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27/11/2017

M.Tech. Mech. Sem I.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.
End Semester Exam
Nov 2017

Q. P. Code:
Duration: 3 Hour
Program: M.Tech
Course Code : MTMD111

Max. Marks: 100
Class: M.Tech(Mechanical) with Machine Design Semester: I
Name of the Course: TRIBOLOGY

Master file.

Instructions:
1. Answer any five questions including Q.No.1 which is compulsory.
2. Assume suitable additional data if necessary and state the same.
3. Use of (1)Machine Design Data Book by V B Bhandari and
(2) List of Formulae and Derivations permitted.

Question No		Max Marks	C O Number	Module No
Q1	Answer any four:- A) Prove that for given dimensions the torque transmitting capacity of Cone Clutch is higher than that of Single Plate Clutch. B) List the basic procedure for selection of rolling contact bearing from the manufacturer's Catalogue. C) Determine the viscosity of lubricant in centi-poise and centi-stokes having viscosity of 200 SUS and specific gravity 0.8. D) State the factors which lead to considerable variation in the wear rate between rubbing surfaces. E) Analysis of Rayleigh step bearing indicates that its load carrying capacity is more than flat tilting pad bearing – Prove the statement. F) Since lubricants are selected to reduce friction and suppress tool wear, what are the considerations in selecting the lubricant for metal working?	20 (5each)	1,2,3	1,2,4,5
Q2.	A)A machine shaft, supported on two identical taper roller bearings A and B , is shown in Fig.1.It is subjected to a radial load of 32 kN and a thrust force of 11 kN. The thrust is taken by bearing A alone. The shaft rotates at 300rpm.The machine is intermittently used and the expected life $L_{10\,h}$ of the bearings is 4000h. The minimum acceptable diameter of the shaft, where the bearings are	12	1	6

