KADI SARVA VISHWAVIDHYALAYA
B.E MECHANICAL Semester–V

Subject: MACHINE DESIGN I **Date: 11/11/2016**
Subject Code: ME (502) **Time: 10:30a.m. – 1:30 p.m.**
Total Marks: 70

Instructions:
1. Answer each section in separate Answer sheet.
2. Use of Scientific calculator is permitted.
3. All questions are **Compulsory**.
4. Indicate **clearly**, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of **rough work**.

SECTION-I

Q:1 (A) What is Derived Series? Explain about different Derived Series and its use with example. **[5]**

(B) A manufacturer is interested in starting a business with five different models of Tractors ranging from 7.5 KW to 75 KW capacities. Specify power capacities of models. There is an expansion plan to further increase number of models from five to nine to fulfil the requirement of farmers. Specify the power capacities of the additional models. **[5]**

(C) Give Answer of following two questions.
(I) Suggest with justification the suitable material for the following component. **[3]**
(a) Connecting rod (b) Chemical Storage Vessel (c) Leaf Spring for Truck.
(II) What do you understand by following Designations of Materials: **[2]**
(a) 40Cr1Mo28 (b) 40NiCr1Mo15

OR

(C) Give Answer of following two questions.
(I) State the major alloying element added to steel and their influence on properties of steel. **[3]**
(II) What are Composites? State their Applications. **[2]**

Q:2 (A) Give Answer of following two questions.
(I) Two plates joined by fillet welds, as shown in Figure 1, are subjected to a tensile load of 200 KN. If allowable shear stress for the weld material is 85 Mpa, Calculate the size of the weld **[2]**
(II) Classify the welded joints in details with neat sketches. **[4]**

(B) Give the difference between following terms Regarding Limit Fits and tolerance. **[4]**
(i) Basic Size and nominal Size (ii) Allowance and Tolerance
(iii) Unilateral and Bilateral Tolerance (iv) Mean and Fundamental Deviation

OR

Q:2 (A) Explain procedure for Design of Welds with in Plane Eccentric Loads. **[5]**

(B) What is the Stress Concentration? What are the various causes of Stress Concentration? Discuss the various methods of reducing the effect of stress Concentration. **[5]**

Q:3 (A) What is the difference between Endurance strength and Endurance limit? Explain it. [4]

(B) A cantilever beam of circular cross section is fixed at one end and subjected to completely reversed force of 10 KN at the free end. The force is perpendicular to the axis of the beam. The distance between Free and fixed ends is 100 mm. The beam is made of steel with ultimate tensile strength of 540 N/mm^2 and tensile yield strength of 320 N/mm2. The construction of the cantilever is such that there is no stress concentration. The size factor, surface finish factor and reliability factor are 0.85, 0.8 and 0.868 respectively. The operating temperature is 50° C for which the temperature factor is 1.010. If the diameter of the beam is 35 mm, determine the Life of the Beam. [6]

OR

Q:3 (A) Explain the procedure for the selection of Flat belts from Manufacture's catalogue. [5]

(B) A plate made of plain carbon steel 20C8 (Sut = 440 N/mm^2 is shown in Figure 2. The theoretical stress concentration factor and notch sensitivity are 2.50 and 0.80 respectively. The surface finish factor, size factor and reliability factor are 0.67, 0.85 and 0.897 respectively. The plate thickness is 30 mm. If the required factor of safety is 2.0, Determine the maximum completely reversed axial force the plate can take for Infinite Life. [5]

SECTION II

Q:4 (A) A Differential band brake which supports a load of 15 KN as shown in Figure 3 is attached to the barrel of 400 mm diameter and drum of 800 mm diameter is keyed to the shaft. The two ends of the band are attached to the brake lever on the opposite sides of the fulcrum at 80 mm and 130 mm respectively. The angle of contact of the band is 240°. The operating force is applied at a distance of 1m from the Fulcrum. [10]

If $\mu = 0.25$, Design

(i) The tight end joint with its end connection. Take $\sigma t = 75$ MPa, $\sigma cr = 150$ MPa, $\sigma = 60$ MPa..

