No. of Printed Pages : **6+Drawing Sheet** | **BME-020**

BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) (BTMEVI)

Term-End Examination 02571

December, 2012

BME-020 : KINEMATICS & DYNAMICS OF MECHANISMS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any five** questions. Use of **scientific** non-programmable calculator is allowed.*

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1. (a) What do you mean by constrained motion ? Explain constrained motion with the help of neat sketches. Give examples. **4+10**

(b) Determine velocity of point E in a mechanism shown in fig. 1.

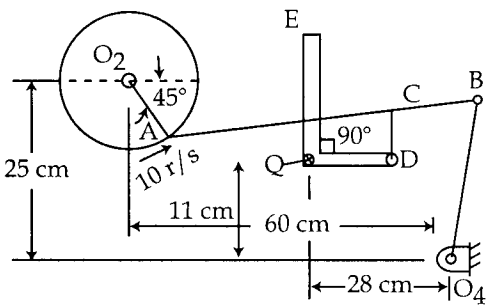

Fig. 1

2. (a) A rigid link AB is rotating in anti - clockwise sense about A with angular velocity 'ω' and angular acceleration 'α'. Determine angular acceleration of point B and middle point of AB. **4+10**

(b) A cam rotating at constant angular velocity operates an oscillating follower. Draw cam profile for the following data :

Angular displacement of the follower	= 20°
Angle for outstroke with SHM	= 90°
Angle of dwell after outstroke	= 45°
Angle for return with uniform acceleration and retardation	= 75 °
Distance between pivot centre and roller centre	= 10.5 cm
Roller radius	= 1.5 cm
Minimum cam radius	= 15 cm
Distance of pivot point from centre of rotation of cam.	= 14 cm

3. (a) Derive the expression for path of contact between two mating spur gears. **6+8**

(b) A single cylinder vertical engine has a bore 35 cm and a stroke of 40 cm. The connecting rod is 110 cm long. Mass of reciprocating parts is 140 kg. At the expansion stroke with Crank at 30° from TDC, the gas pressure is 0.8 MPa. If engine speed is 260 rpm, determine :

(a) the stiffness and initial compression of the spring and

(b) the required initial compression of the spring to give an equilibrium speed at the top most position which is 12 rpm more than that at the lowest position. Neglect effect of obliquity of arms.

8. (a) Explain inversions of single slider crank chain. **4+5+5**

(b) Explain **any two** :

(i) Three position method for synthesis of four bar chain and single slider crank chain.

(ii) Griibler criterion for degrees of freedom of a planar mechanism.

(iii) Field balancing of rotors.

(i) net force at the piston,

(ii) resultant load on the gudgeon pin, and thrust on the cylinder walls.

4. (a) State and prove three centres in - line theorem. Use this theorem to find all the instantaneous centres in a four bar chain having all the four pairs as revolute pairs. 7+7

(b) Fig. 2 shows an indicator mechanism. The bell crank arm is pivoted at O and has mass moment of inertia as I. Find natural frequency of the system.

$k_1 = 30$ N/cm, $k_2 = 40$ N/cm

$k_3 = 15$ N/cm, $a = 20$ cm

$m_1 = 10$ kg, $b = 16$cm

$m_2 = 6$ kg $c = 18$ cm

$I = 630$ gm cm^2.

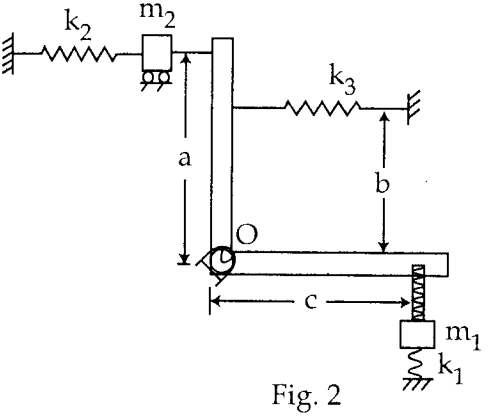

Fig. 2

5. (a) Compare the functions of fly wheel and governor. Give example where these are used. **4+10**

(b) A steam locomotive has two cylinders. The locomotive is uncoupled and cylinders are placed inside at a distance of 675 mm. The crank of each is 435 mm long and they make 90° with each other. The revolving and reciprocating parts with each cylinder weigh 2500 N and 3000 N respectively. The whole of revolving and 2/3 of reciprocating masses are to be balanced by providing balancing masses in planes of rotation of the driving wheels at radius of 800 mm. The driving wheels are 1.95 m in diameter and 1.5 in apart. Find magnitude and position of balancing masses. Also find, maximum hammer blow, variation of tractive effort and swaying couple when speed of locomotive is 96 kmph.

6. (a) Explain Dunkerley's method of determining fundamental frequency. Apply this method for the system shown in fig. 3 for finding fundamental frequency. **6+8**

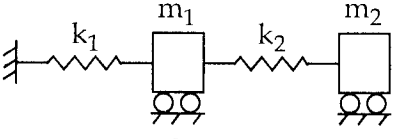

Fig. 3

(b) Fig. 4 shows a gear train in which wheel C is fixed. Gear B is connected to the input shaft and gear F is connected to the output shaft. The arm A, carrying the compound wheels D and E, turns freely on the output shaft. If input shaft speed is 1000 rpm in counter clockwise sense when seen from right, determine speed of the output shaft. The number of teeth are as follows :

$t_b = 20,\ t_d = 60,\ t_e = 30,\ t_c = 80,\ t_f = 32$

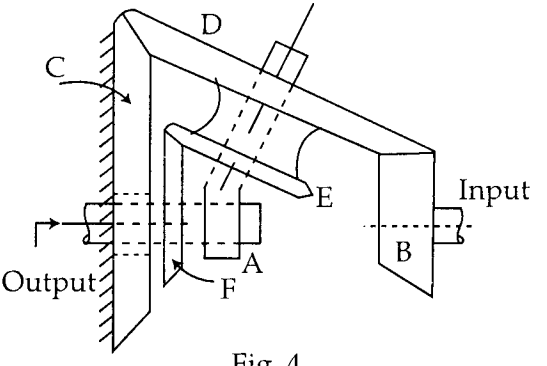

Fig. 4

7. The total sleeve movement in Hartnell governor is 3 cm. The mass of each rotating ball is 1.35 kg. At mid position of the sleeve, the sleeve arm which is 6.25 cm long, is horizontal. The ball arm has a length of 7.5 cm. At mid position of the sleeve, the balls rotate at the radius of 10 cm. Due to mismanagement of the spring, the equilibrium governor speed at the top most position of sleeve is 420 rpm and that corresponding to the lowest position of the sleeve is 435 rpm. Determine : **14**