

THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2004/2005
MEX 3230/MED1201– MECHANICS OF MACHINES
DATE :28th MARCH 2006
TIME :0930 HRS - 1230 HRS
DURATION :03 HOURS



WRITE YOUR INDEX NUMBER CLEARLY

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WRITE YOUR REGISTRATION NUMBER

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READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTION PAPER

Part – B

1. Part – B consists of **nine** questions. Answer **only five** questions.
2. All questions carry equal marks.
3. Time allocation for Part B is **2 hrs and 15 minutes**.
4. Do not spend more than **20 – 25 minutes** for each question.
5. Hand over **Part B** separately.

Part – B

Question 01:

- a) Obtain an expression for the path of contact in terms for addendum circle radius, pitch circle radius and pressure angle.
(08 marks)
- b) Two gears having 50 and 60 involute teeth are in mesh. Their pressure angle (Φ) and module (m) are 20° and 10 mm respectively. The line of contact on each side of the pitch point is half the maximum possible length. Find the height of addendum for each gear wheel and the length of the arc of contact.
(12 marks)

Question 02:

A horizontal single cylinder reciprocating engine has a crank **OC** of radius 40 mm and a connecting rod **PC** =140 mm long as shown in Fig.Q1. If the crank rotates at 3000 rev/min clockwise, determine the velocity and the acceleration of the piston.

The sliding piston has a mass of 0.5 kg and a diameter of 80 mm. The gas pressure acting on it is 1.2 MPa for the configuration shown in Fig.Q1. Calculate the effective turning moment acting on the crank. Assume that the connecting rod and crank has negligible inertia and friction.

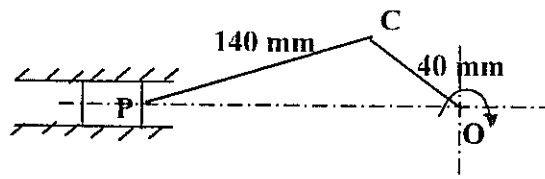


Fig.Q1

(20 marks)

Question 03:

- (a) Explain the following terms
(i) Underdamped
(ii) Critically damped and
(iii) Overdamped

(06 marks)

- (b) The cord can be assumed inextensible in the spring mass pulley system as shown in Fig.Q3. Find the natural frequency of vibration if the mass is displaced slightly and released. Use energy method.

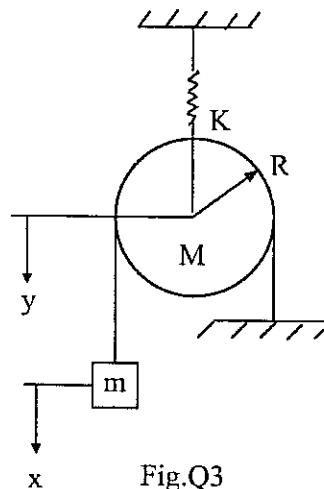


Fig.Q3

(12 marks)

Question 04:

- a) If I is the moment of inertia and Ω is the mean speed of the flywheel, prove that the maximum fluctuation of energy can be expressed as

$$E_{\max} = \frac{K_s I \Omega^2}{100}$$

Where K_s is the coefficient of fluctuation of speed expressed as a percentage.

(08 marks)

- b) A two-stroke twin-cylinder engine is single acting with its cranks set at right angles and it runs at 1500 rev/min. The torque angle diagram is a triangle for the power stroke with a maximum torque of 200 Nm at 60° after dead center of the corresponding crank. The torque on the return stroke is negligible. Sketch the torque-crank angle diagram and hence find

- (i) the power developed
- (ii) the torque on the load

(12 marks)

Question 05:

- a) Write the difference between static balance and dynamic balance.

(05 marks)

- b) A line shaft carries four rotors A , B , C and D each 200 mm apart from one another. Out of balance forces produced by the rotors A , B and C are 600N, 1000N and 500N respectively at the shaft speed of 500 rev/min. If the shaft is dynamically balanced find the directions of the out of balance forces of rotors B , C and D relative to the rotor A . Also determine the magnitude of the out of balance force produced by rotor D .

(15 marks)

Question 06:

- a) Write an expression for the sensitivity of a governor and hence explain **isochronism** of the Porter governor.

(08 marks)

- b) In an engine governor of the Porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the central load is 12 kg, the mass of the each ball is 1 kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 20 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40° , calculate the range of speed of the governor taking friction into account.

(12 marks)

Question 07:

- a) What are the functions of a friction clutch?

(05 marks)

- b) A single plate friction clutch, with two sides of the plate effective, transmits 25kW at 1500 rev/min. The coefficient of friction is 0.3. If there is a uniform plate pressure of $P = 60 \text{ kN/m}^2$, and the inner radius is 0.6 times of the outer radius, calculate the axial force required.

After the clutch has been in use for some time conditions of uniform wear occur. What would then be

- (i) the maximum plate pressure and
(ii) power transmitted due to the application of axial force

(15 marks)

Question 08:

- a) Compare and contrast simple gear trains and epicyclic gear trains. Draw a diagram to illustrate a simple epicyclic gear trains.

(05 marks)

- b)

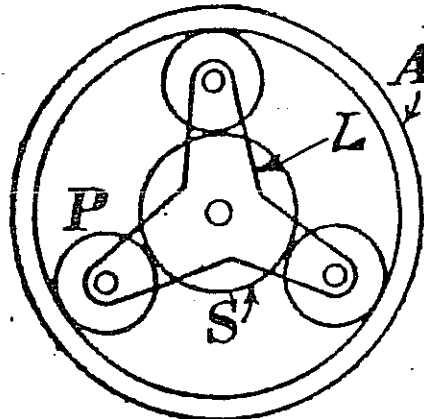


Fig. Q8

In an epicyclic gear of the sun and planet type shown in Fig. Q8, the pitch circle diameter of the annular wheel A is to be nearly 216 mm and the module is 4 mm. When the annular ring is stationary, the spider which carries three planet wheels P of equal size is to make one revolution of the driving spindle carrying the sun wheel S .

Determine the number of teeth for all wheels and the exact diameter of the pitch circle of the angular wheel.

(15 marks)

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