

--	--	--	--	--	--	--	--	--	--

Fourth Semester B.E. Degree Examination, June/July 2017

Kinematics of Machines

Time: 3 hrs.

Max. Marks: 80

*Note: 1. Answer FIVE full questions, choosing one full question from each module.
2. In the sketches of mechanisms, clearly distinguish link & construction line.*

Module-1

- 1 a. Define 'kinematic pair' and 'degree of freedom'. Sketch 'spherical pair' and state its degree of freedom. (06 Marks)
- b. Name an exact straight line motion mechanism having only turning pairs. Draw a neat proportionate sketch of the same. State geometric relationships among its links. Indicate the point tracing straight line and prove that the point can trace straight line. (10 Marks)

OR

- 2 a. In a 4-bar mechanism, the lengths of driver crank, coupler and follower link are 150 mm, 250 mm and 300 mm respectively. The fixed link length is L_0 . Find the range of values for L_0 to make it a crank-rocker mechanism. (06 Marks)
- b. Draw a neat proportionate sketch of 'Whitworth mechanism'. Indicate clearly the positions of driver crank corresponding to the extreme positions of shaper tool. (06 Marks)
- c. State an application for the following:
- | | |
|------------------------|----------------------|
| i) Drag link mechanism | ii) Oldham coupling |
| iii) Geneva wheel | iv) Toggle mechanism |
- (04 Marks)

Module-2

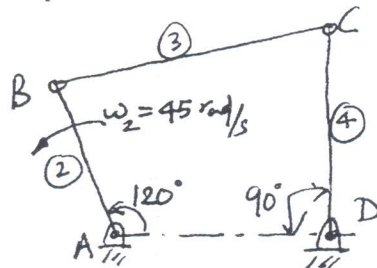
- 3 An IC engine mechanism has crank AB of 0.5m and connecting rod BC of 2m length. Crank AB rotates uniformly at 600 rpm in clockwise direction. When the crank has turned 45° from top dead centre (TDC), find the magnitude and direction of angular acceleration of connecting rod. (16 Marks)

OR

- 4 a. State and prove Kennedy's theorem. (06 Marks)
- b. A slider crank mechanism has crank of length 'r' and connecting rod 'l'. Crank rotates uniformly at ' ω ' rad/s in anticlockwise direction. Crank has moved θ from IDC. Assuming r, l, ω and θ are known, state the procedure of 'Klein's construction' for:
- | | |
|--------------------------|---------------------------|
| i) Velocity analysis and | ii) Acceleration analysis |
|--------------------------|---------------------------|
- (10 Marks)

Module-3

- 5 A four bar mechanism ABCD is shown in Fig.Q5. Find the angular velocities of links 3 and 4 by complex algebra and vector algebra method, if $\omega_2 = 45$ rad/s, counter clockwise, from first principles. (16 Marks)



AB = 100 mm
BC = r_3
CD = 300 mm
AD = 250 mm

Fig.Q5

OR

- 6 Obtain Freudenstein's equation for four bar mechanism. (16 Marks)

Module-4

- 7 a. State law of gearing and define:
 i) Path of contact and
 ii) Arc of contact. (06 Marks)
- b. The number of teeth on each of the two equal spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6 mm. If the length of arc of contact is 1.75 times the circular pitch, find the addendum. (10 Marks)

OR

- 8 An epicyclic gear train has a fixed annular wheel C concentric with sun wheel A. A planet wheel B gears with A and C and can rotate freely on a pin carried by an arm D which rotates about an axis coaxial with that of A and C. If T_1 and T_2 are the numbers of teeth on A and C respectively, show that the ratio of the speeds of D to A is $\frac{T_1}{T_1 + T_2}$. (16 Marks)

