

| | | | | | | |
|--|---------------|----------------|----------------|--|---------------------------|--|
| Number of units 6 | T 4 | Pr 2 | Th 2 | Number of weekly hours | Annual System 30 weeks | Al-Esra'a University College Department: Engineering of Refrigeration and Air Conditioning Technologies |
| | | | | Theory of Machines and Vibrations | Third stage | |
| Course Objective | | | | | | |
| To develop students' fundamental knowledge and insight into the theory of machines , balancing of rotating masses, theory of gears, governors, cams, belts, free vibrations and damped vibration to be used in machines design . | | | | | | |

| Week | Topic | Lab. Experiment Assignments | Notes |
|-------------|---|------------------------------------|--------------|
| 1 | Introduction and Definition. Graphical Representation of Displacement, velocity and acceleration with respect to time. Solved problems. | Four bar mechanism | |
| 2 | Velocity in mechanisms. | Quick return mechanism | |
| 3 | Solved problems for velocity in mechanisms. Acceleration in mechanisms. | | |
| 4 | Accelerations in slider crank mechanisms. Solved problems for acceleration in mechanisms. | | |
| 5 | Balancing of rotating masses. Balancing of a single rotating mass by a single mass rotating in the same plane. Balancing of a single rotating mass by two masses rotating in different planes. Balancing of several masses rotating in the same plane. (a) Analytical method. (b) Graphical method. | | |
| 6 | Balancing of several masses rotating in different planes. Solved problems. | | |
| 7 | Classification of gears, spur gears, velocity ratio (gear ratio). Center to center distance. | | |
| 8 | Gear trains, velocity ratio of simple gear trains, velocity ratio of compound gear trains, solved problems. | Epicyclic gear train | |
| 9 | Epicyclic gear trains, simple epicyclic gear trains. | | |
| 10 | Compound epicyclic gear trains. | | |
| 11 | Solved problems. | Governors | |
| 12 | Types of governors, watt governor, solved problems. | | |
| 13 | Porter governor: (a) Equilibrium method. (a) Instantaneous center method. Solved problems. | Balancing of rotating masses | |
| 14 | Proell governor, Hartnell governor, solved problems. | | |
| 15 | Types of belts, types of flat belt drive, selection of belt drive. Velocity ratio of open belt drive. Effect of belt thickness on Velocity ratio, slip of the belt. Creep of the belt. | | |

Half-year Break

| | | | |
|----|--|--------------------|--|
| 16 | <p>Velocity ratio of a compound belt drive. Length of belt. (a)Open belt. (b)Cross belt. Ratio of driving tension for flat belts. Determination of angle of contact. (a)Open belt. (b)Cross belt.</p> | | |
| 17 | <p>Power transmitted by a belt. Centrifugal tension (T_c). Maximum tension in the belts (T_{max}). Condition for the Transmission of Maximum Power. Initial tension in the belt (t_0). V – Belt drive and rope drive. Solved problems.</p> | | |
| 18 | <p>Types of brakes. Simple block or shoe brake. (a) Single block or shoe brake. (b) Double block or shoe brake. Band brake: (a) Simple band brake. (b) Differential band brake.</p> | | |
| 19 | <p>Band and block brake. Internal expanding shoe brake. The braking of a vehicle. (a) Value of retardation when the brakes are applied to rear wheels only. (b) Value of retardation when the brakes are applied to front wheels only. (c) Value of retardation when the brakes are applied to all the wheels. Solved problems.</p> | | |
| 20 | <p>Types of followers. Nomenclatures for cam profile. Motions of the follower. (a) Uniform motion or uniform velocity of a follower. Solved problems.</p> | | |
| 21 | <p>(b) Simple harmonic motion of follower. (c) Uniform acceleration and uniform retardation. Solve problems.</p> | | |
| 22 | <p>Cam profile construction. Solve problems.</p> | | |
| 23 | <p>Types of vibration. Important definitions for vibrating motion. Equivalent spring stiffness. Solved problems.</p> | Damped vibration | |
| 24 | <p>Free vibrations. Methods of finding the natural frequency of free. Longitudinal vibrations. (a) Equilibrium method. (b) Energy method. (c) Rayleigh's method. Method for natural frequency of free transverse vibration. Solved problems.</p> | Whirling of shafts | |
| 25 | <p>Natural frequency of transverse vibrations of shafts or Beams under different types of loads and end conditions. (a) Natural frequency of a shaft carrying a single concentrated load. (b) Natural frequency of a shaft carrying a uniformly distributed load. Natural frequency of transverse vibration of a system of several load attached to the same shaft. (a) Energy or (Rayleigh's) method. (b) Dunkerley's method. Solved problems.</p> | Gyroscope | |
| 26 | <p>Whirling speeds or critical speeds. Solved problems.</p> | | |
| 27 | <p>Frequency of free damped vibrations (viscous damping). Solve problems.</p> | | |

| | | | |
|----|--|--|--|
| 28 | Expression for displacement for over-damped, under-damped and critical-damped system. Logarithmic decrement.Solvedproblems. | | |
| 29 | Natural frequency of free torsional vibrations. Free torsional vibrations of a single rotor system. Free torsional vibrations of a two rotor system. | | |
| 30 | Torsional equivalent shaft.Solvedproblems. | | |

Practical Part(Experiments)

| No | Topic |
|----|-------------------------------|
| 1 | Four bar mechanism |
| 2 | Quick return mechanism |
| 3 | Epicyclic gear train |
| 4 | Balancing of rotating masses |
| 5 | Damped vibration |
| 6 | Whirling of shafts |
| 7 | Gyroscope |
| 8 | Governors |
| 9 | Flyweel |
| 10 | Spherical guide cam |
| 11 | V-belt system |
| 12 | Piston- connecting rod system |