CBCS SCHEME

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15ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Define the following with an example for each :
i) Flexible link ii) Spherical pair iii) Successfully constrained pair
iv) Quick return motion. **(04 Marks)**

b. Determine the DOF of : i) Toggle mechanism ii) Robert's mechanism. **(04 Marks)**

c. With a neat sketch, explain Whitworth Quick Return Motion Mechanism. **(08 Marks)**

2 a. State Grashoff's criterion and explain the inversions of Grashoff's chain. **(04 Marks)**

b. Derive and state condition for Correct steering. **(04 Marks)**

c. With a neat sketch, explain Oldham's coupling. **(08 Marks)**

3 Fig. Q3, shows a mechanism in which dimensions of various links are as follows :
OP = RS = 50mm , PQ = QS = 450mm.
The uniform speed of crank OP is 180 rpm. Determine angular velocity of QS and rubbing velocity at the pin Q which is 60mm in diameter. Also find angular acceleration of QS, velocity of R. **(16 Marks)**

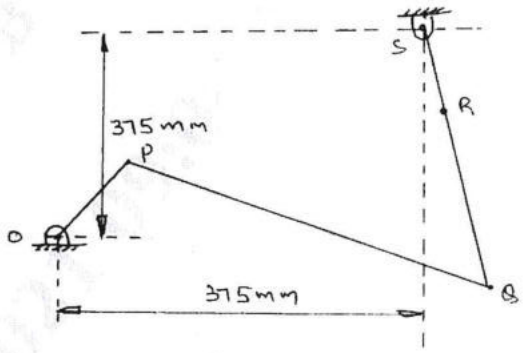

Fig. Q3

4 a. Determine the Instantaneous centres for the mechanisms shown below in Fig. Q4(a)(i) & (ii)

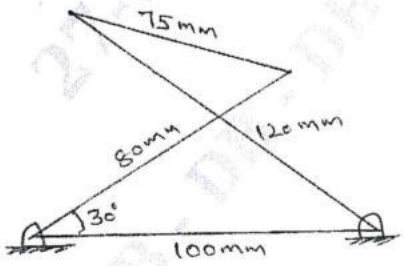

Fig. Q4(a)(i)

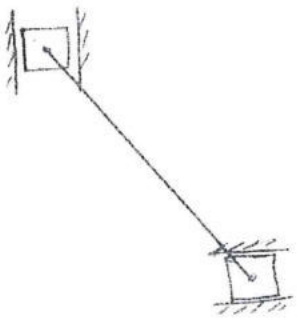

Fig. Q4(a)(ii) **(06 Marks)**

b. Find the velocity of point 'C' of the mechanism shown in the Fig. Q4(b). The link P, A is 100 rpm.

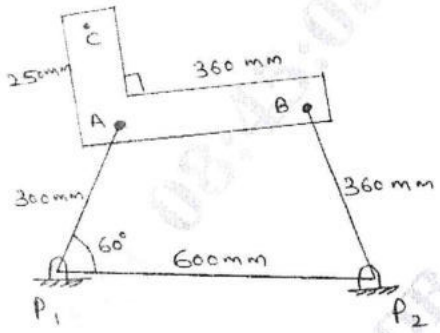

Fig. Q4(b) **(10 Marks)**

5 In an IC Engine Mechanism, Crank radius is 50mm and connecting rod length is 200mm. The crank is rotating at 100 rad/s CW. At a particular instant the crank is at 40^0 from TDC position. For this position of the mechanism , find out the velocity of piston using Complex Algebra method. **(16 Marks)**

6 Design a four bar mechanism to co-ordinate 3 positions of the input and output links as follows. Using Freudenstein's equation.

	1	2	3
θ	20^0	35^0	50^0
ϕ	35^0	45^0	60^0

Draw the mechanism in second position. **(16 Marks)**

7 a. Define the following with respect to gear : i) Law of gearing ii) Pressure angle iii) Involute profile iv) Interference v) Module. **(05 Marks)**

b. Two 20^0 pressure angle involute gears in mesh have a module of 10mm. The addendum is one module. The large gear has 50 teeth and the pinion 13 teeth.

i) Does interference occur?

ii) If yes, to what value should the pressure angle be changed to eliminate interference? **(11 Marks)**

8 An epicyclic gear train is shown in Fig. Q8, wheel D is held stationary by the shaft A and arm B rotates at 200 rpm. The wheel E (20 teeth) and F (40 teeth) are fixed together and rotate freely on a pin carried by the arm. The wheel G(30 teeth) is mounted on shaft C. Find the speed of shaft C, stating the direction of rotation relative to that of B. If the gearing transmits 7.5 kw, what is the holding torque on shaft A? **(16 Marks)**

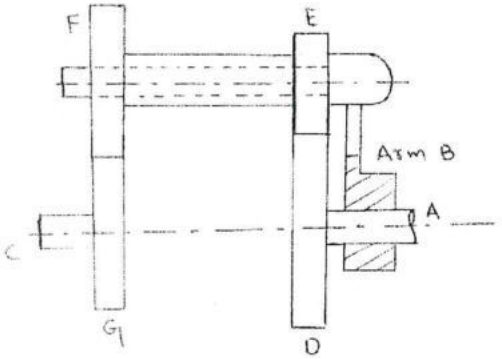

Fig. Q8

9 A cam operates an offset roller follower. The least radius of the cam is 30mm, roller diameter is 30mm and offset is 20mm, the cam rotates at 360 rpm. The angle of ascent is 48^0, angle of dwell is 42^0 and angle of descent is 60^0. The motion is to be SHM during ascent and uniform acceleration and deceleration during descent. Draw the cam profile. **(16 Marks)**

10 A circular arc cam drives a flat faced follower. The base circle radius is 40mm and nose radius is 10mm. If the total angle of action is 120^0 and the total lift of the follower is 20mm, find

i) Maximum velocity and acceleration.

ii) Maximum retardation of the follower when the cam rotates at 600 rpm. **(16 Marks)**

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CBCS SCHEME

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15ME43

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of thermodynamic data hand book permitted.***
3. ***Draw neat sketches, wherever necessary.***

1 a. Compare Otto, Diesel and Dual cycles for the same compression ratio and heat addition. Use P-V and T-S diagrams. **(06 Marks)**

b. What is an "Air Standard Cycle"? why are such cycles conceived? **(02 Marks)**

c. An engine working on the Otto cycle has an air standard efficiency of 56% and rejects 544 kJ/kg of heat. The pressure and temperature of air at the beginning of compression are 0.1 MPa and 60°C respectively. Compute
(i) Compression ratio of the engine.
(ii) Work done per kg of air.
(iii) Pressure and temperature at the end of compression.
(iv) Maximum pressure of the cycle. **(08 Marks)**

2 a. Discuss the various methods employed to improve the thermal efficiency of an open cycle G.T. Plant. **(09 Marks)**

b. A simple Gas turbine unit consists of single stage compressor, regenerator, combustion chamber and single stage turbine. The initial pressure and temperature are 1.03 bar and 15.5°C. The pressure ratio of the cycle is 5. The maximum temperature of the cycle is limited to 813 K. The isentropic efficiency of the compressor and turbine are 85% and 80% respectively. Take C_P = 1 kJ/kgK and γ = 1.4 for air and gases and find the air flow rate through the plant. If the power output of the turbine is 1560 kW. Neglect the mass of fuel. Take effectiveness of regenerator = 0.85. Compute the thermal efficiency of the plant. **(07 Marks)**

3 a. Compare Carnot and Rankine cycles for a steam power plant. Enumerate the importance of mean temperature of heat addition and explain the various methods employed to increase the mean temperature of heat addition. **(08 Marks)**

b. In a reheat cycle, steam at 500°C expands in a HP turbine till it is saturated vapor. It is reheated at constant pressure to 400°C and then expands in a L.P. turbine to 40°C. If the maximum moisture content at the exhaust of the turbine is limited to 15% find (i) The reheat pressure (ii) Pressure at the inlet of the HP turbine. (iii) Net specific work output (iv) the efficiency (v) The steam rate
Assume all ideal processes. Use Mollier diagram. **(08 Marks)**

4 a. Obtain an expression for the thermal efficiency of a Regenerative Rankine cycle with single open heater. Obtain an expression for mass of steam bled. **(06 Marks)**

b. Discuss how of 'diminishing returns' with regard to efficiency of regenerative rankine cycle with 'n' heaters. **(04 Marks)**

c. A regenerative cycle operates with steam supplied at 30 bar and 300°C and condenser pressure of 0.08 bar. The extraction points for two heaters (open type) are at 3.5 bar and 0.7 bar respectively. Calculate thermal efficiency. Neglect pump work. Use Mollier diagram. **(06 Marks)**

