16RMED07

विज्ञानं ब्रह्म

श्री माता वैष्णो देवी विश्वविद्यालय

Shri Mata Vaishno Devi University
School of Mechanical Engineering

Minor-I

Subject Code: MEL 2018 **Time : 1 hour**

Subject: Dynamics of Machines **Marks:20**

Note: Solve all the questions.

1. What are the conditions for a body to be in equilibrium under the action of two, three forces and a torque. (4 marks)

2. Figure 1 shows a cam with a reciprocating roller follower system. Various forces acting on the follower are indicated in the figure. At the instant, an external force F_1 of 40 N, a spring force F_2 of 15 N and cam force F_5 of unknown magnitude act on it along the lines of action as shown. F_3 and F_4 are the bearing reactions. Determine the magnitudes of the forces F_3, F_4 and F_5. Assume no friction. (6 marks)

3. A four link mechanism with the following dimension is acted upon by a force 80 N at angle 150^0 on link DC (Figure 2):

AD = 50 mm, AB = 40 mm, BC = 100 mm, DC = 75 mm, DE = 35 mm .

Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration. (10 marks)

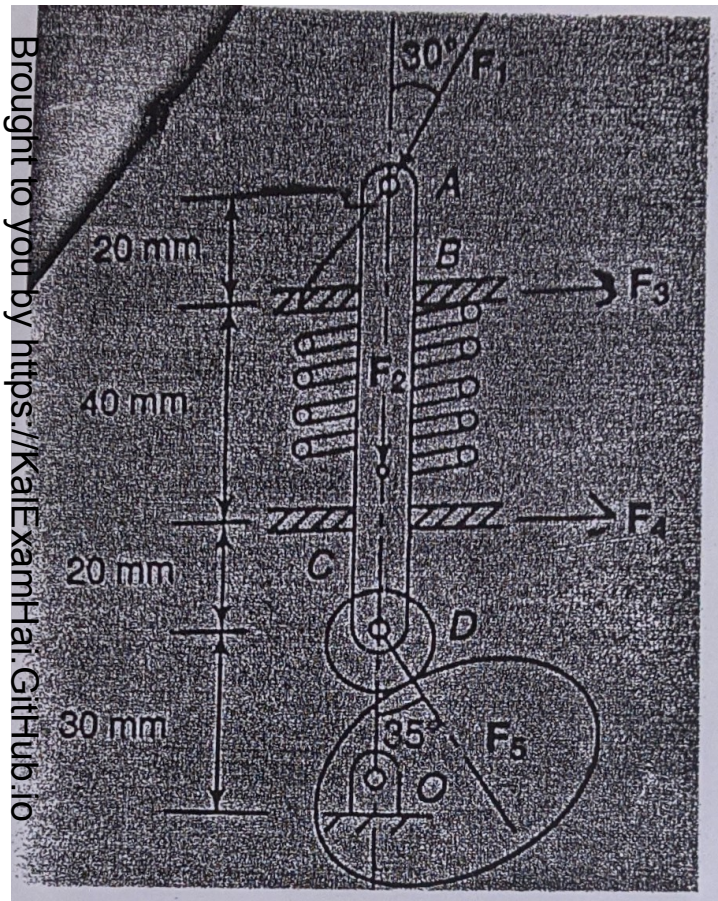

Figure 1

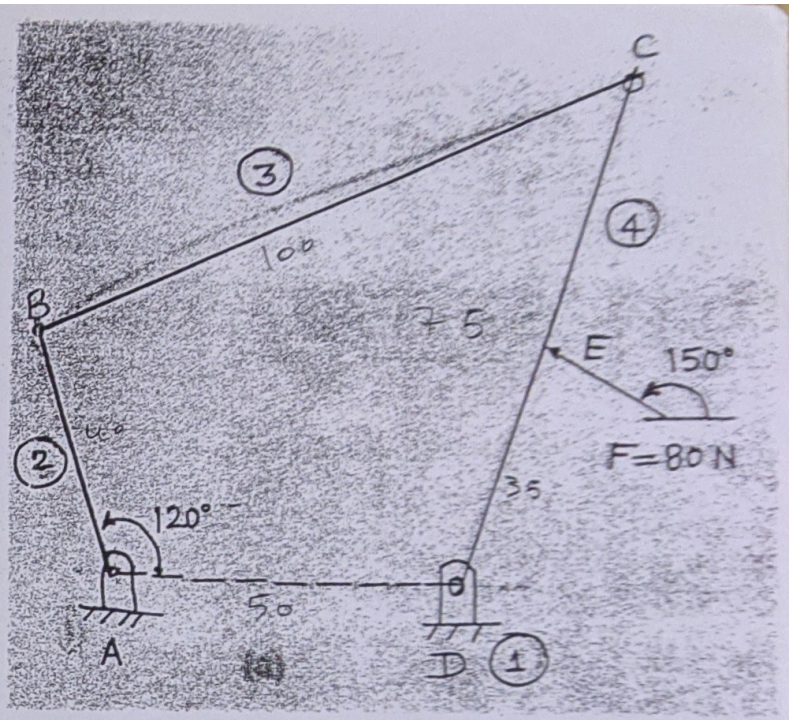

Figure 2

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Department of Mechanical Engineering

Minor-II

Subject code: MEL 2018
Subject: Dynamics of Machines

Time: 1 hour
Marks: 20

1. Explain the method of finding the countermasses in two planes to balance the dynamic unbalance of rotating masses. (4)
2. A circular disc mounted on a shaft carries three attached masses 4 kg, 3 kg and 2.5 kg at radial distance 75 mm, 85 mm and 50 mm and at the angular positions of 45^0, 135^0 and 240^0 respectively. The angular positions are measured counter-clockwise from the reference line along x-axis. Determine the amount of the countermass at a radial distance of 80 mm required for the static balance. (6)
3. The following data relate to a four-link mechanism:

a = 55 mm	m_a = 0.045 kg	g_a = 28 mm	$\varnothing_a = 0^0$
b= 165 mm	m_b = 0.13 kg	g_b = 85 mm	$\varnothing_b = 15^0$