Module-5

- 9 Draw the profile of a cam to raise a valve with SHM through 40 mm in $1/4^{\text{th}}$ revolution, keep it fully raised through $1/10^{\text{th}}$ revolution and to lower it with uniform acceleration and retardation in $1/6^{\text{th}}$ revolution. The valve remains closed during the rest of revolution. The diameter of roller is 20 mm and minimum radius of cam is 30 mm. The axis of valve rod passes through the axis of cam shaft. The cam rotates at 360 rpm, clockwise. Find maximum velocity and acceleration during raise and return of follower. (16 Marks)

OR

- 10 A symmetrical cam with convex flanks operates a flat-footed follower. The lift is 8 mm, base circle radius is 25 mm and the nose radius is 12 mm. If the total angle of cam action is 120° , find the radius of the convex flanks. Determine the maximum velocity and the maximum acceleration when the cam shaft rotates at 500 rpm. (16 Marks)

* * * * *

CBCS Scheme

USN

--	--	--	--	--	--	--	--	--	--

15ME43

Fourth Semester B.E. Degree Examination, June/July 2017

Applied Thermodynamics

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.

2. Use of thermodynamic data book is permitted.

Module-1

- 1 a. Obtain air standard efficiency expression for diesel cycle. (08 Marks)
b. The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process the pressure is 1 bar and the temperature is 300 K. The heat transfer to the air per cycle is 1900 kJ/kg of air. Calculate:
i) Pressure and temperature at the end of each process of the cycle.
ii) Thermal efficiency. (08 Marks)

OR

- 2 a. With a neat sketch, explain the working of Ram jet. (06 Marks)
b. In a constant pressure open cycle gas turbine air enters at 1 bar and 20°C, leaves the compressor at 5 bar. Using the following data, temperature of gases entering the turbine = 680°C, pressure loss in the combustion chamber = 0.1 bar, compressor and turbine efficiency = 0.85 and 0.80, $\gamma = 1.4$, $C_p = 1.024$ kJ/kgK for air and gas, combustion chamber efficiency = 85%, find:
i) The quantity of air circulation if the plant develops 1065 kW.
ii) Heat supplied /kg of air circulation.
iii) The thermal efficiency of the cycle. Mass of the fuel may be neglected. (10 Marks)

Module-2

- 3 a. With a schematic diagram, explain the working of regenerative Rankine cycle. Show the process on T-S and H-S diagram. (08 Marks)
b. In a steam power plant operating on ideal Rankine cycle steam enters the turbine at 20 bar with an enthalpy of 3248 kJ/kg and an entropy of 7.127 kJ/kgK. The condenser pressure is 0.1 bar. Find the cycle efficiency and specific steam consumption in kg/kWh. Do not neglect pump work. (08 Marks)

OR

- 4 a. What are the advantages and disadvantages of binary vapour power cycle? (06 Marks)
b. In a reheat cycle, the initial steam pressure and the maximum temperature are 150 bar and 550°C, If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5% and assuming ideal processes, determine: (i) Reheat pressure, (ii) Cycle efficiency, (iii) Steam rate, steam is reheated to 550°C. (10 Marks)

Module-3

- 5 a. Define the following:
i) Stoichiometric air
ii) Enthalpy of formation
iii) Combustion efficiency. (06 Marks)

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.

- b. During a test on a diesel engine the following observations were made. The power developed by the engine is used for driving a DC generator. The output of the generator was, 210 A at 200 V, the efficiency of generator being 82%. The quantity of fuel supplied to the engine was 11.2 kg/h. Calorific value of fuel being 42600 kJ/kg. The air fuel ratio was 18:1. The exhaust gases were passed through an exhaust gas calorimeter for which the observations were as follows, water circulated through exhaust gas calorimeter = 580 lit/h. temperature rise of water through calorimeter = 36°C. Temperature of exhaust gases at exit from calorimeter = 98°C, Ambient temperature = 20°C. Heat lost to jacket cooling water = 32% total heat supplied. Specific heat of exhaust gases = 1.05 kJ/kgK. Calculate BP of the engine, η_{bt} and draw up heat balance sheet on minute basis. (10 Marks)