5 a. Define (i) Stoichiometric air (ii) Excess air (iii) Enthalpy of formation (iv) Combustion efficiency. **(06 Marks)**

b. With a neat sketch, explain the working principle of an Orsat apparatus. **(05 Marks)**

c. An S.I. Engine uses a hydrocarbon fuel of unknown composition and the volumetric analysis of the exhaust gas gives the following :
CO_2 – 14.4%, CO – 0.4%, O_2 – 5.5%, N_2 – 79.7%
Calculate on mass basis.
(i) Percentage theoretical air.
(ii) Air fuel ratio (actual)
(iii) Composition of the fuel on mass basis. **(05 Marks)**

6 a. Discuss the Willan's line methods employed to determine the fictional power of an I.C. Engine. **(04 Marks)**

b. With a P-θ diagram, explain the combustion phenomenon in C.I. Engines. **(06 Marks)**

c. The following data is from a trial on a 4-cylinder, 4-stroke petrol engine which is coupled to a hydraulic dynamometer at constant speed and full throttle:
B.P with all cylinders working : 14.7 kW
B.P with cylinder 1 cutoff : 10.4 kW
B.P with cylinder 2 cutoff : 10.3 kW
B.P. with cylinder 3 cutout : 10.4 kW
B.P. with cylinder 4 cutout : 10.2 kW
Petrol used = 5.44 kg/h, C.V. of the fuel = 42000 kJ/kg
Diameter and stroke of piston : 8 cm and 10 cms respectively,
Clearance volume = 100 cm^3
Find (i) the mechanical efficiency (ii) Relative efficiency on IP basis. **(06 Marks)**

7 a. Explain the following terms with regard to refrigeration :
(i) Refrigeration effect
(ii) Unit of refrigeration
(iii) Desirable properties of a refrigerant. **(06 Marks)**

b. A E12 vapor compression refrigeration system has a conducting temperature of 50°C and evaporating temperature of 0°C. The refrigeration capacity is 7 tons. The vapor leaving the evaporator is saturated and the liquid leaving the condenser is also saturated. Assuming isentropic compression. Determine
(i) Flow rate of refrigerant.
(ii) Power required to run the compressor.
(iii) Heat rejected in the plant.
(iv) COP of the system.
Use the following properties :

Temp °C	Pressure bar	h_f kJ/kg	h_g kJ/kg	S_f kJ/kg K	S_g kJ/kg K
50	12.199	84.864	206.298	03.34	0.6792
0	3.086	36.022	187.397	0.1418	0.696

(07 Marks)

c. Give a case study on Cold storage. **(03 Marks)**

8 a. Explain the following terms with regard to air conditioning :
   (i) Dry air
   (ii) Specific humidity
   (iii) Humidity ratio
   (iv) Degree of saturation. **(08 Marks)**

b. The Sling psychrometer reads 40°C DBT and 28°WBT. Calculate :
   (i) Specific humidity
   (ii) Vapor density of an air.
   (iii) Dew point temperature
   (iv) Enthalpy of the mixture per kg of dry air.

   Assume atmospheric pressure to be 1.03 bar. **(08 Marks)**

9 a. Derive an expression for minimum work of compression for a 2-stage reciprocating air compressor with perfect intercooling. **(08 Marks)**

b. A three stage compressor is used to compress H_2 from 1.04 bar to 35 bar. The compression in all stages follows the law $PV^{1.25} = C$. The temperature at the inlet of compressor is 288 K. Neglecting clearance and assuming perfect inter cooling find the power required to drive the compressor in kW to deliver 14 m^3/min of H_2 measured at inlet conditions. Also find the intermediate pressures. **(08 Marks)**

10 a. Derive an expression for optimum pressure ratio for maximum discharge and further obtain an expression for maximum discharge. **(07 Marks)**

b. What do you understand by super saturated or metastable flow in nozzles? **(04 Marks)**

c. The inlet conditions of steam to a convergent – divergent nozzle is 2.2 MN/m^2 and 260°C. The exit pressure is 0.4 MN/m^2. Assuming frictionless flow upto the throat and a nozzle efficiency of 85 percent, determine (i) the flow rate for a throat area of 32.2 cm^2 (ii) exit area. **(05 Marks)**

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CBCS SCHEME

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15ME44

Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. What is surface tension? Derive equation of intensity of pressure for (i) Droplet (ii) Bubble. **(05 Marks)**

b. Briefly explain U-tube differential manometer. Derive the expression for pressure difference at two points using U-tube differential manometer. **(06 Marks)**

c. A tank contains water upto a depth of 2m and above it an oil of specific gravity 0.9 for a depth of 1m. Find the pressure intensity:
(i) at the interface of two liquids (ii) at the bottom of the tank. **(05 Marks)**

2 a. Briefly explain the conditions of equilibrium of a floating body. **(04 Marks)**

b. A circular plate 3.0 m diameter having a concentric circular hole of diameter 1.5 m is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5 m respectively. Determine the total pressure and position of centre of pressure on one face of the plate. **(05 Marks)**

c. Derive an expression for metacentric height analytically. **(07 Marks)**

3 a. Briefly explain different types of fluid flow. **(05 Marks)**

b. Derive expression for continuity equation for three dimensional flow in Cartesian coordinates. **(05 Marks)**

c. A stream function is given by $\psi = 3xy$, determine:
(i) Whether flow is possible
(ii) Whether flow is rotational or irrotational
(iii) Acceleration components at a point (1, 1) **(06 Marks)**

4 a. Derive Bernoullis equation from first principle. **(08 Marks)**

b. A horizontal venturimeter with inlet and throat diameters of 300 mm and 100 mm respectively is used to measure the discharge of water. The intensity of pressure is 130 kN/m^2 at inlet section whereas the vacuum pressure head at throat is 350 mm of mercury. Assuming that the 3% of head is lost between the inlet and throat, find the value of coefficient of discharge [C_d], and the amount of discharge. **(08 Marks)**

5 a. An oil of viscosity 0.1 Pa.S and relative density is 0.9 flows between two parallel plates 25 mm apart with a mean velocity of 1.8 m/sec. Determine:
(i) Maximum velocity
(ii) Shear stress at the boundary
(iii) Loss of head in a distance of 10 m
(iv) Velocity at 5 mm from the plate. **(07 Marks)**

b. Define Reynolds Number. What is its significance? **(04 Marks)**

c. Sketch the shear stress and velocity profile across a section of a circular pipe, for viscous flow. What are the expressions governing shear stress and velocity profile? **(05 Marks)**

6 a. Briefly explain, with neat sketches that types of energy or head losses through pipe. **(06 Marks)**

b. A horizontal pipe line 40 meters long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 mts of its length the pipe is 15 cm diameter and then its diameter is suddenly, enlarged to 30 cm. The height of water level in the tank is 8 meters above the center of pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both the sections of the pipe. **(06 Marks)**

c. What do you understand by pipes in parallel? What are the characteristics of pipes in parallel? **(04 Marks)**

7 a. Briefly explain about Boundary layer separation and methods to control it. **(05 Marks)**

b. A square plate of side 2m is moved in a stationary air of density 1.2 kg/m^3, with a velocity of 50 km/hr. If coefficients of drag and lift are 0.2 and 0.8 respectively, determine:
(i) Lift force
(ii) Drag force
(iii) Resultant force and its direction
(iv) Power required to keep the plate in motion. **(06 Marks)**

c. Briefly explain (i) Friction Drag (ii) Pressure drag **(05 Marks)**

8 a. Briefly explain the following dimensionless numbers and their applications:
(i) Reynolds Number
(ii) Mach Number **(05 Marks)**

b. The capillary rise 'H' of a fluid of mass density 'e' and surface tension 'σ' in a tube of diameter 'd' depends upon the angle of contact 'α' and acceleration due to gravity 'g'. Obtain an expression for 'H' using Buckingham π theorem in the following form

$$\frac{H}{d} = \phi\left[\frac{\sigma}{egd^2}, \alpha\right]$$ **(06 Marks)**

c. What is Similitude? Briefly explain the types of similarities between a model and prototype. **(05 Marks)**

9 a. Briefly explain the basic thermodynamic relations useful for gases. **(05 Marks)**

b. Obtain an expression for velocity of sound for compressible fluid undergoing isothermal process. **(06 Marks)**

c. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kgK and K = 1.4 for air. Assume temperature as 15°C. **(05 Marks)**

10 a. Briefly explain about Oblique Shocks. **(05 Marks)**

b. Summarize the steps involved in CFD analysis. **(07 Marks)**

c. Write a note on CFD applications. **(04 Marks)**

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15ME44

Fourth Semester B.E. Degree Examination, July/August 2021
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b. A horizontal venturimeter with inlet and throat diameters of 300 mm and 100 mm respectively is used to measure the discharge of water. The intensity of pressure is 130 kN/m^2 at inlet section whereas the vacuum pressure head at throat is 350 mm of mercury. Assuming that the 3% of head is lost between the inlet and throat, find the value of coefficient of discharge [C_d], and the amount of discharge. **(08 Marks)**

