KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B. Sc. Engineering 3rd Year 2nd Term Examination, 2021
ME 3217
(Machine Design II)
Time: 3 Hours   Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
   ii) Figures in the right margin indicate full marks.
    iii) Assume reasonable data if missing any.

SECTION-A

1. A countershaft is supported by two tapered roller bearings using an indirect mounting. The radial bearing loads are 2240 N for the left-hand bearing and 4380 N for the right hand bearing. An axial load of 800 N is carried by the left bearing. The shaft rotates at 400 rev/min and is to have a desired life of 40 kh. Use an application factor of 1.4 and a combined reliability goal of 0.90. Using an initial $K = 1.5$, find the required radial rating for each bearing. Select the bearings using suitable figure.   35

2(a) In bearings tested at 2000 rev/min with a steady radial load of 18 kN, a set of bearings showed an L_{10} life of 115 h and an L_{80} life of 600 h. The basic load rating of this bearing is 39.6 kN. Estimate the Weibull shape factor b and the characteristic life θ for a two parameter model. This manufacturer rates ball bearings at 1 million revolutions.   20

2(b) Estimate the remaining life in revolution of a 02-30 mm angular contact ball bearing already subjected to 20×10^4 rev. with a radial load of 18 kN, if it is now subjected to a change in load to 30 kN.   15

3(a) A full journal bearing has a journal diameter of 32 mm, with a unilateral tolerance of −0.012 mm. The bushing bore has a diameter of 32.05 mm and a unilateral tolerance of 0.032 mm. The bearing is 64 mm long. The journal load is 1.75 kN and it runs at a speed of 900 rev/min. Using an average viscosity of 55 mPa.s find the maximum film pressure, and the total oil flow rate for the minimum clearance assembly.   15

3(b) A full journal bearing has a shaft journal diameter of 25 mm, with a unilateral tolerance of −0.01 mm. The bushing bore has a diameter of 25.04 mm and a unilateral tolerance of 0.03 mm. The L/d ratio is unity. The bushing load is 1.25 kN and the journal rotates at 1200 rev/min. Analyze the minimum clearance assembly if the average viscosity is 50 mPa.s and find the minimum oil film thickness, the power loss, and the percentage of side flow.   20

4. A steel spur pinion and gear have a diametral pitch of 12 teeth/in, milled teeth, 17 and 30 teeth, respectively, a 20° pressure angle, a face width of 7/8 inch, and a pinion speed of 525 rev/min. The tooth properties are $S_{ut} = 76$ kpsi, $S_y = 42$ kpsi and the Brinell hardness is 149. Use the Gerber criteria to compensate for one way bending. For a design factor of 2.25, what is the power rating of the gearset?   35

SECTION-B

5. An uncrowned straight bevel pinion has 30 teeth, a diametral pitch of 6, and a transmission accuracy number of 6. The driven gear has 60 teeth. Both are made of grade 80-55-06 ductile iron. The shaft angle is 90°. The face width is 1.25 inch, the pinion speed is 900 rev/min, and the normal pressure angle is 20°. The pinion is mounted outboard of its bearings; the bearings of the gear straddle it. What is the power rating based on AGMA bending strength? Assume life goal is 10^9 rev at a reliability of 0.99 and apply a factor of safety of 2.   35

6. Design a cylindrical worm-gear mesh to connect an electric motor to a lifting mechanism. The motor speed is 1200 rpm and velocity ration is to be 20:1. The output power requirement is 25 hp. The shaft axes are 90° to each other. An overload factor $K_o = 1.25$ is appropriate for 90°F ambient temperature. The motor case area is 1200 in² and externally cooled by a fan. A design factor of 1.2 is to be included to address other unquantifiable risks.   35

7. The figure depicts a band brake whose drum rotates counterclockwise at 200 rev/min. The drum diameter is 400 mm and the band lining 75 mm wide. The coefficient of friction is 0.20. The maximum lining interface pressure is 480 kPa.   35

   (a) Find the brake torque, necessary force P, and steady-state power.

   (b) Complete the free body diagram of the drum. Find the bearing radial load that a pair of straddle-mounted bearings would have to carry.