c= 80 mm	m_c = 0.05 kg	g_c = 42 mm	$\varnothing_c = 0^0$
d= 150 mm			

Complete force balancing by adding countermasses to the input and the output links is desired. Determine the mass-distance values and angular position of each counter mass. (6)

4. Deduce expressions for variation in tractive force, swaying couple and hammer blow for an uncoupled two cylinder locomotive engine. (4)

SHRI MATA VAISHNO DEVI UNIVERSITY
Department of Mechanical Engineering

Major

Subject code: MEL 2018 **Time: 3 hour**
Subject: Dynamics of Machines **Marks: 50**

1. The dimensions of a four-link mechanism are: AB = 400 mm, BC = 600 mm, CD=500 mm, AD=900 mm, and <DAB= 60^0. AD is the fixed link. E is a point on link BC such that BE = 400 mm and CE = 300 mm (BEC clockwise).
   A force of 150 <45^0 N acts on DC at a distance of 250 mm from D. Another force of magnitude 100 <180^0 acts at point E. Find the required input torque on link AB for static equilibrium of the mechanism. (8)
2.
   - What are the conditions for a body to be in equilibrium under the action of two forces, three forces and a torque? (3)
   - A circular disc mounted on a shaft carries three attached masses 5 kg, 3 kg and 2.5 kg at radial distance 70 mm, 80 mm and 50 mm and at the angular positions of 45^0, 135^0 and 240^0 respectively. The angular positions are measured counter-clockwise from the reference line along x-axis. Determine the amount of the counter-mass at a radial distance of 100 mm required for the static balance. (5)
3. Deduce expressions for variation in tractive force, swaying couple and hammer blow for an uncoupled two cylinder locomotive engine. Determine the value of tractive force and swaying couple when the lines of stroke of the two cylinders are at 45^0 and 90^0 to each other. (8)
4. Prove that inertia force on the piston, $F_b = mf = mr\omega^2\{\cos\theta + (\cos 2\theta)/n\}$
   Where

θ	=	Crank angle,
m	=	Mass of the reciprocating parts
r	=	Radius of the crank
f	=	Acceleration
n	=	l/r
l	=	length of the connecting rod