(ii) Lever cross section if h = 2.5 b assuming $\sigma t = 75$ MPa

(iii) Fulcrum Pi, assuming, Pb = 20 MPa. Check the brake for heat dissipation, If drum rotates at 240 rpm. The operation is intermediate.

Assume, Diameter of Rivet is 6 mm, No of Rivet is 8, $l/dp = 1.2$.

For intermediate Load, Pavg x V = 1.93 x 10^6 N/ms.

(B) Differentiate between Rolling element bearing and Sliding bearing. [5]

OR

(B) A high pressure cylinder consists of a steel tube with inner and outer diameters of 20 mm and 35 mm respectively. It is jacketed by an outer steel tube with an outer diameter of 50 mm. The tubes are assembled by a shrinking process in a way that the maximum principal stress induced in any tube is limited to 100 N/mm2. Calculate the interference pressure and original dimensions of tubes. The modulus of elasticity of the steel used for tubes is 2 x 10^5 N/mm^2. [5]

Q:5 (A) Explain step by step Design procedure of Cone Clutch. [5]

(B) Following Data refers to a C.F (Centrifugal) clutch: [5]
Mass of each shoes = 4 Kg, No of shoes = 4, Inner Diameter of Drum = 320 mm
Distance of C.g of Shoe from the center of spider = 135 mm, Coefficient of Friction between the shoes and Drum = 0.25, Running speed = 1000 rpm, Shoe engagement speed = 750 rpm. Assume, Each shoe subtends an angel of 60° at the center.
Find, (i) Power transmitted capacity of the clutch
(ii) Size of each shoe, if p = 0.1 MPa.

OR

Q:5 (A) What is a Clutch? Discuss the various types of clutches giving at least one practical application for each. [5]

(B) A Leather faced Cone Clutch has a cone angle of 25°. The intensity of normal pressure between the contact surface is not to exceed 0.07 MPa, and breadth of conical face is not to be greater than one third of the mean radius. If $\mu = 0.2$ and the clutch is to transmit 30 KW power at 1500 rpm, [5]
Find (i) Dimensions of contact surfaces. Take engagement factor, $\beta = 1.25$.
(ii) Axial spring force required to engage the clutch.

Q:6 (A) Explain the purpose of Pre Stress with help of Stress diagram. [5]

(B) A closed cylinder of 300 mm inner diameter is to be designed to withstand an internal pressure of 25 MPa. The cylinder is to be made of plain carbon steel 15C8.(Sut = 440 N/mm2, Syt = 240 N/mm2 and v = 0.29). If the factor of Safety based on yield strength is 1.5. Determine the thickness of the cylinder wall using: [5]
(i) The Maximum Principal Stress Theory (ii) The Maximum Principal Strain Theory
(iii) The Maximum Shear Stress Theory (iv) The Distortion Energy Theory

OR

Q:6 (A) Following Data refer to a Journal Bearing of a C.F pump: [5]
Diameter of Shaft = 60 mm, Diameter of Bearing = 60.06 mm, Bearing Length = 90 mm, Load Supported = 28 KN, Operating Speed = 900 rpm, Minimum thickness of oil film = 0.015 mm, Use the equation.

$$S = \left[\frac{\mu . n}{p}\right]\left(\frac{r}{c}\right)^2 = \frac{0.0823\left[2+\epsilon^2\sqrt{1-\epsilon^2}\right]}{\pi^2 . \epsilon}$$

Find, (i). Suitable value of SAE-10 oil viscocity at 62 °C.
(ii). Power lost in friction.
(iii). State whether the bearing is working under hydrodynamic condition or not ? Assuming a bearing modulus of 15.

(B) A 6310 SKF deep groove Ball bearing is to a following loading cycle: [5]
(i) For 25 % of the time, Fr = 600 N, Fa = 250 N at 800 rpm
(ii) For 55 % of the time, Fr = 700 N, Fa = 200 N at 1000 rpm
(iii) For 30 % of the time, Fr = 300 N, Fa = 150 N at 1200 rpm
Determine the rating life of the bearing in hours. Also find the life that 50 % of the bearing will exceed before fatigue failure. Assume steady load condition and Inner Race is rotates. Dynamic (C) and Static (C_0) Basic load rating are 47.5 KN and 36 KN

respectively for Bearing SKF 6310.