5 a. An oil of viscosity 0.1 Pa.S and relative density is 0.9 flows between two parallel plates 25 mm apart with a mean velocity of 1.8 m/sec. Determine:
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(iv) Velocity at 5 mm from the plate. **(07 Marks)**

b. Define Reynolds Number. What is its significance? **(04 Marks)**

c. Sketch the shear stress and velocity profile across a section of a circular pipe, for viscous flow. What are the expressions governing shear stress and velocity profile? **(05 Marks)**

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b. A square plate of side 2m is moved in a stationary air of density 1.2 kg/m^3, with a velocity of 50 km/hr. If coefficients of drag and lift are 0.2 and 0.8 respectively, determine:
(i) Lift force
(ii) Drag force
(iii) Resultant force and its direction
(iv) Power required to keep the plate in motion. **(06 Marks)**

c. Briefly explain (i) Friction Drag (ii) Pressure drag **(05 Marks)**

8 a. Briefly explain the following dimensionless numbers and their applications:
(i) Reynolds Number
(ii) Mach Number **(05 Marks)**

b. The capillary rise 'H' of a fluid of mass density 'e' and surface tension 'σ' in a tube of diameter 'd' depends upon the angle of contact 'α' and acceleration due to gravity 'g'. Obtain an expression for 'H' using Buckingham π theorem in the following form

$$\frac{H}{d} = \phi\left[\frac{\sigma}{egd^2}, \alpha\right]$$ **(06 Marks)**

c. What is Similitude? Briefly explain the types of similarities between a model and prototype. **(05 Marks)**

9 a. Briefly explain the basic thermodynamic relations useful for gases. **(05 Marks)**

b. Obtain an expression for velocity of sound for compressible fluid undergoing isothermal process. **(06 Marks)**

c. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kgK and K = 1.4 for air. Assume temperature as 15°C. **(05 Marks)**

10 a. Briefly explain about Oblique Shocks. **(05 Marks)**

b. Summarize the steps involved in CFD analysis. **(07 Marks)**

c. Write a note on CFD applications. **(04 Marks)**

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CBCS SCHEME

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15ME46B/15MEB406

Fourth Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. Define metrology. State the objectives of metrology. **(08 Marks)**
b. Explain line standards and end standard with suitable examples. **(04 Marks)**
c. Calculate the dimensions using M-87 set 49.3825 mm. **(04 Marks)**

2 a. Explain with neat sketch "Imperial Standard Yard". **(05 Marks)**
b. Four end bars of basic length 125 mm are to be calibrated using standard bar of 500 mm whose actual length is 499.9991 mm. It was also found that length of bars B, C and D in comparison with A are +0.0001 mm, +0.0005 mm and –0.0002 mm respectively and the length of all the four bars put together in comparison with the standard bar is +0.0003 mm longer. Find the actual length of each end bars. **(05 Marks)**
c. Distinguish between sine bar and sine centre with suitable sketches. **(06 Marks)**

3 a. Explain any two types of fits. **(06 Marks)**
b. Distinguish between hole basis and shaft basis system of fits. **(05 Marks)**
c. List and explain gauge materials used for making gauges. **(05 Marks)**

4 a. Classify different types of comparators. **(05 Marks)**
b. Explain with neat sketch the working of LVDT. **(06 Marks)**
c. Explain with neat sketch working of Solex Pneumatic Comparator. **(05 Marks)**

5 a. Explain with sketch for measurement of effective diameter by three wire method. **(08 Marks)**
b. Explain with neat sketch tool maker's microscope. **(08 Marks)**

6 a. Describe with neat sketch gear roll tester for composite error (Parkinson gear tester). **(08 Marks)**
b. Define best wire size. Derive an expression for best size wire. **(08 Marks)**

7 a. Define measurement. Describe with suitable example, generalized measurement system. **(08 Marks)**
b. Define the following terms: (i) Accuracy (ii) Precision (iii) Calibration **(03 Marks)**
c. List the advantages of electrical transducer elements over mechanical transducer elements. **(05 Marks)**

8 a. Describe in detail a ballast circuit. **(06 Marks)**
b. List the materials and uses of piezoelectric crystals used in piezoelectric transducer. **(04 Marks)**
c. Describe with neat sketch of Cathode-Ray Oscilloscope (CRO). **(06 Marks)**

9 a. Explain with neat sketch hydraulic dynamometers. **(08 Marks)**
b. Explain with neat sketch pirani thermal conductivity gauge. **(08 Marks)**

10 a. Describe with neat sketch the working of optical pyrometer. **(08 Marks)**
b. Describe with neat sketch of a simple resistance bridge arrangement for strain measurement. **(08 Marks)**

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CBCS SCHEME

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17ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Kinematics of Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Differentiate between
(i) Higher and Lower pair
(ii) Mechanism and Machine
(iii) Kinematics and Dynamics **(06 Marks)**

b. With neat sketch explain the types of joints in a kinematic chain. **(06 Marks)**

c. What are the inversions? With sketch describe various inversions of 4 bar chain. **(08 Marks)**

2 a. With a neat proportionate sketch, explain crank and slotted lever quick return motion mechanism. **(10 Marks)**

b. Derive an expression for necessary condition for current steering and explain Ackerman steering gear with neat sketch. **(10 Marks)**

3 In a 4 bar mechanism, the dimensions of the links are under: AB = 50mm, BC = 66mm, CD = 56mm, AD = 100mm. At the instant when ∠DAB = 60°, the link AB has an angular velocity of 10.5 rad/s in the counter-clockwise direction. Determine
(i) Angular velocities of links BC and CD
(ii) Velocity of the point E on the link BC when BE = 40mm.
(iii) Velocity of rubbing at pins A, B, C and D when the radii of the pins are 30, 40, 25 and 35mm respectively. **(20 Marks)**

4 a. Explain the method of finding acceleration of slider crank mechanism using Klen's construction **(08 Marks)**

b. State and prove Kennedy's theorem. **(06 Marks)**

c. Write a note on Corioli's component of acceleration. **(06 Marks)**

5 In an IC engine mechanism, crank radius is 50mm and connecting rod length is 200mm. The crank is rotating at 100 rad/s clockwise. At a particular instant the crank is at 40° from TDC position. For this position of the mechanism, find out the velocity of piston using complex algebra method. **(20 Marks)**

6 a. Derive the expression for Freudenstein's equation for 4 bar mechanism. **(12 Marks)**

b. Explain function generation for slider crank mechanism. **(08 Marks)**

7 a. Obtain an expression for the minimum number of teeth on pinion to avoid interference. **(10 Marks)**

b. A pinion with 120mm pitch diameter meshes with a gear of 400mm pcd. The teeth are of module 2mm and pressure angle of 25°. If the addendum of each wheel is 6mm find the angle by which the pinion turns to maintain contact. Also find the maximum sliding velocity, assume pinion is the driver and it rotates at 200 rpm. **(10 Marks)**

8 An epicyclic gear train has a fixed annular wheel A concentric with sun wheel C. The gear A has a 72 teeth and C has 32 teeth. A planet wheel B gears with A and C and is carried on an arm F which rotates about the centre of A at 18 rpm. Determine the speed of gears B and C. **(20 Marks)**

9 The following data relate to a cam profile which operates a knife edge follower rising with SHM and lowering with UARM.
Minimum radius of cam 30mm
Line of stroke of follower is offset 15mm from the axis of the cam.
Lift of the follower 45mm
Angle of ascent 70°
Angle of descent 120°
Angle of dwell in highest position of follower is 45°
Speed of cam 200 rpm in CW direction.
Draw the profile of the cam and determine maximum velocity and acceleration during lift of the follower. **(20 Marks)**

10 A symmetrical cam with convex flanks operates a flat-faced follower. The lift is 8mm, base circle radius is 25mm and the nose radius is 12mm. If the total angle of cam action is 120°, find the radius of the convex flank. Determine the maximum velocity and the maximum acceleration when the cam shaft rotates at 500 rpm. **(20 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions.
2. Use of Thermodynamics data hand book is permitted.