   (c) What is the lining pressure P at both ends of the contact arc?
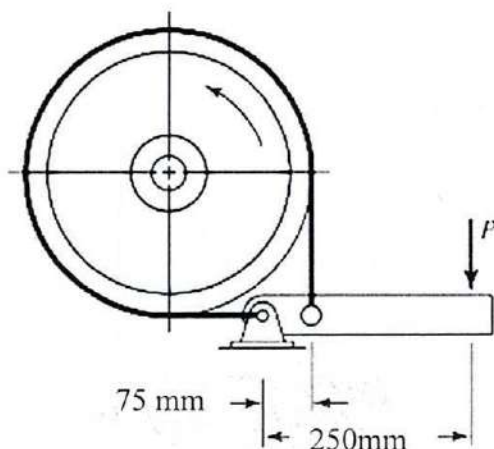
8. A single gate V belt is to be selected to deliver engine power to the wheel drive transmission of a riding tractor. A 5-hp single-cylinder engine is used. At most, 60 percent of this power is transmitted to the belt. The driving sheave has a diameter of 6.2 inch, the driven sheave has a diameter of 12.0 inch. The belt selected should be as close to a 92 inch pitch length as possible. The engine speed is governor controlled to a maximum of 3100 rev/min. Select a satisfactory belt and assess the factor of safety and the belt life in passes.   35

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechanical Engineering
B. Sc. Engineering 3rd Year 2nd Term Examination, 2021
ME 3225
(Measurement and Industrial Instrumentation)
Time: 3 Hours   Total Marks: 210
N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

SECTION-A

1(a) What are meant by measurement error and correction? Briefly explain different types 09
of measurement errors.

1(b) How does error occur when spherical end gauges are not aligned? Explain with 08
mathematical calculation.

1(c) Define a sinebar and state its functions. What are the factors on which the accuracy of 08
sinebar depends?

1(d) Balls of diameters 20 mm and 16 mm were used to measure the following parameters 10
of a taper ring gauge. The large ball protruded 4 mm above the end face of the gauge
and the distance from this face to the top of the small ball was 38 mm. Calculate
   i)   The angle of the taper and the large end diameter.
   ii) Assuming no errors in the balls and errors up to 0.04 mm in the measured
        distance, determine the possible error in the calculated angle.

2(a) What are the different ways of relative humidity? Explain the working principle of hair 14
hygrometer.

2(b) What are the different instruments used for measuring torque? Explain the working 11
principle of prony brake dynamometer.

2(c) What are the various ways of measuring air velocity in open atmosphere? Explain with 10
neat sketch.

3(a) Describe the procedure for measuring flow rate of fluid through a pipe by venturi meter 15
and write down all necessary calculations.

3(b) How bourdon pressure gauge measures the pressure of fluid? Describe its construction 12
and working principle.

3(c) How strain gauge is used to measure the force on an object. 08

4(a) What are the commonly used viscometers? Explain the working principle of falling 12
sphere viscometer.

4(b) What are the end-line and in-line flowmeter? Describe the working principle of an in- 13
line flowmeter.

4(c) What is thermistor? What are the advantages and disadvantages of thermistor? 10

SECTION-B

5(a) How a bore diameter can be measured with the help of four balls? Explain the   09
procedure.

5(b) What is meant by comparator? Mention its application. Describe the merits and   09
demerits of mechanical comparator.

5(c) Mention the methods by which tooth thickness of gear can be measured. Describe most   11
effective method of measuring gear tooth thickness.

5(d) Calculate the chord length and its distance below the tip for a gear of module 4 and   06
pressure angle of 20°.

6(a) Define gauge. Distinguish among worker gauge, inspection gauge and reference gauge.   07

6(b) The radius of curvature R of a concave surface is measured by noting two dimensions   10
d and h such that $R = \frac{d^2}{8h} + \frac{h}{2}$. If the error in measurement of d is $\pm 1\%$ and h is $\pm 0.5\%$,
determine the total error in measurement of R if $d = 50$ mm and $h = 5$ mm.

6(c) How digital inside caliper measures the inside diameter of a hole? Describe with neat   08
sketch.

6(d) Which angle measurement system is used in servomotor? Explain its working principle   10
with neat sketch.

7(a) Briefly explain the working principle of infrared sensor and give comparison with   12
ultrasonic sensor.

7(b) Describe the Doppler radar velocity measurement process for moving objects with   12
necessary diagram.

7(c) Briefly explain the working principle of a non-contact temperature measurement   11
sensor.

8(a) Explain the force measurement methods by using magnetic suspension balance and   12
double series magnetic suspension method. Compare their performances in
measurement accuracy.

8(b) Briefly describe the working principle of a magnetic flow meter with neat sketch.   08

8(c) Piezo electric transducers can be used as a sensor and as an actuator, Explain.   08

8(d) Write in short notes on measurement responsibility ISO 9000:2000.   07

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