Use Following Table for, Calculation Factor.

Calculation Factor

Type of Bearing	Series	$\frac{F_a}{C_0}$	e	$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
				X	Y	X	Y
Deep Groove	60,62,63	0.025	0.22	1	0	0.56	2
		0.04	0.24	1	0	0.56	1.8
		0.07	0.27	1	0	0.56	1.6

Figure 1

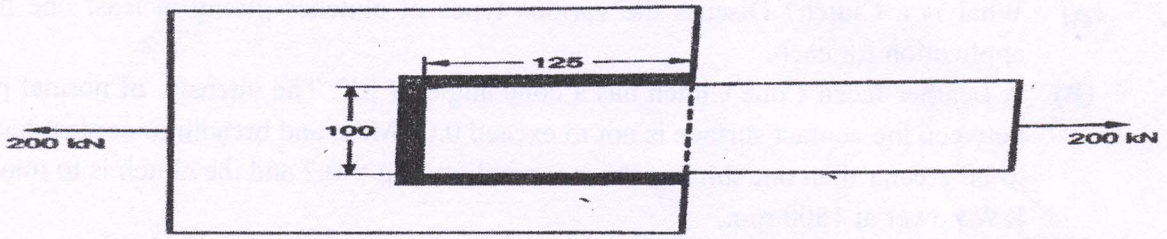


Figure 2

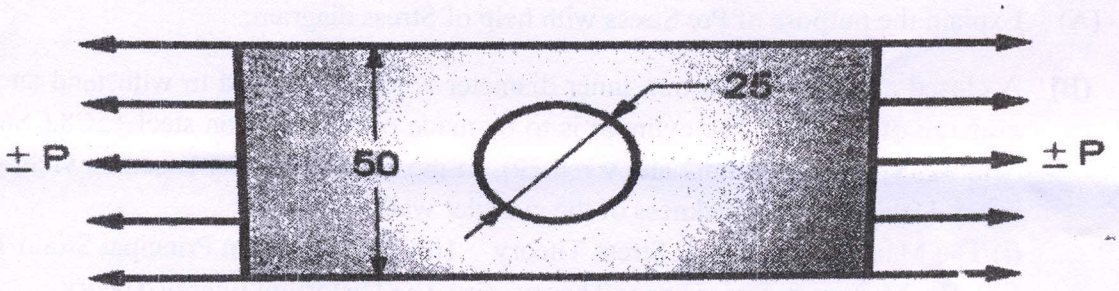
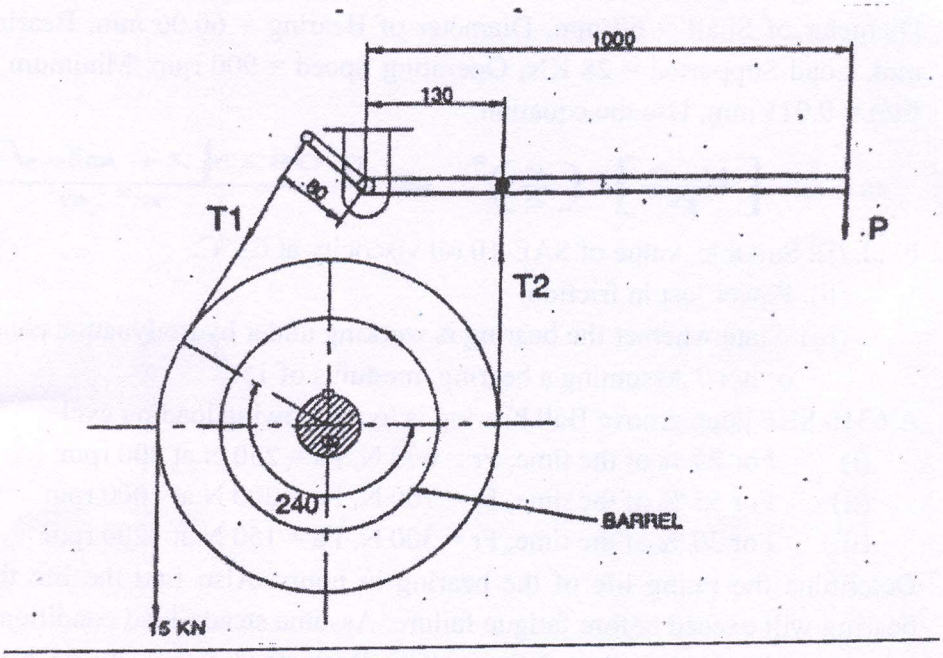