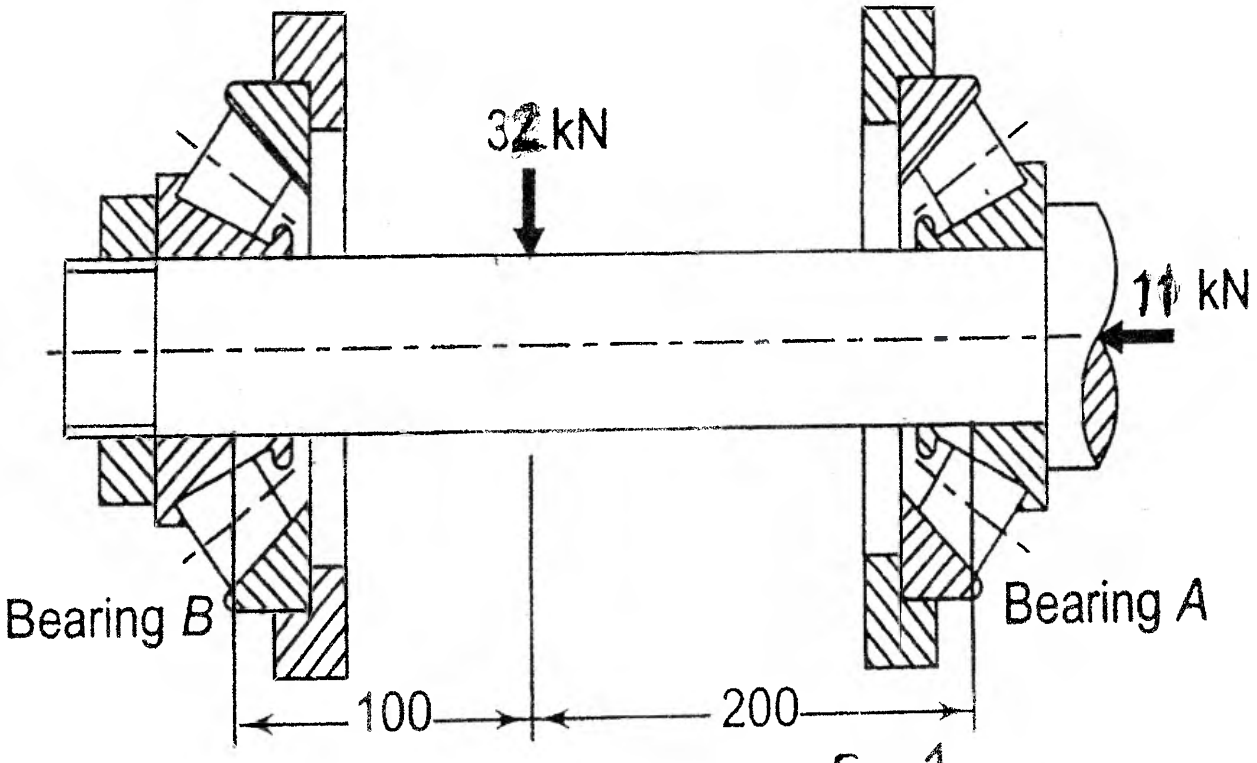
M.Tech. Mech. Sem I

	mounted, is 60mm. Select suitable taper roller bearings for the shaft. B) A four- wheeled automobile car has a total mass of 1000kg. The moment of inertia of each wheel about a transverse axis through its centre of gravity is 0.5 kg-m^2. The rolling radius of the wheel is 0.35m.The rotating and reciprocating parts of the engine and the transmission system are equivalent to a moment of inertia of 2.5 kg-m^2, which rotates at five times the road wheel speed. The car is travelling at a speed of 100 km / h on a plane road. When the brakes are applied, the car decelerates at 0.5g.There are brakes on all four wheels. Calculate: i) The energy absorbed by each brake .ii) The torque capacity of each brake.	08	4	7
Q3	A) The following data is given for the hydrostatic step bearing of a vertical turbo-generator. Thrust load = 450kN ; Shaft diameter = 400mm ;Recess diameter = 250mm ;Shaft speed = 750 rpm ;Viscosity of lubricant = 30cP Draw the effect of film thickness on energy losses in the graph sheet and indicate the optimum film thickness for minimum power loss. Cross check the answer with analytical calculation. B) A 360^0 journal bearing has the following features: a) Ratio of bearing length to journal diameter = 0.5 ; b) Bearing length =25 mm ; c)Radial load = 5kN ; d) Journal speed = 1000rpm ;e) Radial clearance = 0.05mm ; f) Oil viscosity = 30cP Find: i) Friction coefficient : ii) Oil flow : iii) Eccentricity	12 08	2 3	5 3
Q4	A) Explain requirement of gas lubrication. State merits and demerits of gas bearing. B) A rectangular plate having 50mm length and an infinite width is approaching a fixed plane surface. Initially the oil film thickness is 0.035 mm and viscosity of oil is 75 cP. Load supported per unit width of plate is 30kN /m. Calculate: i) The time required to squeeze the film to 0.008mm. ii) The maximum pressure. iii) Average pressure. iv) Load carrying capacity.	08 12	2 1,4	5 4,5

M.Tech. Mech. Sem I.

Q5	A) A hydrodynamic plane slider bearing with fixed shoe is operating under the following conditions. Length of bearing = 300 mm; Length to width ratio =2; Sum of surface roughness for fixed shoe and moving plate = 0.006mm; Minimum oil film thickness = 5(sum of surface roughness) ; Viscosity of oil =30M Pa-s ; Sliding velocity = 150 m/min. Neglect side leakage. Calculate:- B) Maximum load carrying capacity ; ii) Maximum pressure ; iii) Optimum oil-film thickness ; iv) Position of point of application of load ; v) Power lost in friction. ii) The cylinder of a four stroke diesel engine has the following specifications: Brake power =5kW Speed =600 rpm Indicated mean effective pressure =0.5MPa Make suitable assumptions and calculate: i) Bore and length of cylinder liner. ii)Thickness of the cylinder liner. iii)Thickness of the cylinder head.	12 08	1,3 4	3,4 7
Q6	Explain the following:- A) Hydrodynamic lubrication. B) Parameters of bearing design. C) Elastohydrodynamic Lubrication. D)The concept and scope of Surface Engineering	20 (5each)	1,3,4	4,6,7
Q7	A) Explain the factors contributing to the reduction of Adhesive wear, Abrasive wear, Fatigue wear and Erosive wear. B) The Rayleigh step bearing is having the following details. Length of bearing =850mm Width of bearing =250mm; Load on bearing =200kN Sum of surface roughness on contacting surfaces =5μ Minimum oil film thickness =18(Sum of surface roughness value) Sliding velocity =7.5 m/s Calculate: i) Step dimensions B_1 and B_0 ii) Maximum oil film thickness iii) Viscosity of lubricant iv) Maximum pressure at step..	08 12	4 3	6,7 5

M. Tech. Mech. Sem I



Q. No. 2 Fig 1

M.Tech. Machine Design. Sem I.