1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle. **(10 Marks)**

b. An engine of 250mm bore and 375mm stroke works on otto cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1 bar and 50°C. If maximum pressure is 25 bar find: i) Air standard efficiency of the cycle ii) Mean effective pressure. **(10 Marks)**

2 a. Derive an expression for the optimum pressure ratio for the maximum network output in an Brayton cycle. **(08 Marks)**

b. What are methods of improving the efficiency of Brayton cycle? **(02 Marks)**

c. The following data refers to an open cycle gas turbine. Pressure ratio = 5, Maximum temperature = 1075K, Minimum temperature = 290K, C_p for gas = 1.15kJ/kg.K, γ for air = 1.4 and γ for gas = 1.33, calorific value of the fuel = 45000kJ/kg, Efficiency of the compressor = 0.85, Efficiency of the turbine = 0.9, Efficiency of combustion = 0.95, Mass flow rate = 5kg/sec, Find: i) Thermal efficiency of the plant ii) Power output of the plant iii) Air to fuel ratio. **(10 Marks)**

3 a. Discuss the effect of i) Boiler pressure ii) Condenser pressure iii) Superheat on the performance of Rankine cycle. with the help of T-S diagram. **(09 Marks)**

b. With a schematic diagram and its P-V and T-S diagrams explain the Rankine cycle and also derive its thermal efficiency. **(11 Marks)**

4 a. With a schematic diagram and its T-S diagram, explain the working of reheat vapour cycle of deduce an expression for cycle efficiency. **(10 Marks)**

b. A steam turbine working of a Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10 kg/s, determine,
i) Quality of steam at the end of expansion
ii) Turbine shaft work
iii) Power required to operate the pump
iv) Work ratio. **(10 Marks)**

5 a. Explain the following terms with reference to a combustion process:
i) Stoichiometric air ii) Enthalpy of formation iii) Enthalpy of combustion
iv) Adiabatic flame temperature v) Enthalpy of reaction. **(10 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an Orsat apparatus. CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine: i) The composition of fuel ii) The air-fuel ratio iii) The percentage of excess air used. **(10 Marks)**

6 a. Define indicated power. Explain briefly how the frictional power of a multicylinder engine is determined using Morse test. State the assumptions made. **(10 Marks)**

b. A two stroke diesel engine was motored when meter reading was 1.5kW. Test on the engine was carried out for one hour and data observed were, brake torque = 120N-m, rpm = 600, fuel used = 2.5kg, cooling water = 818kg, CV of fuel = 40.3MJ/kg, Rise in temperature of cooling water = 10°C, room temperature = 27°C, A:F used = 32:1, exhaust gas temperature = 347°C, C_p for exhaust gases = 1.05kJ/kg.K. Determine, brake power, indicated power, mechanical efficiency and thermal efficiency. Draw heat balance sheet on minute and percentage basis. **(10 Marks)**

7 a. With a neat sketch, explain the working of vapour absorption refrigeration system. **(10 Marks)**

b. A food storage chamber requires a refrigeration system of 10 Ton capacity with an evaporator temperature of -10°C and condenser temperature of 30°C. The refrigerant F-12 is sub cooled by 5°C before entering the throttle valve and the vapour is superheated by 6°C before entering the compressor. The specific heats of vapour and liquid are 0.7327 and 1.235 respectively. Determine: i) The refrigerating capacity per kg ii) Mass of refrigerant circulated per minute iii) COP. **(10 Marks)**

8 a. Define the following: i) Dry bulb temperature ii) Wet bulb temperature iii) Specific humidity iv) Saturated air v) Degree of saturation. **(10 Marks)**

b. Represent the following processes on a psychrometric chart i) Sensible heating ii) Dehumidification. **(04 Marks)**

c. Atmospheric air at 101.325kPa has 30°C DBT and 15°C DPT, without using the psychrometric chart using the property values from the tables, calculate:
i) Partial pressure of air ii) Specific humidity iii) Relative humidity. **(06 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance ratio and the index of expansion and compression. **(10 Marks)**

b. A single stage double acting reciprocating compressor delivers $0.25m^3/s$. of air measured at 1.013 bar and 27°C. The delivery pressure is 7bar. At the beginning of compression, air is at 0.98 bar and 40°C. The clearance volume is 4% of swept volume. The stroke to bore ratio is 1:3. Compressor runs at 300rpm. Calculate, the volumetric efficiency cylinder dimensions and indicated power if the index of compression and expansion is 1.3. **(10 Marks)**

10 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the geometric mean of the suction and discharge pressures. **(10 Marks)**

b. Mention the types of nozzles. Explain any one. **(04 Marks)**

c. A two stage reciprocating air compressor works between pressure limits of 1 bar and 8 bar and draw in air at 15°C at the rate of 467 litres per minute. The compression in both stages is isentropic and inter cooling is perfect. Estimate minimum power supplied. **(06 Marks)**

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CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. State and prove Pascal's law. **(10 Marks)**

b. The right limb of a simple U tube manometer containing Hg is open to the atmosphere. While the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12cms below the level of Hg in the right limb. Find the pressure of liquid or fluid in the pipe if the difference of Hg level in two limbs is 20cm. **(10 Marks)**

2 a. A caisson for closing the entrance to a dry done is of trapezoidal form 16 m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure arc the caisson, if the water on the outside is just with the tap and dock is empty. **(10 Marks)**

b. The velocity distribution of flow over a plate is parabolic with vertex 30cms from the plane, where the velocity is 180cm/s. If the viscosity of the fluid of 0.9N-s/m^2 find the velocity gradient and shear stresses at distances of 0.15cms and 30cms from the plane. **(10 Marks)**

3 a. Derive continuity equation in Cartesian coordinates for fluid flow in 3-dimensions. **(10 Marks)**

b. Differentiate between:
   i) Study flow and Unsteady flow
   ii) Viscous flow and Turbulent flow. **(05 Marks)**

c. Define and explain stream function and velocity potential function. **(05 Marks)**

4 a. State assumption in Bernoulli's equation and derive the relation. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

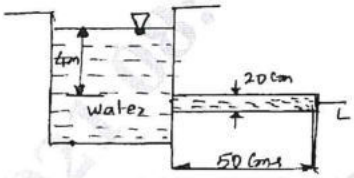
c. A 30cm × 15cm venturimeter is inserted in a vertical pipe line carrying oil of specific gravity 0.85, the flow of oil is upwards. Throat section is 50cm above inlet section of venturimeter. The oil mercury differential manometer gives a reading of 30cm of mercury. Find the rate of oil flow in lts/sec and the pressure difference between inlet and throat section. Assume C_d 0.96. Neglect all losses. **(08 Marks)**

5 a. Derive an expression for loss of head due to sudden enlargement. **(10 Marks)**

b. For laminar flow between the stationary parallel plates. Obtain an expression for velocity distribution. **(10 Marks)**

6 a. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$, refer the Fig.Q.6(a). **(10 Marks)**

Fig.Q.6(a)



b. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1N-s/m^2 is pumped through a 3cm diameter pipe. If the pressure drop per metre length of the pipe is 15kPa. Determine:
i) The mass flow rate of oil kg/min
ii) Shear stress at the pipe wall
iii) Reynolds number of the flow and
iv) The power required per 40m length of the pipe to maintain the flow. **(10 Marks)**

7 a. What is the meaning of Boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **(10 Marks)**

b. Using Rayleigh's method, show that the power 'P' developed by a Hydraulic turbine is given by $P = \rho N^3 D^5 \phi\left[\frac{gH}{N^2D^2}\right]$, where ρ = density of the liquid, N = rotational speed of the turbine in rpm, D = Diameter of the runner, H = Working Head, g = gravitational acceleration. **(10 Marks)**

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 Bucking Ham's π theorem method, show that

$$Q = ND^3\phi\left[\frac{P}{\rho N^3D^5}, \frac{\mu}{\rho ND^2}\right]$$ **(10 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 horizontal. The pull on the string is 24.525N, when the wind is flowing at a speed of 30km/hr. Find the corresponding coefficient of drag and lift. Take density of air = 1.25kg/m^3. **(10 Marks)**

9 a. Explain stagnation properties. Obtain an expression for velocity of sound for adiabatic process. **(10 Marks)**

b. A projectile travels in air of pressure 15N/mm^2 at 10°C at a speed of 1500km/hr. Find the Mach number and Mach angle. Assume γ = 1.4 and R = 287J/kg K. **(05 Marks)**

c. What are the normal and oblique shocks? **(05 Marks)**

10 a. Starting from fundamental, show the velocity of propagation of elastic wave in an isothermal medium is given by $C = \sqrt{RT}$. **(06 Marks)**

b. Define the following terms: i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow. **(10 Marks)**

c. Explain the meaning of CFD and its applications. **(04 Marks)**

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CBCS SCHEME

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17ME45B/17MEB405

Fourth Semester B.E. Degree Examination, July/August 2021
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Explain the classification of Machine Tools with suitable example. **(10 Marks)**

b. Explain the constructional features and working of center less Grinding machine with a neat sketch. **(10 Marks)**