Figure 3



KADI SARVA VISHWAVIDYALAYA

B.E. Semester-5th sem (Mechanical Engg.) Examination (Nov-2014)

Subject code: ME502 **Subject Name: Machine Design: I**

Date:- 14/11/2014 **Time:- 10.30 am to 1.30 pm** **Total Marks:- 70**

Instructions:

1. **Answer each section in separate answer sheet**
2. **All questions are compulsory.**
3. **Indicate clearly, the options you attempt along with its respective question number.**
4. **Assume suitable data, wherever it is necessary**

<table>
<tr><td></td><td></td><td>Section-I</td><td></td></tr>
<tr><td>Q.1</td><td>[A]</td><td>1) Explain hydrostatic lubrication with neat sketch.
2) Discuss causes of failure of antifriction bearing</td><td>05</td></tr>
<tr><td></td><td>[B]</td><td>Select a suitable deep groove ball bearing for a 70mm diameter shaft, running at 400RPM. The computed load on the bearing are, Fr = 7500N and Fa = 4875N. The bearing is to have a desired rotation life of 2400 hours at a reliability of 94%. The load is a light shock, and the inner races rotate. Use following data.
<table>
<tr><th>Bearing No.</th><th>d (mm)</th><th>Co (kN)</th><th>C (kN)</th></tr>
<tr><td>6014</td><td>70</td><td>24.5</td><td>29.0</td></tr>
<tr><td>6214</td><td>70</td><td>37.5</td><td>47.5</td></tr>
<tr><td>6314</td><td>70</td><td>63.0</td><td>80.0</td></tr>
</table>
<table>
<tr><th>Fa/Co</th><th colspan="2">Fa/Fr > e</th><th>e</th></tr>
<tr><td></td><td>X</td><td>Y</td><td></td></tr>
<tr><td>0.025</td><td rowspan="4">0.56</td><td>2.0</td><td>0.22</td></tr>
<tr><td>0.04</td><td>1.8</td><td>0.24</td></tr>
<tr><td>0.07</td><td>1.6</td><td>0.27</td></tr>
<tr><td>0.13</td><td>1.4</td><td>0.31</td></tr>
</table></td><td>05</td></tr>
<tr><td></td><td>[C]</td><td>A ball bearing is operating on a work cycle consisting of three parts: - a radial load of 3000 N at 1440 rpm for one quarter cycle, a radial load of 5000 N at 720 rpm for one half cycles and a radial load of 2500 N at 1440 rpm for remaining cycle. The expected life of the bearing is 10000 hours. Calculate the dynamic load carrying capacity of the bearing.</td><td>05</td></tr>
<tr><td></td><td></td><td>OR</td><td></td></tr>
<tr><td></td><td>[C]</td><td>A lightly loaded bearing 80mm long has 80mm diameter and supports a radial load of 3000N. The clearance ratio (c/r) = 0.001. The lubricating oil SAE 30 has viscosity of 33×10^{-3} PaS at 60°C. The shaft speed is 750RPM. The end leakage factor (k) = 0.002. Find (i) Co-efficient of friction (ii) friction torque developed (iii) power lost in friction.</td><td>05</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Q.2</td><td>[A]</td><td>Write the properties of friction lining material.</td><td>02</td></tr>
</table>

