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CBCS SCHEME

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21ME51

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define the following terms :
(i) Mechanism
(ii) Structure
(iii) Degree of freedom
(iv) Kinematic pair
(v) Inversion of mechanism **(10 Marks)**

b. Explain the following inversions of four-bar chain with neat sketches:
(i) Beam Engine
(ii) Coupling rod of a locomotive **(10 Marks)**

OR

2 PQRS is a four bar mechanism with link PS fixed as shown in Fig.Q2. The lengths of the links are PQ = 62.5 mm, QR = 175 mm, RS = 112.5 mm, PS = 200 mm. The crank PQ rotates at 10 rad/sec clockwise. Draw the velocity and acceleration diagrams when angle QPS = 60° and 'Q' and 'R' lie on the same side of PS. Find angular velocity and angular acceleration of links QR and RS.

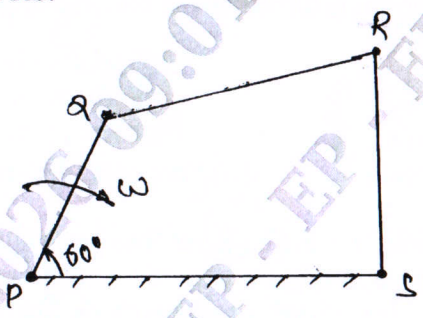

Fig.Q2 **(20 Marks)**

Module-2

3 a. Discuss the conditions for static equilibrium of the following :
i) Two force member
ii) Three force member
iii) Two force and a torque member **(06 Marks)**

b. A four bar mechanism as shown in Fig.Q3(b), is acted upon by a force P = 100$\angle 120^0$ N on link CD. The dimensions of various links are AB = 40 mm, BC = 60 mm, CD = 50 mm, DA = 30 mm and DE = 20 mm. Determine the magnitude and direction of input toque 'T' on the link AB for the static equilibrium of the mechanism. **(14 Marks)**

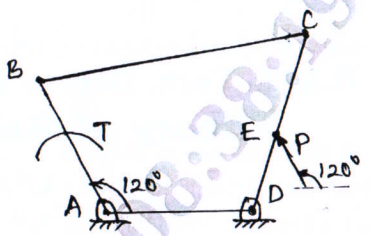

Fig.Q3(b)

OR

4 a. State and explain D' Alembert's principle. **(04 Marks)**

b. A punching machine is operated by an electric motor which supplies a constant torque. The motor delivers 3.68 KW. At the commencement of operation the flywheel of the punching machine has a speed of 300 rpm. The moment of inertia of the flywheel is 60 kg-m^2. Each punching operation requires 5600 N-m of energy and actual punching takes 1 sec. Find:

i) The number of punchings that can be made in an hour.

ii) The reduction in speed after punching is over. **(16 Marks)**

Module-3

5 a. State and prove the law of gearing with neat sketch. **(05 Marks)**

b. The two involute spur gears of 19 and 47 teeth respectively are in mesh. This module is 6.5 mm, pressure angle is 20° and 6.5 mm addendum. Determine the number of pair of teeth in contact and the angle turned by the pinion and gear wheel for one pair of teeth in contact. **(15 Marks)**

OR

6 a. Sketch and explain :

i) Simple gear train ii) Compound gear train. **(06 Marks)**

b. Two shafts 'A' and 'B' are co-axial. The gear 'C' (50 teeth) is rigidly mounted on shaft 'A'. The compound gear D-E gears with 'C' and an internal gear 'G'. 'D' has 20 teeth and gears with 'C' and 'E' has 35 teeth gears with an internal gear 'G'. The gear 'G' is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft 'B' as shown in Fig.Q6(b). Find the number of teeth on internal gear 'G' assuming that all gears have the same module. If the shaft 'A' rotates at 110 rpm. Find the speed of shaft 'B'.

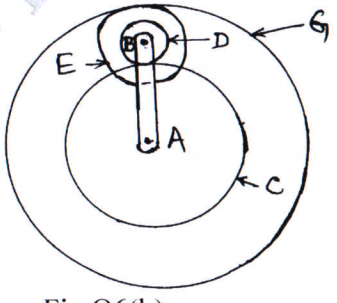

Fig.Q6(b) **(14 Marks)**

Module-4

7 a. Explain Static and Dynamic balancing of rotating masses. **(04 Marks)**

b. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm 60 mm and 80 mm in planes measured from 'A' at 300 mm, 400 mm and 700 mm. The angles between the cranks measured A.C.W are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. **(16 Marks)**

OR

8 a. Explain the balancing of primary and secondary forces in multi-cylinder in-line engines. **(06 Marks)**

b. The arms of a porter governor are each 300 mm long and are pivoted on the governor axis. The mass of each ball is 5 kg and the mass of central sleeve is 15 kg. The radius of rotation of the balls is 200 mm when the sleeve begins to rise and reaches a value of 250 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 30 N of load at the sleeve, determine how the speed range is modified. **(14 Marks)**

Module-5

9 a. Briefly explain the following :
i) Free and forces vibration
ii) Damped and Undamped vibrations
iii) Deterministic and Random vibrations
iv) Longitudinal and Transverse vibrations
v) Torsional and Transient vibrations. **(10 Marks)**

b. Determine the natural frequency of oscillation of the shown in Fig.Q9(b), using energy method.

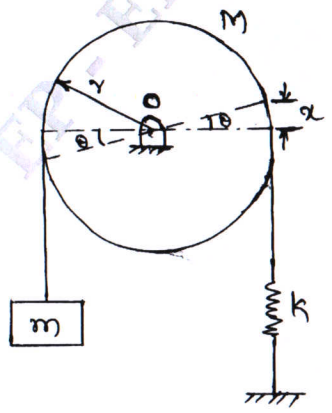

Fig.Q9(b) **(10 Marks)**

OR

10 a. Define Transmissibility and derive an expression for the Transmissibility ratio and the phase angle for transmitted force. **(10 Marks)**

b. A machine of mass one tone is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine
(i) Force transmitted to the foundation
(ii) Amplitude of vibration of the machine
(iii) Phase lag of transmitted for with respect to the external force. **(10 Marks)**

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