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Department of Mechanical Engineering

UMT 304: Theory of Machines

Tutorial Sheet No 7

1. Each crank and the connecting rod of a four-crank in-line engine are 200 *mm* and 800 *mm* respectively. The outer cranks are set a 120˚ to each other and each has reciprocating mass of 200 *kg*. The spacing between adjacent planes of cranks are 400 *mm*, 600 *mm* and 500 *mm*. If the engine is in complete primary balance, determine the reciprocating masses of the inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210 rpm.
2. The intermediate cranks of four-cylinder symmetrical engine, which is in complete primary balance, are at 90˚ to each other and each has a reciprocating mass of 400 *kg*. The centre distance between intermediate cranks is 600 *mm* and between extreme cranks, it is 1800 *mm*. Lengths of the connecting rods and the cranks are 900 *mm* and 200 *mm* respectively. Calculate the masses fixed to the extreme cranks with their relative angular positions. Also, find the magnitude of the secondary forces and couples about the centre line of the system if the engine speed is 500 *rpm*.
3. A single-cylinder reciprocating engine has a reciprocating mass of 60 *kg*. The crank rotates at 60 *rpm* and the stroke is 320 *mm*. The mass of the revolving parts at 160 *mm* radius is 40 *kg*. If two-thirds of the reciprocating parts and the whole of the reciprocating parts are to be balanced, determine
    i. Balance mass required at a radius of 350 *mm*
    ii. Unbalanced force when the crank has turned 50˚ from top-dead centre.

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