	[B]	The following specification refers to a centrifugal clutch: Power to be transmitted = 15 kW No. of shoes = 4 Inner radius of drum = 150 mm Distance of C.G. of shoe from the centre of the spider =120 mm Coefficient of friction the shoe and drum = 0.25 Running Speed = 900 r.p.m. Shoe engagement starts at Speed = ¾ th of the Running Speed Permissible pressure intensity = 0.10 MPa Angle of contact subtended by friction lining of shoe at the centre of the spider = 40° Find (i) Mass of each shoe and (ii) size of each shoe.	08
		OR	
Q.2	[A]	Derive the equation for axially loaded unsymmetrical welded section.	04
	[B]	A plate 100mm wide and 12.5mm thick is to be welded to another plated by mean of parallel fillet welds. The plates are subjected to the load 50kN find length of the weld so that maximum stress does not exceed 56Mpa. Consider the joint first under the static loading and then under fatigue loading.	06
Q.3	[A]	Define endurance strength and endurance limit.	02
	[B]	A hot rolled steel rod is to be subjected to a torsional load that will vary from a -100 Nm to +400 Nm. Determine the diameter of rod using a factor of safety 1.75. For the material of the rod take σ_{ut} = 489 MN/m^2 and σ_{yp} = 315 MN/m^2 .Take surface condition modifying factor = 0.68, Size factor = 0.85, Load factor = 0.58, Stress concentration factor = 1.	08
		OR	
Q.3	[A]	1) What are the major principles in the design of casting? 2) What are the salient features used in the design of forging? Explain.	05
	[B]	1) What do you mean by standardization? Explain role of preferred numbers in standardization? 2) Standardize six speeds between 250 to 1400 rpm and State the series of torque for 0.5kw drive.	05
		Section-II	
Q.4	[A]	1) Compare the simple band brake and differential band brake.(Write 4 points) 2) Describe with the help of neat sketch the principle of operation of an internal expanding shoe brake	02 03

	[B]	A Band brake as shown in **figure-1** is required to balance a torque of 980 N-m at the drum shaft. The drum is to be made of 400 mm diameter & keyed to the shaft. The band is to be lined with ferodo lining having a coefficient of friction 0.25. The maximum pressure between the lining & drum is 0.5 N/mm^2. Design the steel band, lever & pin. The permissible stresses for the band, lever and pin are 70 Mpa in tension and compression and 56 Mpa in shear.	**10**
		OR	
	[B]	A simple shoe brake as shown in **figure-2** is operated through linkage. The force applied is 120N. Determine the torque developed. If the allowable pressure intensity between the shoe and the drum is 0.8 MPa. Find the dimensions of the shoe, Take $\mu = 0.3$ and drum diameter D = 250mm.	**10**
Q.5	[A]	Draw the circumferential and radial stress distribution diagram for the three cases. 1) Considering only shrinkage pressure 2) Considering only internal pressure 3) Considering both shrinkage and internal pressure.	**03**
	[B]	A high pressure cylinder consists of a steel tube with inner and outer diameters of 30mm and 60mm respectively. It is jacketed by an outer steel tube with an outer diameter of 80mm diameter. The tubes are assembled by a shrink fit, so that the maximum hoop stress induced in any tube is limited to 80MPa. If $E = 2.1 \times 10^5$MPa. Find 1) Shrinkage pressure 2) Interference required 3) Original dimensions of tubes before shrinking 4) Temperature to which the jacket must be heated if $\alpha = 10 \times 10^{-6}/^oC$.	**07**
		OR	
Q.5	[A]	Difference between Flat belt and V-belt. (Write 4 points)	**02**
	[B]	Determine the percentage increase in power capacity made possible in changing over from a flat pulley to a V belt drive. The diameter of the flat pulleys is the same as the pitch circle diameter of the V belt grooved pulleys. The pulley rotates at the same speed as the grooved pulley. The belt materials are the same and they have the same cross sectional area, with coefficient of friction for both as 0.3. The groove angle of the V belt pulley is 60^0 and the angle of contact for both the cases is 150^0.	**08**
Q.6	[A]	Draw the neat sketch of hydraulic press and mention the name of each part.	**03**

