CBCS Scheme

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15ME52

Fifth Semester B.E. Degree Examination, June/July 2018
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State the condition for static equilibrium of a body subjected to a system of,
(i) Two forces (ii) Three forces (iii) Member with two forces and a torque. **(06 Marks)**

b. For the mechanism shown in Fig. Q1 (b), find the required input torque for the static equilibrium. The length of OA and AB are 250 mm and 650 mm respectively. F = 500 N. **(10 Marks)**

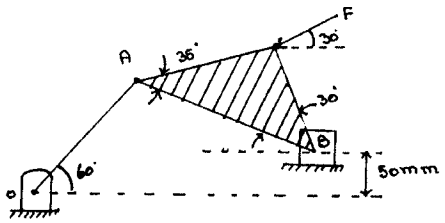

Fig. Q1 (b)

OR

2 a. Explain in brief D'Alembert's principle and state why it is used. **(06 Marks)**

b. In a vertical double acting engine, the connecting rod is 4.5 times the crank. Stroke of the piston is 400 mm and the mass of the reciprocating parts is 100 kg. The engine runs at 250 rpm. If the net load on the piston due to steam pressure is 25 kN when the crank has turned through an angle of 120° from the top dead centre, determine
(i) Piston effort.
(ii) Thrust in the connecting rod
(iii) Pressure on slide bars.
(iv) Crank pin effort
(v) Thrust on crank shaft bearing
(vi) Turning moment on the crank shaft. **(10 Marks)**

Module-2

3 a. Briefly explain the static and dynamic balancing. **(04 Marks)**

b. Four masses A, B, C and D are carried by a rotating shaft at a radii 100 mm, 125 mm, 200 mm and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B,C and D are 10 kg, 5 kg and 4 kg respectively. Find the required mass 'A' and the relative angular positions of the four masses. So that the shaft shall be in complete balance. **(12 Marks)**

OR

4 a. What do you mean by primary and secondary unbalance in reciprocating engines? **(04 Marks)**

b. The Cranks and connecting rod of a 4 cylinder in line engine running at 1800 rpm, are 50 mm, 250 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end and the cranks appear at intervals of 90° in an end view in the order 1 – 4 – 2 – 3. The reciprocating masses corresponding to each cylinder is 1.5 kg. Determine
(i) Unbalanced primary and secondary forces if any.
(ii) Unbalanced primary and secondary couples with reference to central plane of engine. **(12 Marks)**

Module-3

5 a. Derive the expression for speed of a porter governor with usual notations taking friction in to account. **(06 Marks)**

b. In a porter governor, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of central load is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 24 N at the sleeve. If the limiting inclinations of the upper arms to the verticals are 30° and 40°. Find the range of speed taking friction in to account. **(10 Marks)**

OR

6 a. Explain the effect of Gyroscopic couple of a ship under,
(i) Steering (ii) Pitching (iii) Rolling **(08 Marks)**

b. Analyse the stability of a two wheel vehicle turning right. Derive the necessary equation. **(08 Marks)**

Module-4

7 a. Define the following terms:
(i) Simple harmonic motion (ii) Resonance.
(iii) Degrees of freedom (iv) Phase difference. **(04 Marks)**

b. With a neat sketch, explain the beats phenomenon and obtain it's resultant motion. **(06 Marks)**

c. Add the following motions analytically and check the solution graphically,
$x_1 = 2\cos(\omega t + 0.5)$; $x_2 = 5\sin(\omega t + 1.0)$ **(06 Marks)**

OR

8 a. Explain energy method of finding natural frequency of a spring mass system. **(06 Marks)**

b. Find the natural frequency of the system shown in Fig. Q8 (b), by using Newtons method and Energy method. **(10 Marks)**

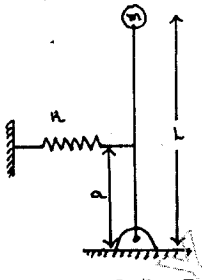

Fig. Q8 (b)

Module-5

9 a. Set up the differential equation for a spring mass Damper system and obtain complete solution for the under damped system. **(10 Marks)**

b. For a spring mass damper system of mass 3.5 kg; spring of stiffness 2.5 N/mm and damping co-efficient of 0.018 N-S/mm. Find
(i) Logarithmic decrement (ii) Ratio of any two successive amplitude
(iii) Number of cycles after which original amplitude reduces to 20%. **(06 Marks)**

OR

10 a. Derive expression for steady state amplitude of vibration of mass in a spring mass damper system, when the mass is subjected to harmonic excitation. Also find phase angle. **(10 Marks)**

b. A pump of 200 kg is driven through a belt by an electric motor at 3000 rpm. The pump is mounted on isolators with total stiffness 5 MN/m and damping 3.125 kN-S/m. Determine the vibratory amplitude of the pump at the running speed due to harmonic force of 1 kN. Also determine maximum amplitude when the pump is switched on and the motor speed passes through resonant condition. **(06 Marks)**

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