22/11/17

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END SEM

Nov 2017

Date: 22 Nov 2017

Program: M.Tech Machine Design

Duration: 3 Hours

Course code: MTMD102

Maximum Marks: 100

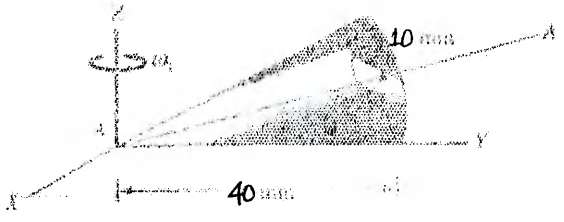
Name of the Course: Machine Dynamics and Advance Vibration

Semester: I

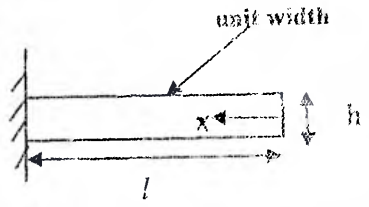
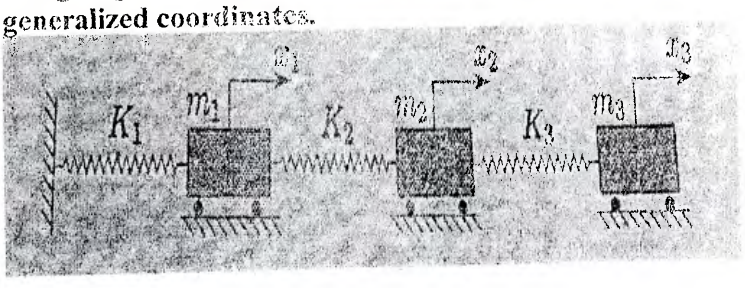
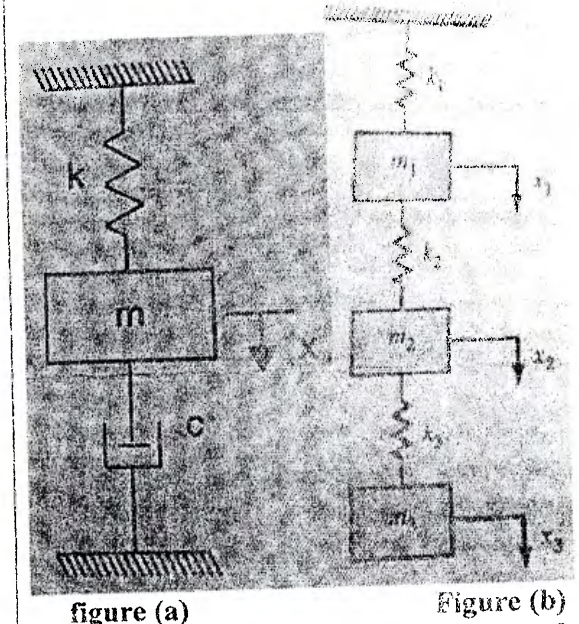
Master file.

Instructions:

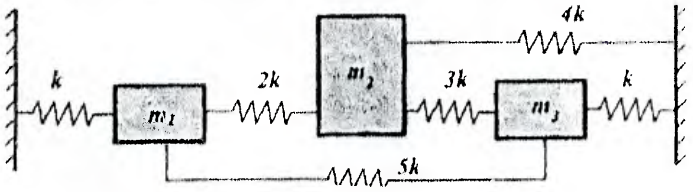
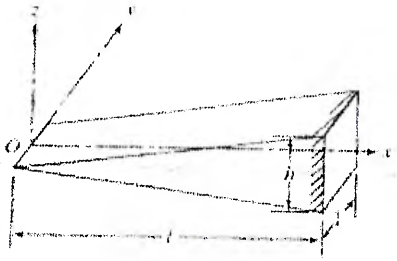
Question no. 1 is compulsory.
Attempt any five questions.
Assume Suitable data if necessary.