	[B]	A hydraulic press for tiles is required to press tiles of 400×400×35 mm thickness. Available fluid pressure is 22 N/mm^2. The maximum force to be applied is 100 kN. Design the ram, cylinder, base plate & supporting column. Assume suitable materials for different parts of Hydraulic press & accordingly select design stresses.	07

Sr.No.	Name of Part	Material	Allowable stress
1	Cylinder	Cast iron	σ_t = 65 N/mm^2
2	Ram	Plain carbon steel	σ_t = 95 N/mm^2
3	Base Plate	Cast iron	σ_c = 215 N/mm^2
4	Supporting column	Alloy steel	σ_t = 137.5 N/mm^2

OR

Q.6	[A]	Difference between open belt drive and cross belt drive. (Write 4 points)	02
	[B]	Design an open belt drive using the manufacture's data to transmit 30kW at 800RPM. The speed reduction desired 3.2:1. The distance between two pulleys is 3.6m. The larger pulley is to have a diameter of 1500mm. Assuming load correction factor of 1.3, arc of contact factor of 1.0335 and for Hi-speed belt, corrected belt rating equal to (0.0118V)/5.08, V in m/s. Find 1) Diameter of motor (driving) pulley 2) Width of belt 3) Length of belt 4) Specify the belt size. Use the following Hi-speed belt data.	08

No. Of ply	Standard belt width, mm
3	32,44,90,100
4	25;32,40,44,50,63,76,90,100,112,125,140,152
5	90,200,224,76,100,112,125,152
6	100,112,125,152,180,200

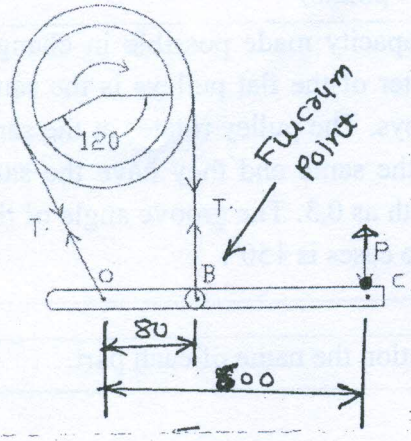


FIGURE : 1

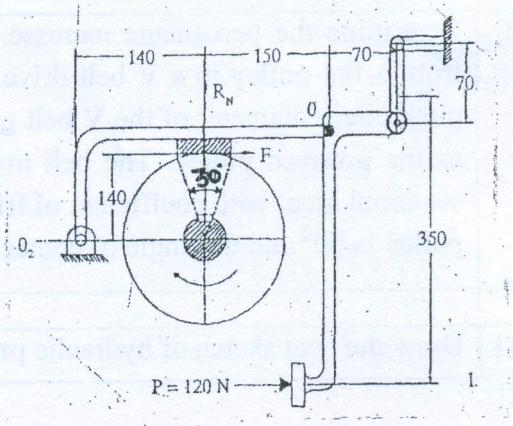


FIGURE : 2

BEST OF LUCK...

KADI SARVA VISHWAVIDYALAYA

B.E SEMESTER V THEORY EXAMINATION (NOV- 2015)

SUBJECT CODE : ME502 SUBJECT NAME : MACHINE DESIGN - I

DATE: 21/11/2015 TIME: 10:30 -1:30 TOTAL MARKS: 70

Instructions:

1. Answer each section in separate Answer Sheet.
2. Use of scientific Calculator is permitted.
3. All questions are compulsory.
4. Indicate **clearly**, the options you attempted along with its respective question number.
5. Use the last page of main supplementary for rough work.

Section - 1

Q.1 (All Compulsory)

(A) Explain following terms for the helical spring 5
Spring index, Solid Length, Spring Rate, Wahls factor

(B) Mention various materials for : Pressure vessels, Bearings, Pulleys, Clutches & Brakes. 5

(C) Explain following terms for Journal Bearing 5
Bearing Characteristic Number, Viscocity Index, Somerfied Number, Bearing Modulus

OR

(C) Which are the qualities of friction lining material used in clutch? Name the friction material used in clutch. 5

Q.2 Answer the following Questions.