2 a. Define Drilling. With a neat sketch, explain Radial Drilling machine. **(10 Marks)**

b. Describe with a neat sketch typical Horizontal shapes. **(10 Marks)**

3 a. Define the term, machining. Explain with neat sketches the various operations can be performed in a lathe. **(10 Marks)**

b. Explain with neat sketches the types of motions in machining to the following:
   i) Internal Turning/Boring
   ii) Drilling
   iii) Milling
   iv) Shaping. **(10 Marks)**

4 a. Explain with neat sketches the machining processes on drilling machine. **(10 Marks)**

b. With a neat sketch, explain the concept of gear cutting using horizontal milling machine. **(10 Marks)**

5 a. Briefly describe the requirements of cutting tool materials. **(10 Marks)**

b. i) In brief, describe the functions of cutting fluid.
   ii) List out the properties of cutting fluids and brief them. **(10 Marks)**

6 a. Determine the machining time in turning a bar of 76mm diameter to 68mm diameter. The length of the bar is 250mm, feed 0.25mm/rev, cutting speed 60mpm and depth of cut is 2mm. Assume total tool approach and over travel distance is 6mm. Also determine the metal removal rate. **(16 Marks)**

b. Find the time required for drilling a 20mm diameter hole on a workpiece of thickness 50mm. Neglect the length of approach. The rotational speed of drill bit is 200rpm. Over travel is 10mm. Feed is 0.12mm/rev. **(04 Marks)**

7 a. List the comparison between orthogonal and oblique cutting. **(10 Marks)**

b. Describe with sketches mechanics of milling process. **(10 Marks)**

8 a. Explain different types of chip formation during machining. **(10 Marks)**

b. Draw the shear angle relationship and derive the equation.

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha}$$ **(10 Marks)**

9 a. Define tool wear. List and describe the various parameters affecting the tool wear on cutting tools. **(10 Marks)**

b. Define Machinability. Discuss the various criteria considered for determining machinability. **(10 Marks)**

10 a. Discuss the reasons for tool failure. **(10 Marks)**

b. Discuss the Economics of machining processes. **(10 Marks)**

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CBCS SCHEME

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17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1	a.	What is metrology? Explain the objectives of metrology.	(05 Marks)
	b.	Explain subdivision of standards.	(07 Marks)
	c.	With a neat sketch, explain International prototype meter.	(08 Marks)
2	a.	Explain the wringing phenomena of slip gauges.	(05 Marks)
	b.	With a neat sketch, explain the working of sine centre.	(07 Marks)
	c.	With a neat sketch, explain the working of autocollimator.	(08 Marks)
3	a.	State and explain Taylor's principle of gauge design.	(05 Marks)
	b.	With neat sketches, explain different types of fit.	(07 Marks)
	c.	Explain the principle of interchangeability and selective assembly.	(08 Marks)
4	a.	Define comparator. What is the need of a comparator?	(05 Marks)
	b.	Explain with a neat sketch the working principle of mechanical optical comparator.	(07 Marks)
	c.	Explain with a neat sketch the working principle of solex pneumatic gauge.	(08 Marks)
5	a.	With a neat sketch, explain screw thread terminology.	(05 Marks)
	b.	Derive an expression for measurement of effective diameter by two wire method.	(07 Marks)
	c.	With a neat sketch, explain the working of Tools maker's microscope.	(08 Marks)
6	a.	With a neat sketch, explain gear teeth terminology.	(05 Marks)
	b.	With a neat sketch, explain the working of coordinate measuring machine.	(07 Marks)
	c.	With a neat sketch, explain the working of laser interferometer.	(08 Marks)
7	a.	Explain generalized measurement system, with a block diagram.	(05 Marks)
	b.	Define: (i) Accuracy (ii) Calibration (iii) Error (iv) Threshold (v) Hysteresis (vi) Least count (vii) Range	(07 Marks)
	c.	Explain with a neat sketch, electronic transducers.	(08 Marks)
8	a.	With a block diagram, explain telemetring system.	(05 Marks)
	b.	With a neat block, explain stylus type oscillography.	(07 Marks)
	c.	With a circuit diagram, explain Ballast circuit.	(08 Marks)
9	a.	With a neat sketch, explain the working of prony brake dynamometer.	(10 Marks)
	b.	With a neat sketch, explain McLeod gauge.	(10 Marks)
10	a.	Define thermocouple. State the laws of thermocouple and explain.	(08 Marks)
	b.	Define strain gauge. With a neat sketch, explain Wheatstone bridge circuit.	(08 Marks)
	c.	Write short notes on: (i) Thermo couple material (ii) Seebeck effect	(04 Marks)

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CBCS SCHEME

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18ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions.***
2. ***Use of thermodynamics data hand book is permitted.***

1 a. Derive an expression for efficiency of diesel cycle. **(08 Marks)**

b. The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke, the pressure is 100 kPa and temperature is 15°C, the heat transfer to the air per cycle is 1800 kJ/kg of air. Determine:
(i) The pressure and temperature at all the salient points.
(ii) Thermal efficiency
(iii) Mean effective pressure **(12 Marks)**

2 a. Explain the process of combustion in C.I. engine with the help of P-θ diagram. **(08 Marks)**

b. In a test of a 4-cylinder, 4-stroke engine 75 mm bore and 100 mm stroke, the following results were obtained at full throttle at a particular constant speed and with fixed fuel supply of 6.0 kg/hr.

B.P. with all cylinders working	15.6 KW
B.P with cylinder no.1 cutoff	11.1 KW
B.P with cylinder no.2 cutoff	11.03 KW
B.P with cylinder no.3 cutoff	10.88 KW
B.P with cylinder no.4 cut off	10.66 KW

If the calorific value of the fuel is 83,600 kJ/kg and clearance volume is 0.0001 m^3, calculate:
(i) Mechanical efficiency
(ii) Indicated Thermal efficiency
(iii) Air standard efficiency **(12 Marks)**

3 a. For a simple gas turbine cycle, the optimum pressure ratio for maximum work output of cycle is $R_p = \left\{ \eta_C \eta_t \frac{T_3}{T_1} \right\}^{\frac{\gamma}{2(\gamma-1)}}$. Prove. **(08 Marks)**

b. A gas turbine unit has a pressure ratio of 6:1 and maximum temperature in the cycle is 610°C. The efficiencies of compressor and turbine are 0.8 and 0.82 respectively. Calculate the overall efficiency of the gas turbine cycle. **(12 Marks)**

4 a. With the help of schematic and T-S diagrams, explain the methods of improving the efficiency of gas turbine cycle. **(10 Marks)**

b. In an air-standard Brayton cycle the air enters the compressor at 0.1 MPa and 15°C. The pressure loading the compressor is 1.0 MPa and maximum temperature in the cycle is 1100°C.
(i) Determine compressor work, turbine work and efficiency.
(ii) If an ideal regenerator is incorporated into the cycle determine compressor work, turbine work and efficiency. **(10 Marks)**

5 a. Explain with T-S diagrams, why Rankine cycle is used as an ideal cycle for power generation when compared to Carnot cycle. **(10 Marks)**

b. In a Rankine cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. The condenser pressure is 10 kPa. Determine cycle efficiency. **(10 Marks)**

6 a. With the help of neat diagram, explain the working of reheat cycle and derive an expression for the efficiency of the cycle. **(10 Marks)**

b. In a reheat cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. After expansion in the turbine to 400 kPa, the steam is reheated to 400°C and then expanded in the low pressure turbine to 10 kPa. Determine cycle efficiency. **(10 Marks)**

7 a. With P-H diagram and T-S diagram, explain the effect of super heating and sub cooling, on simple saturated refrigeration cycle. **(08 Marks)**

b. A R-12 plant is to develop 5 tons of refrigeration. The condenser and evaporator temperature are 40°C and –10°C respectively. Determine:

(i) COP of refrigerator

(ii) COP of heat pump

(iii) Power required by compressor **(12 Marks)**

8 a. With the help of sketch and psychrometric chart, explain the working of summer air conditioning system for Mangalore city. **(10 Marks)**

b. Air at 20°C, 40% RH is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1 kg of former with 2 kg latter. Find the final condition of air. **(10 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance volume and 'n' polytropic index. **(08 Marks)**

b. A single stage, double acting compressor has a free air delivery of 14 m^3/min measured at 1.013 bar and 15°C. The pressure and temperature in the cylinder during suction is 0.95 bar and 32°C. The delivery pressure is T bar and index of compression and expansion is 1.3. The clearance volume is 5% of swept volume, find: (i) Indicated power (ii) Volumetric efficiency. **(12 Marks)**

10 a. Explain different shapes of nozzles. **(06 Marks)**

b. Starting from steady flow energy equation, derive an expression for velocity of steam coming out of nozzle. **(06 Marks)**

c. Steam at a pressure of 20 bar and 25°C expands to an exit pressure of 4 bar in a convergent-divergent nozzle. Assuming frictionless flow upto throat and considering frictionless factor of 0.85 from throat to exit. Determine:

(i) Mass flow rate of steam for a throat area of 30 cm^2.