OR

- 6 a. With a P- θ diagram, explain the stages of combustion in CI engine. (08 Marks)
 b. Benzene C₆H₆ is burnt in air and the analysis of the products of combustion yielded the following results:
 CO₂ = 10.96%, CO = 0.5%, O₂ = 7.5%, N₂ = 81.04%.
 Determine: i) Actual air-fuel ratio on mole basis ; ii) Actual air-fuel ratio on mass basis;
 iii) Percentage excess air. (08 Marks)

Module-4

- 7 a. With a schematic diagram, explain the working of vapour absorption refrigeration system. Show the processes on T-S diagram. (08 Marks)
 b. An air conditioning plant is required to supply 60 m³ of air/minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. (08 Marks)

OR

- 8 a. With a neat sketch explain the working of winter air conditioning system. Show the processes on psychrometric chart. (08 Marks)
 b. An air refrigeration system working on Bell-Coleman cycle with 15 TOR capacity has its pressure range 1 bar to 10 bar. Air enters the compressor at -5°C and enters the expander at 25°C. Assuming isentropic expansion and compression, find COP, air flow rate and power required. (08 Marks)

Module-5

- 9 a. Show that for perfect intercooling, stage pressure ratio remains the same in multistage air compressor and hence prove that $Z = \left(\frac{P_{x+1}}{P_1} \right)^{1/x}$ where z = stage pressure ratio, p₁ = initial pressure, x = number of stages. (09 Marks)
 b. Steam expands from 17 bar and 284°C to 0.7 bar in a convergent-divergent nozzle. Assuming that the expansion is frictionless and the steam discharged is 0.25 kg/s, calculate the diameter of the nozzle, (i) at a point where the pressure is 9.5 bar, (ii) at exit, using H-S chart. (07 Marks)

OR

- 10 a. Briefly explain the different types of flows in a steam nozzle. (09 Marks)
 b. Determine the size of the cylinder of a double acting air compressor of 45kW in which air is taken at 1 atmosphere and compressed to 16 atmospheric pressure according to the law $PV^{1.25} = C$. Assume speed of the crank as 300 rpm, piston speed = 180 m/min. (07 Marks)

* * * * *

CBCS Scheme

USN

--	--	--	--	--	--	--	--	--	--

15ME44

Fourth Semester B.E. Degree Examination, June/July 2017 Fluid Mechanics

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Define compressibility of a fluid. Derive an expression for compressibility of a fluid undergoing isentropic compression. (04 Marks)
- b. A thin horizontal plate of area A is placed midway in a gap of height 'h' between two horizontal plane surfaces. The gap is filled with a liquid of viscosity μ_1 . The plate requires a force F to move with a constant velocity V . The gap is now filled with another liquid of viscosity μ_2 and the same plate is placed at a distance of $h/4$ from one wall and parallel to it. Experiments indicate that for the same velocity V , the force required was same. Prove that $\mu_1 = \frac{4}{3}\mu_2$. (07 Marks)
- c. A U-tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipeline. Its left end is connected to the pipe and the right limb is open to the atmosphere. The centre of the pipe is 100 mm below the level of mercury in the right limb. If the difference of mercury level in the two limbs is 160 mm, determine the absolute pressure of oil in the pipe. Take atmospheric pressure = 100 kPa. (05 Marks)

OR

- 2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. (08 Marks)
- b. A wooden cylinder of specific gravity 0.6 and circular in cross section is required to float in oil of specific gravity 0.9. Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of the cylinder and D is its diameter. (08 Marks)

Module-2

- 3 a. Derive the continuity equation in three dimensional Cartesian coordinates for a steady incompressible flow. (06 Marks)
- b. Write the expressions for acceleration of a fluid in x , y and z directions. Differentiate between local and convective acceleration. (05 Marks)
- c. The velocity potential function ϕ is given by an expression $\phi = -2\ln(x^2 + y^2)$. Show that it represents a possible case of fluid flow. (05 Marks)