(A) Explain Lubricants and properties of lubricants for sliding contact bearing. 5

(B) A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of the weld so that the maximum stress does not exceed 56 MPa. Consider the joint first under static loading and then under fatigue loading. Stress concentration factor for parallel fillet welding is 2.7. 5

OR

(A) 5
Explain the basic procedure of Machine design.

(B) A 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a radial clearance of 0.05 mm and the viscosity of the oil is 0.021 kg / m-s at the operating temperature. If the bearing is capable of dissipating 80 J/s, determine the maximum safe speed. 5

Q.3 Answer the following Questions.

(A) The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 r.p.m. Determine the Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm. 5

(B) What do you meant by Standardization? Explain the use of it in Machine design. 5

OR

(A) Explain Soderberg's diagram with neat sketch. 5

(B) Define Factor of safety, Notch sensitivity & Stress concentration. 5

Section - 2

Q.4 Answer the following Questions.

(A) Classify Pressure vessels & Explain types of stresses induced in it with sketch. 5

(B) Discuss various methods for reducing stress concetration. 5

(C) A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor 5

of 1.65 for fatigue load. Use Goodman straight line as basis for design.

OR

P.T.O.

(C) A Band brake acts on the ¾ th of circumference of a drum of 400 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 200N.m. One end of the band is attached to a fulcrum pin of the lever and outer end to a pin 90 mm from the fulcrum. If the operating force applied at 450 mm from fulcrum and coefficient of friction is 0.2, find the operating force when drum rotates in the anticlockwise direction. If the brake levers and pins are to be made of mild steel having permissible stresses for tension and crushing as 80MPa and Shear 40 MPa. Design shaft , key, lever and pin. The bearing pressure between the pin and lever may be taken as 6 MPa. 5

Q.5 Answer the following Questions.

(A) A cast iron pulley transmits 20 kW at 300 r.p.m. The diameter of pulley is 550 mm and has four straight arms of elliptical cross-section in which the major axis is twice the minor axis. Find the dimensions of the arm if the allowable bending stress is 15 MPa. Mention the plane in which the major axis of the arm should lie. 5

(B) What is a condition for maximum power transmission in the belt drive ?Derive it for maximum power. 5

OR

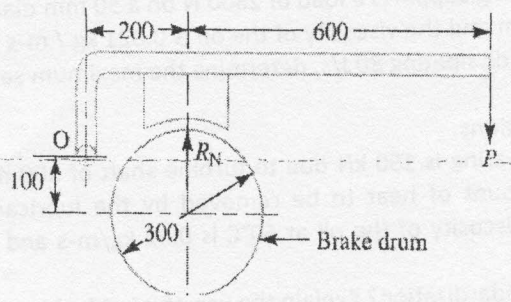
(A) Explain the different types of stresses induced in a belt with neat sketch. 5

(B) A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is 30°. The cross-sectional area of each belt is 750 mm2 and $\mu = 0.12$. The density of the belt material is 1.2 Mg / m3 and the maximum safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 r.p.m. 5

Q.6 Answer the following Questions.

(A) Describe with the help of neat sketch the principle of operation of an internal expanding shoe brake. 5

(B) The block brake, as shown in Fig., provides a braking torque of 360 N-m. The diameter of the brake drum is 300 mm. The coefficient of friction is 0.3. Find The force (P) to be applied at the end of the lever for the clockwise and counter clockwise rotation of the brake drum. 5



All dimensions in mm.

OR

(A) Find the thickness for a tube of internal diameter 100 mm subjected to an internal pressure which is 5/8 of the value of the maximum permissible circumferential stress. Also find the increase in internal diameter of such a tube when the internal pressure is 90 N/mm2. Take E = 205 kN/mm2 and $\mu = 0.29$. Neglect longitudinal strain. 5

(B) A centrifugal clutch is to be designed to transmit 15 kW at 900 r.p.m. The shoes are four in number. The speed at which the engagement begins is 3/4th of the running speed.The inside radius of the pulley rim is 150 mm. The shoes are lined with Ferrodo for which the coefficient of friction may be taken as 0.25. Determine mass of the shoes. 5

---------All the Best --------