(ii) Exit area of the nozzle. **(08 Marks)**

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CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, July/August 2021
Kinematics of Machines

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define the following :
i) Constrained motion ii) Structure iii) Mechanism iv) Kinematic pairs
v) Kinematic chain vi) Degree of freedom. **(06 Marks)**

b. Find degree of freedom for the chains shown in Fig Q1(b) (i), (ii), (iii)

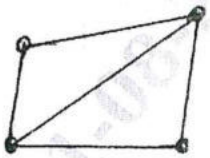

Fig Q1(b) – (i)

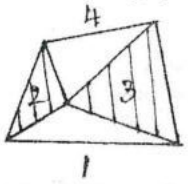

Fig Q1(b) – (ii)

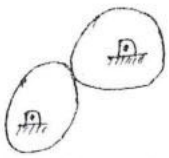

Fig Q1(b) – (iii) **(06 Marks)**

c. Draw a neat sketch of Peaucellier straight line mechanism. Explain with proof how the tracing point describes a straight path. **(08 Marks)**

2 a. What is quick return motion? Explain with neat sketch crank slotted lever mechanism. **(10 Marks)**

b. Explain with neat sketches :
i) Toggle mechanism ii) Ratchet and Pawl mechanism. **(10 Marks)**

3 PQRS in a four bar chain with link PS fixed. The lengths of the links are PQ = 62.5mm, QR = 175mm, RS = 112.5mm and PS = 200mm. The crank PQ rotates at 10 rad/sec clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of link QR and RS by graphical method. **(20 Marks)**

4 a. State and prove Kennedy's theorem. **(08 Marks)**

b. Find all the instantaneous centres of the slider crank mechanism shown in Fig Q4(b) below and find the velocity of the slider when the crank OA rotates with an angular velocity of 10 rad/s. Also determine the angular velocity of the connecting rod. The length of the connecting rod and crank are 800mm and 240mm and the crank makes an angle of 45° from the inner dead centre.

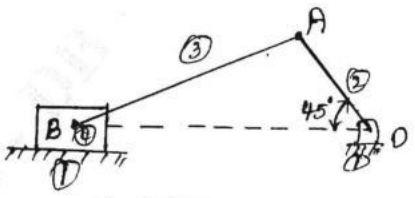

Fig Q4(b) **(12 Marks)**

5 The crank of an IC engine is 90mm and connecting rod length is 450mm. The crank is rotating in anticlockwise direction with angular velocity of 15rad/s and angular acceleration of 100rad/s^2. Find the acceleration of the piston and the angular acceleration of the connecting rod when the crank has turned 60° from the inner dead centre. **(20 Marks)**

6 a. Derive Freudenstein's equation for four bar mechanism. **(12 Marks)**

b. A four bar mechanism is required such that the input and output angles are coordinated as given in the table synthesize the four bar mechanism :

Input crank angle	–	40°	60°	90°
Output follower angle	–	0°	35°	65°

(08 Marks)

7 Construct the profile of a cam to suit the following specification:

Cam shaft diameter	=	40mm
Least radius of cam	=	25mm
diameter of roller	=	25mm
angle of lift	=	120°
angle of fall	=	150°
lift of the follower	=	40mm

Number of pauses (Dwell) are two of 45° equal interval between motions.
During the lift, the motion is S.H.M
During the fall the motion is UARM
The speed of the cam shaft is uniform
The line of stroke of the follower is off-set 13mm from the centre of the cam. **(20 Marks)**

8 A Cam with 3cm as minimum radius is rotating clockwise at a uniform speed of 1200rpm and has to give the motion to the knife edge follower as defined below :

i) Follower to move outward through 3cm during 120° of cam rotation with cycloidal motion
ii) Dwell for the next 60°
iii) Dwell to return to its starting position during the next 90° with UARM
iv) Dwell for the remaining period.

Draw the cam profile when follower axis is off-set to the right by 1cm. **(20 Marks)**

9 a. Derive an expression for the length of path of contact. **(08 Marks)**

b. A pair of 20 ° full depths involutes spur gears having 30 and 50 teeth respectively of module 4mm are in mesh. The smaller gear rotates at 1000rpm. Determine :

i) Sliding velocities at engagement and at disengagement of pair of a teeth
ii) Contanct ratio. **(12 Marks)**

10 a. List and explain the types of gear trains. **(08 Marks)**

b. An epicyclic gear consists of three gears A, B and C as shown in Fig Q10(b). The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18rpm. If the gear A is fixed, determine the speed of gears B and C.

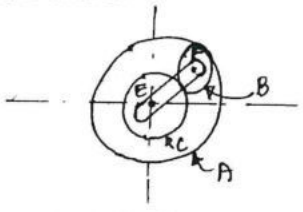

Fig Q10(b) **(12 Marks)**

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15ME42

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Kinematics of Machines

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 neat sketch the mechanism required to convert rotary motion to reciprocating motion [which should have only one turning pair] **(08 Marks)**

b. State and explain the suitable mechanism which can be used in Forming machines/sheet metal punching. **(08 Marks)**

OR

2 a. Some of the 4 bar linkages are shown in Fig Q2(a) where the number indicate the respective link in Lengths in 'cm'. Identify the nature of each mechanism whether

(i) double crank
(ii) crank rocker
(iii) Double Rocker. Give Reason in brief **(12 Marks)**

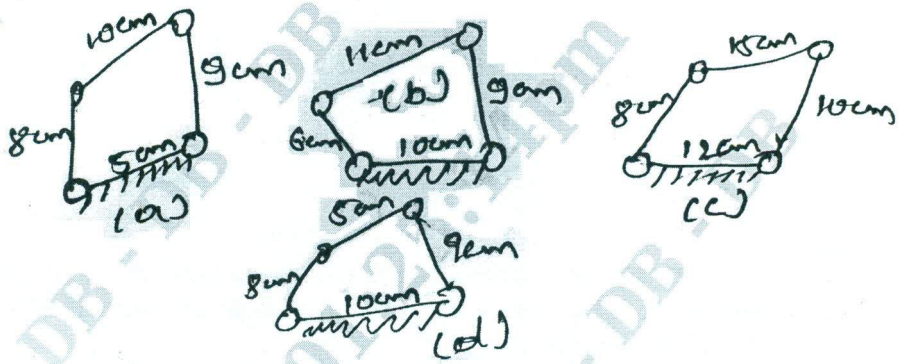

Fig Q2(a)

b. Differentiate between

i) Machine and mechanism
ii) Binary joints and binary links **(04 Marks)**

Module-2

3 In the mechanism shown in Fig Q3 crank 2 rotates out 300 rpm. Find the acceleration of point C in magnitude, direction and sense. Find also the angular acceleration of link 3.

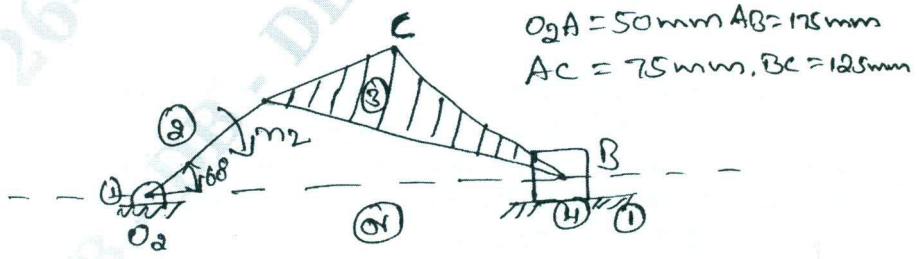

Fig Q3 **(16 Marks)**

OR

4 A pin jointed 4 bar mechanism ABCD show Fig Q4. Link AB = 150mm, BC = 180mm, CD = 180mm and fixed link AD = 300mm. Link AB makes 60° with link AD, and rotates uniformly at 100 rpm. Locate all the instantaneous centres and find the angular velocity of link BC and linear velocity of link CD.

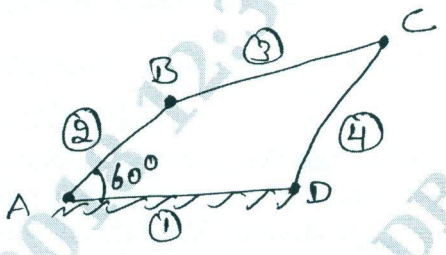

Fig Q4 **(16 Marks)**

Module-3

5 Develop an equation for the relationship between the Angular velocities of the input crank and output crank of 4 bar linkage shown in Fig Q5. Using loop closure equation.