OR

- 4 a. Derive an expression for discharge through a triangular notch. (06 Marks)
- b. A pump has tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.2m and 0.6m respectively. The pressure at the upper end is 240 mm of Hg vacuum, while the pressure at the lower end is 15 kN/m^2 . Assume the head loss to be 20% of the difference in the velocity head. Calculate the discharge. The flow is vertically upwards. The difference of elevation is 3.95 m. (10 Marks)

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-3

- 5 a. Prove that the velocity distribution across a cross section of a circular pipe during viscous fluid flow is parabolic in nature. Also show that the maximum velocity is in the centre of the pipe and is equal to twice the average velocity. (10 Marks)
- b. Water at 15°C flows between two parallel plates at a distance of 1.6 mm apart. Determine:
- Maximum velocity
 - Pressure loss per unit length
 - Shear stress at the plate if the average velocity is 0.2 m/s. Viscosity of water at 15°C is 0.01 poise. Take unit width of the plate. (06 Marks)

OR

- 6 a. Derive Darcy-Weisbach equation for determining loss of head due to friction in a pipe. (08 Marks)
- b. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/s. Find the head loss due to friction and power required to maintain the flow for a length of 1000 m. Take kinematic viscosity of oil = 0.29 stokes. (08 Marks)

Module-4

- 7 a. What is the meaning of boundary layer separation? What is the effect of pressure gradient on boundary layer separation? (08 Marks)
- b. Using Rayleigh's method, show that the power P developed by a hydraulic turbine is given by $P = \rho N^3 D^5 \phi \left[\frac{N^2 D^2}{gH} \right]$, where ρ = density of liquid, N = rotational speed of turbine in rpm, D = diameter of the runner, H = working head, g = gravitational acceleration. (08 Marks)

OR

- 8 a. The rate of discharge Q of a centrifugal pump is dependent upon density of the fluid ρ , pump speed N in rpm, diameter of the impeller D, pressure P, viscosity of the fluid μ . Using Buckingham's π -theorem method, show that $Q = ND^3 \phi \left[\frac{P}{\rho N^2 D^2}, \frac{\mu}{\rho ND^2} \right]$. (08 Marks)
- b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal. The pull on the string is 24.525 N when the wind is flowing at a speed of 30 km/hr. find the corresponding coefficient of drag and lift. Take density of air = 1.25 kg/m³. (08 Marks)

Module-5

- 9 a. Show that the velocity of a sound wave in a compressible fluid medium is given by $c = \sqrt{\frac{k}{\rho}}$ where k and ρ are bulk modulus of elasticity and density of the fluid respectively. (08 Marks)
- b. Calculate the velocity and mach number of a supersonic aircraft flying at an altitude of 1000 m where the temperature is 280 K. Sound of the aircraft is heard 2.15 seconds after the passage of the aircraft on the head of an observer. Take $\gamma = 1.41$ and R = 287 J/kgK. (08 Marks)

OR

- 10 a. Define stagnation temperature of a fluid. Show that the stagnation temperature and static temperatures are related by $\frac{T_0}{T} = 1 + \left(\frac{\gamma - 1}{2} \right) m^2$ where γ = ratio of specific heats, m = mach number. (08 Marks)
- b. Mention the applications and limitations of computational fluid dynamics. (08 Marks)

CBCS Scheme

USN

--	--	--	--	--	--	--	--	--	--

15ME45A

Fourth Semester B.E. Degree Examination, June/July 2017

Metal Casting and Welding

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. List and briefly explain the steps involved in making sand casting. (08 Marks)
b. Explain in detail various allowance given to pattern and reasons to provide the allowance. (08 Marks)

OR

- 2 a. List the types of moulding sand. Briefly explain the properties of moulding sand. (08 Marks)
b. With a neat sketch, explain the working principle of Jolt and Squeeze machine. (08 Marks)