5. The following data refer to a two cylinder uncoupled locomotive:

Rotating mass per cylinder	=	280 kg
Reciprocating mass per cylinder	=	300 kg
Distance between wheels	=	1400 mm
Distance between cylinder centre	=	600 mm
Diameter of treads of driving wheels	=	1800 mm
Crank radius	=	300 mm
Radius of centre of balance mass	=	620 mm
Locomotive speed	=	50km/hr
Angle between cylinder cranks	=	90^0
Dead load on each wheel	=	3.5 tonne

   Determine

- the balancing mass required in the planes of driving wheels if whole of the revolving and two-third of the reciprocating mass are to be balanced.
- the swaying couple
- the variation in the tractive force
- the maximum and minimum pressure on the rails (8)

6.

a. Define the terms (4x1=4)
- Pitch circle
- Module
- Velocity ratio
- Free vibration

b. State and derive the law of gearing (3)

c. What is the path of contact? Derive relation for its magnitude. (3)

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Mechanical Engineering

B. Tech. (ME) Minor I Examination (Even) 2018-19

Entry No: 1 7 B M E 0 2 0

Date:

Total Number of Pages: [01]

Total Number of Questions: [04]

Course Title: Dynamics of Machines

Course Code: MEL 2018

Time Allowed: 1.5 Hours **Max Marks: [20]**

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

Section - A			
Q1.	In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead centre. The crank shaft speed is 450 r.p.m. (clockwise). Using analytical method, determine: 1. Velocity and acceleration of the slider, and 2. Angular velocity and angular acceleration of the connecting rod.	[05]	
Q2.	If the crank and the connecting rod are 300 mm and 900 mm long respectively and the crank rotates at a constant speed of 250 r.p.m., determine:1. The crank angle at which the maximum velocity occurs, and 2. Maximum velocity of the piston.	[04]	

Q3.	Four masses A, B, C & D are completely balanced. Masses C & D make angles of 90^0 and 210^0 respectively with B in the same sense. The planes containing B & C are 300 mm apart. Masses A, B, C & D can be assumed to be concentrated at radii of 360, 480, 240 and 300 mm respectively. The masses B, C and D are 20 kg, 20 kg & 18 kg respectively. Determine the (i) mass A and its angular position,(ii) positions of planes A & D.	[05]	
Q4.	Four masses m_1, m_2, m_3 & m_4 are 200 kg, 300 kg, 240 kg & 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m & 0.3 m respectively and the angles between successive masses are 45^0, 75^0 and 135^0. Find the position and magnitude of the balance mass required, if the radius of rotation is 0.2 m.	[06]	

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (ME) Minor II Examination (Even) 2018-19

Entry No: | | | | | | | | 2 | 1 |

Date:

Total Number of Pages: [01]

Total Number of Questions: [03]

Course Title: Dynamics of Machines
Course Code: MEL 2018

Time Allowed: 1.5 Hours **Max Marks: [20]**

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	The cranks and connecting rod of a 4-cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90^0 in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine: (a) Unbalanced primary and secondary forces, if any, and (b) Unbalanced primary and secondary couples with reference to central plane of the engine.	[06]	
Q2.	An inside cylinder locomotive has its cylinder centre lines 0.7 m apart and has a stroke of 0.8 m. The rotating masses per cylinder are equivalent to 150 kg at the crank pin, and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5 m apart. The cranks are at right angles. The whole of the rotating and 2/3 of the reciprocating masses are to be balanced by masses placed at a radius of 0.8 m. Find the magnitude and direction of the balancing masses. Find the fluctuation in rail pressure under one wheel, variation of tractive effort and the magnitude of swaying couple at a crank speed of 350 r.p.m.	[07]	
Q3.	The three cylinders of an air compressor have their axes 120^0 to one another, and their connecting rods are coupled to a single crank. The stroke is 100 mm and the length of each connecting rod is 150 mm. The mass of the reciprocating parts per cylinder is 1.8 kg. Find the maximum primary and secondary forces acting on the frame of the compressor when running at 3000 r.p.m. Describe clearly a method by which such forces may be balanced.	[07]	

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (ME) Major Examination (Even) 2018-19

Entry No: 17BME021

Date:

Total Number of Pages: [01]

Total Number of Questions: [08]