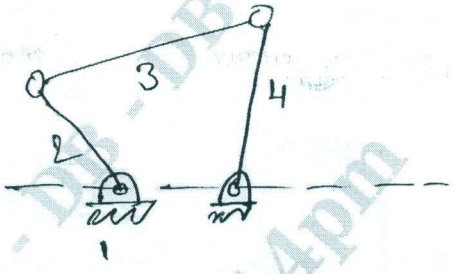

Fig Q5 **(16 Marks)**

OR

6 Design a four bar mechanism when the motions of the input and output links are governed by a function $y = 2x^2$ and x various 2 to 4 with an interval of 1. Assume θ to vary from 40° to 120° and ϕ from 60° to 132°. **(16 Marks)**

Module-4

7 a. A pair of gears 40 and 30 teeth respectively are of 25°involute form. Addendum = 5mm, Module = 2.5mm. If the smaller wheel is the driver and rotate at 1500rpm, find the velocity of sliding at the point of engagement, out pitch point and the point of disengagement, length of path of contact and length of Arc of contact. **(10 Marks)**

b. Explain minimum of teeth an a Gear to avoid interference and minimum number of teeth on a pinion to avoid interference. **(06 Marks)**

OR

8 In an epicyclic gear train, the internal wheels A, B and compound wheel C and D rotate independently about the axis 'O'. The wheels E and F rotate on a pin fixed to the Arm G. E gears with A and C, and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18, C = 28, D = 26

i) Sketch the arrangement
ii) Find the number of teeth on A and B
iii) If the Arm G makes 15rpm CW and A is fixed, find speed of B
iv) If the Arm G makes 150rpm CW and wheel A makes 15rpm CCW, find speed of B.

(16 Marks)

Module-5

9 A cam rotating clockwise at uniform, speed of 300 rpm operates a reciprocating follower through a roller 1.5cm diameter. The follower motion is defined as below

i) Outward during 150° with U.AR.M
ii) Dwell for next 30°
iii) Return during next 120° with SHM
iv) Dwell for the remaining period

Stroke of the follower is 3 cm. Minimum radius of the cam is 3 cm. Draw the cam profile, Follower axis passes through the cam axis. **(16 Marks)**

OR

10 A symmetrical tangent cam operating a roller follower has the following particulars Radius of base circle of cam = 40mm, Roller radius = 20mm, Angle of ascent = 75°, total lift = 20mm, N = 300rpm. Determine :

a. Principle Dimensions of the cam
b. The equation of the displacement curve when follower is in contact with straight flank.
c. Acceleration of the follower, when it is in contact with the straight flank where it merges into circular nose. **(16 Marks)**

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CBCS SCHEME

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15ME43

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer FIVE full questions, choosing one full question from each module.***
2. ***Use of steam table/Mollier chart/Psychrometric chart is permitted.***

Module-1

1 a. Derive an expression of Air-standard efficiency of otto cycle with neat sketch of P-V and T-S diagrams. **(06 Marks)**

b. With a neat sketch, explain the working of Ram jet. **(05 Marks)**

c. Calculate the percentage loss in the ideal efficiency of a diesel engine with compression ratio 14 if the fuel cut-off is delayed from 5% to 8%. **(05 Marks)**

OR

2 a. With a neat block diagram and T-S diagram, explain how 'regeneration' increases thermal efficiency of gas turbine plant. **(06 Marks)**

b. Define Air-standard efficiency. **(02 Marks)**

c. A Gas turbine unit has a pressure ratio 6 : 1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output when the air enters the compressor at 15°C at the rate of 16 kg/s. Take $C_P = 1.005$ KJ/kgK and $\gamma = 1.4$ for compression and $C_P = 1.11$ kJ/kgK and $\gamma = 1.333$ for expansion processes. **(08 Marks)**

Module-2

3 a. With the help of corresponding flow and T-S diagrams explain briefly the working of a practicle regenerative Rankine cycle with one open feed water heater. Derive also an expression for its thermal efficiency. **(08 Marks)**

b. A simple Rankine cycle works between the boiler pressure of 3 MPa and condenser pressure of 4 KPa. The steam is dry saturated before the throttling in the turbine. Determine (i) Rankine cycle efficiency (ii) Work ratio (iii) Specific steam consumption. **(08 Marks)**

OR

4 a. Discuss the effect of, (i) Boiler pressure (ii) Condenser pressure (iii) Super heat on the performance of a Rankine cycle. **(08 Marks)**

b. A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar, 550°C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw h-s diagram. Find (i) Quality of steam at turbine exhaust (ii) Cycle efficiency (iii) Steam rate in $\frac{kg}{hr.KW}$ **(08 Marks)**

Module-3

5 a. Explain the following: (i) Stoichiometric air (ii) Enthalpy of formation. **(04 Marks)**

b. Explain the method of finding friction power using Morse test. **(04 Marks)**

c. A Solid fuel contains by weight, carbon 71%, hydrogen 4%, oxygen 9%, Sulphur 3%, Nitrogen 1% and the remainder is ash. Determine the minimum quantity of air required for complete combustion of 1 kg of fuel. If the actual air supplied is 1.3 times the minimum required for complete combustion, estimate the percentage gravimetric composition of dry gases. **(08 Marks)**

OR

6 a. Classify the IC engines. **(04 Marks)**

b. Define : (i) BSFC (ii) Indicated thermal efficiency. **(04 Marks)**

c. In a trial of a single cylinder oil engine working on dual cycle, the following observations were made:
Oil consumption = 10.2 kg/h ; Calorific value of fuel = 43890 kJ/kg
Air consumption = 3.8 kg/min; Speed = 1900 rpm
Torque on the brake drum = 186 N-m; Quantity of cooling water used = 15.5 kg/min
Temperature rise = 36°C; Exhaust gas temperature = 410°C
Room temperature = 20°C; 'C_P' of exhaust gases = 1.17 kJ/kgK
Calculate Brake thermal efficiency and draw heat balance sheet on minute basis. **(08 Marks)**

Module-4

7 a. With a neat sketch, explain the working of Bell – Coleman air refrigeration cycle. **(06 Marks)**

b. Show the following processes on psychometric chart: (i) Sensible heating and cooling (ii) Cooling and dehumidification **(04 Marks)**

c. In a simple vapour compression cycle, following are the properties of the refrigerant R-12 at various points;
Compressor inlet : $h_2 = 183.2$ KJ/kg; $V_2 = 0.0767$ m^3/kg
Compressor discharge : $h_3 = 222.6$ KJ/kg; $V_3 = 0.0164$ m^3/kg
Compressor exit : $h_4 = 84.9$ KJ/kg; $V_4 = 0.00083$ m^3/kg
The piston displacement volume for compressor is 1.5 litres per stroke and its volumetric efficiency is 80%. The speed of the compressor is 1600 rpm. Find (i) Power rating of the compressor (KW) (ii) Refrigerating effect (KW) **(06 Marks)**

OR

8 a. Define (i) Dry bulb temperature (ii) Wet bulb temperature (iii) Dew point temperature (iv) Relative humidity. **(04 Marks)**

b. State the properties of good refrigerant. **(04 Marks)**

c. An air conditioning system is designed under the following conditions:
Outdoor conditions = 30°C DBT and 75% RH
Required indoor conditions = 22°C DBT and 70% RH
Amount of free air circulated = 3 m^3/sec
Coil dew point temperature = 14°C
The required condition is achieved first by cooling and dehumidification and then by heating. Calculate (i) the capacity of the cooling coil in tones.
(ii) the capacity of the heating coil in KW.
(iii) the amount of water vapour removed in kg/s. **(08 Marks)**

Module-5

9 a. What are the advantages of multistage compression? **(04 Marks)**

b. What do you mean by a supersaturated flow? Explain with the help of h-s diagram. **(06 Marks)**

c. A single stage double-acting air compressor is required to deliver 14 m^3 of air per minute at 1.013 bar and 15°C. The delivery pressure is 7 bar and the speed 300 rpm. Take the clearance volume as 5% of the swept volume with the compression and expansion index n = 1.3, calculate (i) Swept volume of cylinder (ii) Indicated power. **(06 Marks)**

OR

10 a. Derive an expression for the condition for minimum work input required for two stage compressor with perfect intercooling. **(08 Marks)**

b. A multistage compressor is to be designed to elevate the pressure from 1 bar to 120 bar, such that the stage pressure ratio will not exceed 4. Determine (i) Number of stages (ii) Minimum power required (iii) Intermediate pressures (iv) Exact pressure ratio. It is required to compress 15 m^3/min of free air. Take n = 1.2 **(08 Marks)**