Module-2

- 3 a. With a neat sketch, explain the different zones present in CUPOLA FURNACE. (08 Marks)
b. How do you classify the melting furnace? Draw a neat sketch and explain the working of gas fired pit furnace. (08 Marks)

OR

- 4 a. What is die casting? Draw a neat sketch and explain the Hot chamber die casting process. (08 Marks)
b. With a neat sketch, explain centrifugal casting process. Mention merits and demerits. (08 Marks)

Module-3

- 5 a. What is nucleation? Explain types of nucleation with neat sketches. (08 Marks)
b. What is degasification in liquid metals? Mention the methods explain any one. (08 Marks)

OR

- 6 a. What is Fettling? Mention the steps involved in Fettling. Explain with sketch of any two casting defects. (08 Marks)
b. With a neat sketch, explain the principle of lift-out crucible furnace. (08 Marks)

Module-4

- 7 a. Sketch and explain TIG welding process. Mention its advantages and disadvantages. (08 Marks)
b. Explain with a neat sketch, atomic hydrogen welding. (08 Marks)

OR

- 8 a. With a neat sketch, explain LASER beam welding and mention its advantages, disadvantages and limitations. (08 Marks)
b. Sketch and explain seam welding. Mention advantages, disadvantages and applications. (08 Marks)

Module-5

- 9 a. What is heat affected zone (HAZ)? Explain the parameters affecting HAZ. (08 Marks)
b. Write short notes on: i) Welding defects, ii) Residual stresses. (08 Marks)

OR

- 10 a. With neat sketch, explain Oxy-acetylene welding process. (08 Marks)
b. What are different non-destructive testing (NDT) methods and explain with a neat sketch ultrasonic inspection method. (08 Marks)

* * * * *

CBCS Scheme

USN

--	--	--	--	--	--	--	--	--	--	--

15ME46B

Fourth Semester B.E. Degree Examination, June/July 2017 Mechanical Measurements and Metrology

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Explain with a sketch, the international prototype meter. (08 Marks)
b. Briefly explain: i) Wringing procedure ii) Principle of sine bar. (08 Marks)

OR

- 2 a. Explain the principle of Auto-collimeter with a neat sketch and list advantages of wavelength standards. (08 Marks)
b. Show the arrangement of minimum angle gauges required to obtain the following angles.
i) $32^{\circ}36'24''$ ii) $122^{\circ}30'0''$ (08 Marks)

Module-2

- 3 a. Define the terms : i) Limits ii) Fits iii) Tolerance. (06 Marks)
b. Illustrate the following types of gauges
i) Snap gauge ii) Ring gauge iii) Plain plug gauge. (10 Marks)

OR

- 4 a. Explain with a neat sketch, the working of SOLEX COMPARATOR. (08 Marks)
b. Differentiate measuring instruments, gauges and comparators. (08 Marks)

Module-3

- 5 a. With the setup, explain how effective diameter of a screw thread is measured using 3 wire method. (08 Marks)
b. Describe constant chord method to find tooth thickness. (08 Marks)

OR

- 6 a. List the advantages of Lasers and explain in detail any one laser interferometer. (08 Marks)
b. Sketch and explain a CMM. What are the various applications of CMM? (08 Marks)

Module-4

- 7 a. Briefly explain the following terms:
i) System response and time delay ii) Accuracy and error iii) Repeatability (08 Marks)
b. What is the necessity of modifying devices? Enlist the advantages of electrical modifying devices. (08 Marks)

OR

- 8 a. Explain with a neat sketch Ballast circuit. (06 Marks)
b. What are terminating devices? Explain in detail oscillograph. (10 Marks)

Module-5

- 9 a. Explain the working of Pirani gauge with a neat sketch. (08 Marks)
b. Explain with neat sketch Analytical Balance to measure unknown faces. (08 Marks)

OR

- 10 a. What is a thermocouple? Explain the Law's of thermocouple. (08 Marks)
b. Sketch and explain total Radiation pyrometers. (08 Marks)

* * * * *

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.