail and cylindrical slideways.** (S23 - Q3b OR, 04 marks)
5. **Explain methods of adjusting clearances in slideways.** (S23 - Q3c OR, 07 marks)
6. **Write a note on Antifriction Guideways.** (W22 - Q3a, 03 marks) [in PDF (4)]
7. **Give requirement of Protecting devices for slide ways and explain various types of protecting devices with neat sketch.** (W22 - Q3c, 07 marks) [in PDF (4)] *[Also appears in Base PDF Q3c OR, 07 marks]*
8. **Explain the design of aerostatic slideways.** (W22 - Q4c OR, 07 marks) [in PDF (4)]
9. **Explain Re-circulating ball screws.** (S24 - Q4a, 03 marks) [in PDF (2)]
10. **Explain Anti friction guideways and Aero static guideways.** (S24 - Q4b OR, 04 marks) [in PDF (2)]
11. **Explain the various forces to be considered for design of machine tool structure.** (S24 - Q4c OR, 07 marks) [in PDF (2)]
12. **Explain combination guideways using anti-friction rolling members for vertical loading and compound loading with neat diagram.** (W24 - Q3b, 04 marks)
13. **State the characteristics of anti-friction guideways.** (W24 - Q3a OR, 03 marks)
14. **Justify the statement "The life and smooth working of slide-ways depends significantly upon the clearance between the sliding surfaces".** (W24 - Q3b OR, 04 marks)
15. **Explain the condition of design for buckling stability and for wear resistance w.r.t. sliding friction power screws.** (W24 - Q4b OR, 04 marks)
16. **Differentiate between sliding friction and rolling friction power screw.** (W22 - Q4a OR, 03 marks) [in PDF (4)]
17. **With suitable figure show various profiles of slide ways.** (Base PDF - Q3a OR, 03 marks)

Unit 5: Design of Spindles and Spindle Supports

Repeated Questions:

1. **What are the design requirements of spindle units?**
    - (S23 - Q4a, 03 marks)
    - (Base PDF - Q4a, 03 marks) *[Paraphrased: "What is spindle? Explain functions of spindle unit."]*
2. **Explain Preloading of anti friction bearing.**
    - (W22 - Q4c, 07 marks) [in PDF (4)]
    - (S23 - Q4c OR, 07 marks) *[Paraphrased: "Why preloading is carried in antifriction bearing? What are the methods of preloading of ball bearing?"]*
3. **State the functions and requirements of the spindle unit along with the materials.**
    - (W22 - Q4b OR, 04 marks) [in PDF (4)]
    - (S25 - Q4b, 04 marks)

Other Important Questions (Newest to Oldest):

1. **How does spindle stiffness affect machining accuracy?** (S25 - Q5a OR, 03 marks)
2. **Suggest the material for following spindles: 1. Normal accuracy spindle 2. Precision machine tools 3. Heavy duty spindles.** (S23 - Q4b, 04 marks)
3. **Write the general design procedure of column structure.** (S23 - Q4a OR, 03 marks)
4. **What are the desirable properties for material of spindle and Bearing? Suggest material for spindle and bearing.** (S23 - Q4b OR, 04 marks)
5. **Enlist the various spindle ends with simple sketch.** (S24 - Q4a OR, 03 marks) [in PDF (2)]
6. **Suggest the material for rolling bearing with reasons.** (S24 - Q4b, 04 marks) [in PDF (2)]
7. **Factors Affecting Stiffness of Machine Tool Structure and methods of Improving it.** (S24 - Q4c, 07 marks) [in PDF (2)] *[This seems mis-categorized from Unit 3, but appears in PDF (2) under a Q4.]*
8. **Derive the equation for total deflection of spindle axis due to compliance of spindle supports.** (W24 - Q3c, 07 marks)
9. **The rolling contact ball bearing are to be selected to support the overhung countershaft. The shaft speed is 720 r.p.m. The bearings are to have 99% reliability corresponding to a life of 24 000 hours. The bearing is subjected to an equivalent radial load of 1 kN. Consider life... Find the basic dynamic load rating of the bearing from manufacturer's catalogue, specified at 90% reliability.** (Base PDF - Q4c OR, 07 marks) *[Incomplete numerical problem as per PDF scan]*