Course Title: Dynamics of Machines

Course Code: MEL 2018

Time Allowed: 3.0 Hours **Max Marks: [20]**

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

Section - A

Q1.	The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60 mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating parts is 1.2 kg. During the expansion stroke when the crank has turned 20° from top dead center, the gas pressure is 850 kN/m². Determine the (i) net force on the piston, (ii) net load on the gudgeon pin, (iii) thrust on the cylinder walls.	[06]	
Q2.	Two 20° gears have module pitch of 2 mm (i.e. number of teeth on gears 1 and 2 are 40 and 24 respectively. If the gear 2 rotates at 600 rpm, determine the velocity of sliding when the contact is at tip of the tooth of gear 2. Take addendum equal to one module. Also, find the maximum velocity of sliding.	[07]	
Q3.	Discuss Interference in Involute Gears	[04]	
Q4.	A gear train in which gears D-E and F-G are compound gears. D gears with A and B; E gears with F; and G gears with C. The numbers of teeth on each gear are A=55, B=120, C=130, D=30, E=70, F=30, G=60. If the wheel A is fixed and the arm makes 70 revolutions clockwise, find the revolutions of B and C. (FIG A)	[07]	
Q5.	The axes of a three-cylinder air compressor are at ~~1200~~ 120° to one another and their connecting rods are coupled to a single crank. The length of each connecting rod is 200 mm and the stroke is 140 mm. The reciprocating parts have a mass of 2.4 kg per cylinder. Determine the primary and secondary forces if the engine runs at 2000 rpm.	[07]	
Q6.	The cranks of a three-cylinder locomotive are set at 120°. The reciprocating masses are 450 kg for the cylinder and 390 kg for each outside cylinder. The pitch of the cylinders is 1.2 m and the stroke of each piston is 500 mm. The planes of rotation of the balance masses are 960 mm from the inside cylinder. If 40% of the reciprocating masses are to be balanced, determine the magnitude and the position of the balancing masses required at a radial distance of 500 mm, and the hammer-blow per wheel when the axel rotates at 350 rpm.	[07]	
Q7.	A 20° involute pinion with 20 teeth drives a gear having 60 teeth. Module is 8 mm and addendum of each gear is 10 mm. 1. State whether interference occurs or not. Give reasons. 2. Find the length of path of approach and arc of approach if the pinion is the driver.	[07]	
Q8.	Explain the types of vibrations	[05]	

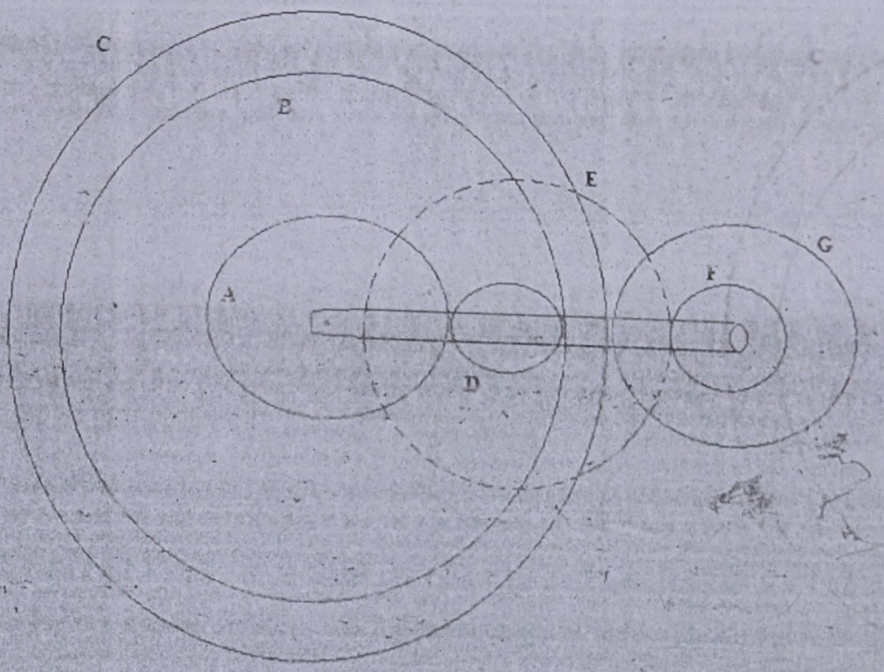

Fig. A