Q. No.		Maximum Marks	Course Outcome Number	Module No.
Q1	(a) Derive the equation of motion for torsional vibration of a shaft.	05	02	04
	(b) State the Chasles' theorem for describing the general motion of a rigid body.	03	01	01
	(c)A cone is rolling without slipping such that its centerline rotates at the rate of 5 revolutions per second about the Z-axis. What is the angular velocity ω of the body relative to the ground? What is the angular acceleration vector for the body? 	12	01	01
Q2	(a) Explain the vibration absorber. What do you mean by vibrometer? How would you use it for measuring mechanical vibrations?	08	03	05
	(b)Find fundamental frequency of a transverse vibration of a cantilever beam shown in figure using Rayleigh's method. Use deflection shape $w(x) = (1-x/l)^2$	08	02	04

M.Tech. Machine Design. Sem I

	 (c) Describe the magnification factor. How the magnification factor is related to the frequency ratio?	04	02	03
Q3	(a)Derive the equation of motion for the system shown using Lagrange's equation with x_1, x_2 and x_3 as generalized coordinates. 	12	02	04
	(b) Two cylinders of the same size but different masses roll down an incline, starting from rest. Cylinder A has a greater mass. Which reaches the bottom first? Why? Justify the reason.	08	01	02
Q4	(a) For single degree of freedom vibrating system shown in figure (a), determine the motion of the mass subject to the initial conditions x (0) = 0.15 m and $\dot{x}$ = 0.04 m/s. Given m=1 kg, c= 5 N-s/m and k= 5 N/m. and plot the responses using MATLAB.	10	02	04
	 figure (a) Figure (b) (b) Using Holzer method find the natural frequencies of the system shown in figure (b), assume m_1=m_2=m_3 = 1 kg and k_1 = k_2 = k_3 = 1 N/m. assume the displacement and natural frequency range 0.30 to 2.0	10	02	04

M.Tech. Machine Design. Sem I

Q5	(a) Define stiffness influence coefficient. Find the stiffness coefficient of the spring mass system shown in figure using stiffness influence coefficient method.  	10	02	03
	(b)Find the natural frequencies of the tapered cantilever beam using Rayleigh – Ritz method. Assuming the deflection functions $W_1(x) = (1-x/l)^2$, $W_2(x) = x/l\,(1-x/l)^2$ and $W_3(x) = x^2/l^2(1-x/l)^2$  Figure: tapered cantilever beam	10	04	02
Q6	(a) Find the free vibration response of a two degree of freedom system with equation of motion using modal analysis. $$\begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix}\begin{Bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{Bmatrix} + \begin{bmatrix} k_1+k_2 & -k_2 \\ -k_2 & k_2+k_3 \end{bmatrix}\begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \vec{F} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix} \quad (E.1)$$ Assume the following data $m_1 = 10$, $m_2 = 1$, $k_1 = 30$, $k_2 = 5$, $k_3 = 0$, and $$\vec{x}(0) = \begin{Bmatrix} x_1(0) \\ x_2(0) \end{Bmatrix} = \begin{Bmatrix} 1 \\ 0 \end{Bmatrix}, \qquad \dot{\vec{x}}(0) = \begin{Bmatrix} \dot{x}_1(0) \\ \dot{x}_2(0) \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix} \quad (E.2)$$	10	02	03
	(b) What is critical damping? Elaborate its importance.	03	02	03
	(c) Describe the nonlinear vibration. How is it differ from linear vibration? Explain any two nonlinear vibration systems.	07	04	07
Q7	(a) Plot the variations of natural frequency and the time period with static deflection of an undamped system using MATLAB. Take the range of $\delta_{st}0$ to 0.5	10	03	04
	(b) Write short note on following: 1. Equation of motion for longitudinal vibration in a bar.	05	02	04
	2. Eigen value for MDOF vibration system.	05	02	03

M.Tech. Machine Design - Sem I.

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END-SEM-NOV2017

Program: M. Tech (Machine Design) **Date: 20/11/2017**

Course code/course Name/sem: MTMD101/ Stress Analysis/ I

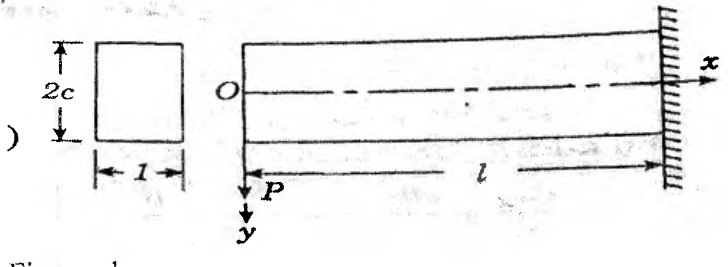
Maximum Marks: 100 **Time: 3hrs**

Note: Master file.