Unit 6: Dynamics of Machine Tools

Repeated Questions:

1. **What are the effects of vibration on performance of design of machine tools and how these can be minimized?**
    - (S23 - Q5c, 07 marks)
    - (Base PDF - Q5b, 03 marks) *[Paraphrased: "Write a note on machine tool chatter." - Chatter is a vibration effect]*
    - (S25 - Q5c, 07 marks) *[Paraphrased: "Write a note on machine tool chatter."]*
2. **Enlist the different methods to reduce instability in machine tools. Explain its significance.**
    - (W24 - Q5a OR, 03 marks)
    - (Base PDF - Q5b OR, 03 marks) *[Paraphrased: "What are the methods to reduce instability in machine tools."]*
    - (S25 - Q5c OR, 03 marks) *[Paraphrased: "What are the methods to reduce instability in machine tools."]*

Other Important Questions (Newest to Oldest):

1. **Explain vibration absorbers.** (S24 - Q5b, 04 marks) [in PDF (2)]
2. **Describe the general procedure for evaluating the dynamic stability of Equivalent Elastic System (EES)-cutting process closed loop system.** (W24 - Q5c, 07 marks)
3. **Explain Machine tool chatter.** (S24 - Q5c, 07 marks) [in PDF (2)] *[Part of a two-part question]*

Unit 7: Control Systems in Machine Tools

Repeated Questions:

1. **Explain the adaptive control system for machine tools.**
    - (Base PDF - Q5c, 07 marks)
    - (S24 - Q5c, 07 marks) [in PDF (2)] *[Part of a two-part question]*
    - (S23 - Q5a OR, 03 marks) *[Paraphrased: "What are the advantages of adaptive control system?"]*
2. **Classify control system of machine tool? Explain any one in detail.**
    - (S24 - Q5c, 07 marks) [in PDF (2)] *[This is the first part of the same question as above in PDF (2)]*

Other Important Questions (Newest to Oldest):

1. **What are the advantages of adaptive control system?** (S23 - Q5a OR, 03 marks)
2. **Explain Adaptive Control Optimization (ACO) system with neat sketch.** (W24 - Q5c OR, 07 marks)
3. **Write a short note on adaptive control system.** (W22 - Q4b OR, 04 marks) [in PDF (4)]

Unit 8: Ergonomics and Aesthetic Design of Machine Tool

Repeated Questions:

1. **Explain the importance of ergonomic consideration applied to the design of control members of machine tools.**
    - (S23 - Q5b, 04 marks)
    - (Base PDF - Q5c OR, 07 marks) *[Paraphrased: "Explain the ergonomic consideration applied to the design of control members of machine tools."]*
2. **What are the aesthetics considerations applied to design of machine tools.**
    - (Base PDF - Q5a, 03 marks)
    - (S23 - Q5a, 03 marks) *[Paraphrased: "How will you use aesthetic considerations for effective design of Machine tools?"]*

Other Important Questions (Newest to Oldest):

1. **Identify the machine tool components where ergonomic consideration can be applied?** (S24 - Q5a, 03 marks) [in PDF (2)]
2. **Explain the significance of ergonomic considerations in design for following control members of machine tool: 1) Cranks 2) Levers.** (W24 - Q5b, 04 marks)
3. **What is anthropometric Data? How it is useful in design of machine tool.** (S23 - Q5b OR, 04 marks)
4. **Identify the machine tool components where aesthetic consideration can be applied?** (S24 - Q5b OR, 04 marks) [in PDF (2)]
5. **Discuss the role of Aesthetics in Product design.** (W22 - Q5a, 03 marks) [in PDF (4)]
6. **Discuss following in brief: 1. Value Engineering 2. Consumer Quality level.** (W22 - Q5a OR, 03 marks) [in PDF (4)]
7. **Draw general layout of knee type vertical milling machine with relative motion.** (W22 - Q5b, 04 marks) [in PDF (4)] *[Also appears in S25 Q5b, 04 marks]*
8. **Draw general layout of Lathe with relative motion.** (W22 - Q5b OR, 04 marks) [in PDF (4)]
9. **Explain design procedure of columns.** (W22 - Q5c, 07 marks) [in PDF (4)]

****