- **Question 1 is compulsory, solve any four of remaining six.**
- **Assume suitable data if necessary**
- **Answer to the sub-questions should be grouped together.**

Q.no.		Max. Marks	Module	COs
1	a) Determine i) deviatoric stress tensor, ii) normal and shearing stresses on octahedral plane, iii) principal stresses and their dcs, iv)plane of maximum shear; for a state of a stress as shown in the adjacent . $\begin{Bmatrix} 70 & -40 & 20 \\ -40 & 10 & 20 \\ 20 & 20 & -20 \end{Bmatrix}$ b) A forged connecting rod made up of SAE4340 having yield strength 410 MPa. A point on this connecting rod is subjected to state of a stress as given above. Find the factor of safety on yield stress.	14 06	1	1
2	a) Derive the following compatibility equation in terms of stress components: $\nabla^2(\sigma_x + \sigma_y) = 0$; Also show that in absence of body forces the above equation is valid for both the 2-D situations i.e. plane stress and plane strain. b) A cantilever beam as shown in fig.1, is subjected to stress function as- $\emptyset = ax^4 + bx^3y + cx^2y^2 + dxy^3 + ey^4$ Obtain the expressions for various stress distribution.	10 10	1,2, 3	1,4
3	a) A cantilever beam of 2.25m length is of rectangular cross-section 60mm x 80mm. It is subjected to end load of 1kN. Calculate the stress distribution at the fixed end. b) Derive the expression for radial and hoop stresses for a solid disc subjected to angular rotation. c) A turbine rotor 50cm external diameter and 20cm internal diameter revolves at 120 rpm. Find the maximum hoop and radial stresses assuming disc to be solid. Given: rotor weight= 7.7 gm/cm^3 and possion's ratio=0.3.	6 8 6	1,2, 3,6	1,4
4	a) For the component subjected to torsion prove that: i. $\frac{\partial^2\emptyset}{\partial x^2} + \frac{\partial^2\emptyset}{\partial y^2} = -2G\theta$ ii. $T = 2\iint \emptyset dxdy$	12	4	1,4

M Tech. Machine Design. Sem I.

	All the terms with their usual meaning and ∅ is Prandtl's stress function. b) A square shaft has 42 mm sides and has same cross sectional area as shafts having circular and equilateral triangle cross section. If each shaft is subjected to a torque of 1kN-m.determine the maximum shearing stresses for each of the three shafts.	08		
5	a) State of a stress at a point is given by, σ_x = 100 MPa, σ_y = -20 MPa, σ_z = -40MPa, $\tau_{xy} = \tau_{xz} = \tau_{zy} = 0$. Determine i) Principal shear strain ii) octahedral shear strain. Take E= 200 GPa. ν=0.25.	06	5	1,4
	b) For a given strain at a point determine stress matrix 0.001 0.001 -0.002 0.001 -0.003 -0.005 -0.002 -0.005 0.002 Take E= 200*10⁶ kPa.; G = 80* 10⁶ kPa	06		
	c) Given the following displacement field: $u_x = 3x^2y + y^2$; $u_y = 3yz + xy$; $u_z = 4xz^2 + 5xy^2$; i. What is the deformation position of a point *P* initially at (2,-1,3)? ii. What is the change in distance between two points after deformation originally at P(1,2,3) and Q(1,-1,2)?	08		
6	a) Classify the strain gauges; what are the characteristics of ideal SG? What is gauge factor? b) Draw the neat sketch of experimental set-up and discuss photo-elastic method of stress analysis. What is isocromatic and iso clinic fringe pattern?	10 10	7	2,3
7	a) Define stress-optic law and derive the expression : $\sigma_1 - \sigma_2 = \frac{f_\sigma N}{h}$ where f_σ = material fringe value, N=fringe order, h= model thickness. b) Write step by step graphical construction for determination of normal and shearing stress on a plane whose direction cosine's are given (3D mohr circle). c) The principal stresses on a plane are: σ_1= 9, σ_2 = 6, σ_3= 3 kPa. Determine normal and shearing stresses on a plane whose direction cosine's are ½, ½ , $1/\sqrt{2}$ by using three dimensional mohr's circle.	10 5 5	7,3	1,2,3, 4
	 Fig. no.1			