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15ME44

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 the following properties of fluids with their units:
(i) Weight density.
(ii) Dynamic viscosity.
(iii) Bulk modulus **(06 Marks)**

b. An oil film of thickness 1.5 mm is used for lubrication between a square plate of size 0.9m × 0.9m slides down an inclined plane having an inclination of 20° with the horizontal. The weight of square plate is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Find the kinematic viscosity of oil. specific gravity of the oil is 0.7 **(05 Marks)**

c. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of Sp.gravity 0.8 and having vacuum pressure is flowing. The other end of manometer is open to atmosphere. Find the vacuum pressure in pipe, if difference of mercury level in two limbs is 40 cm and height of fluid in the left from the centre of pipe is 15 cm below. **(05 Marks)**

OR

2 a. State and prove Pascal's law. **(06 Marks)**

b. Derive expression for total pressure and centre of pressure for a plane surface immersed vertically in a static mass of fluid. **(06 Marks)**

c. A uniform body of size 3m long × 2m wide × 1 m deep floats in water. What is the weight of the body if depth of immersion is 0.8 m? Determine the meta centric height also. **(04 Marks)**

Module-2

3 a. Explain different types of fluid flow. **(06 Marks)**

b. The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point P(2, 3). Find the velocity potential ϕ. **(04 Marks)**

c. Obtain the Euler's equation of motion along a stream line and hence derive Bernoulli's equation for a steady incompressible fluid flow. State the assumptions made. **(06 Marks)**

OR

4 a. Derive an expression for discharge through a triangular notch. **(05 Marks)**

b. A jet of water of diameter 50 mm having velocity 40 m/s, strikes a curved fixed symmetrical plate at its centre. The jet is deflected through an angle 120° at the outlet of the curved plate. Calculate the force exerted by jet of water in the direction of jet and perpendicular to jet. **(05 Marks)**

c. Find the discharge of water flowing through a pipe 30 cm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 15 cm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.6 in an inverted U-tube which gives a reading of 30 cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe. **(06 Marks)**

Module-3

5 a. Prove that the ratio of maximum velocity to average velocity for laminar flow between two stationary parallel plates is 1.5. **(10 Marks)**

b. A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find (i) the pressure gradient (ii) Average velocity (iii) Reynold's number of the flow. **(06 Marks)**

OR

6 a. What are the energy losses that occur in pipes? Give the expressions for different minor energy losses. **(04 Marks)**

b. An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 lit/sec. Find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow. **(06 Marks)**

c. Three pipes of lengths 800 m, 500 m and 400 m and of diameters 500 mm, 400 mm and 300 mm respectively are connected in series. These pipes are replaced by a single pipe of 1700 m. Find the diameter of single pipe. **(06 Marks)**

Module-4

7 a. Define the terms:
(i) Boundary layer thickness.
(ii) Energy thickness
(iii) Lift
(iv) Drag **(04 Marks)**

b. Write a short note on boundary layer separation and methods to control it. **(06 Marks)**

c. A long plate of size 5m × 2m is moving in air with velocity of 9 km/hr parallel to its length. Calculate the drag force on both sides of plate if, (i) Boundary layer is laminar over the complete plate. (ii) Boundary layer is turbulent over the complete plate.
Take $\rho_{air} = 1.2$ kg/m^3 and $\mu = 1.8 \times 10^{-4}$ poise **(06 Marks)**

OR

8 a. The pressure difference Δp in a pipe of diameter D and length *l* due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π-theorem. Obtain an expression for $\Delta\phi$. **(10 Marks)**

b. Explain (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity **(06 Marks)**

Module-5

9 a. Define stagnation properties. Obtain an expression for stagnation pressure of a compressible fluid in terms of Mach number and pressure. **(10 Marks)**

b. A projectile travels in air of pressure 15 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and Mach angle. Assume r = 1.4 and R = 287 J/kgK **(04 Marks)**

c. What are normal and oblique shocks? **(02 Marks)**

OR

10 a. Show that velocity of propogation of elastic wave in an adiabatic medium is given by $C = \sqrt{rRT}$ starting from fundamentals. **(08 Marks)**

b. Calculate the stagnation temperature on nose of plane which is flying at 800 km/hr through still air having a pressure 8 N/cm^2 and temperature -10°C. Take R = 287 J/kgK and r = 1.4 **(02 Marks)**

c. Define compuational fluid dynamics. Mention the applications of CFD. **(06 Marks)**

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15MEB405

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the principle of working of a lathe. Draw neat sketch of lathe show the principle parts. **(08 Marks)**

b. What factors govern the classification of lathe? **(04 Marks)**

c. How is the size of lathe determined? **(04 Marks)**

OR

2 a. What are the basic elements of drilling machine? Explain the function of each. **(08 Marks)**

b. What are advantages and disadvantages of shaping machines? **(08 Marks)**

Module-2

3 a. Explain the working and auxillary cutting motions in machine tool. **(08 Marks)**

b. Explain with example working motion for following machine tool:
(i) Lathe (ii) Milling (iii) Drilling (iv) Planning **(08 Marks)**

OR

4 a. With the help of suitable sketches, describe construction and working of milling arbors. **(08 Marks)**

b. Explain following drilling operations :
(i) Boring (ii) Counter Boring (iii) Countersinking (iv) Spot facing. **(08 Marks)**

Module-3

5 a. What are the different types of cutting fluid? Explain it briefly. **(08 Marks)**

b. What are functions of cutting fluid? **(04 Marks)**

c. What are the important factors to be considered while selecting cutting fluids? **(04 Marks)**

OR

6 a. Explain different types of cutting tool materials. **(08 Marks)**

b. Explain factors affecting surface finish. **(08 Marks)**

Module-4

7 a. How machining time is given for shaping operation? **(08 Marks)**

b. Give expression for feed, speed and depth of cut for grinding. **(08 Marks)**

OR

8 a. Write a short note on feed for milling operation. **(04 Marks)**

b. Which factors affect machining time for milling? **(04 Marks)**

c. For the rough grinding operation, determine the machining time with following data:
Stock to be removed = 0.40 mm Depth of cut = 0.02 mm
Cutting speed = 30 m/min Diameter of work = 40 mm
Face width of wheel = 60 mm Length of work = 210 mm **(08 Marks)**

Module-5

9 a. Explain Basic elements of machining. **(04 Marks)**

b. Write a note on American Standards Association (ASA) system of tool signature. **(04 Marks)**

c. Draw Merchant's circle diagram to show cutting forces acting on cutting tool. **(08 Marks)**

OR

10 a. What are the possible causes of tool failure? Explain in detail. **(08 Marks)**

b. What are the factors affecting the tool life? **(08 Marks)**

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15ME46B

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 the characteristics of line and end standards. **(05 Marks)**

b. With a neat sketch, explain Imperial Standard Yard. **(05 Marks)**

c. Four length bars of basic length 100mm are to be calibrated using a calibrated length bar of 400mm, whose actual length is 399.9992mm. It was also found that length of bars B, C, D in comparison to A are + 0.0002 , + 0.0004 and – 0.0001mm respectively and the length of all four bars put together in comparison to standard calibrated bar is + 0.0003mm longer. Determine the actual dimensions of all the four end bars. **(06 Marks)**

OR

2 a. Explain with a neat sketch, Wringing phenomenon of slip gauges. **(08 Marks)**

b. With a neat sketch, explain the uses of sine bar. **(08 Marks)**

Module-2

3 a. Explain with a neat sketch, different types of fits. **(08 Marks)**

b. Explain briefly Selective assembly and Interchangeability. **(08 Marks)**

OR

4 a. With a neat sketch, explain plug gauges and snap gauges. **(10 Marks)**

b. With a neat sketch, describe the construction and working of Jahansson – Mikro Kator. **(06 Marks)**

Module-3

5 a. Explain the 3 – wire method of finding effective diameter of screw threads. **(08 Marks)**

b. With a sketch, define the following terms with respect to a screw thread i) Major diameter ii) Effective diameter iii) Pitch iv) Angle of thread. **(08 Marks)**

OR

6 a. Explain with a neat sketch, 'Tool Maker's microscope. **(08 Marks)**

b. With a neat sketch, explain laser interferometer. **(08 Marks)**

Module-4

7 a. Briefly explain the generalized measurement system, with block diagram. **(08 Marks)**

b. List and explain the different types of errors. **(08 Marks)**

OR

8 a. Explain the inherent problems present in mechanical modifying system. **(08 Marks)**

b. Explain the working of "Cathode Ray Oscilloscope". **(08 Marks)**

Module-5

9 a. Explain briefly i) Proving ring ii) Prony brake dynamometer. **(08 Marks)**

b. Explain with neat sketch, the working of Bridgemann gauge. **(08 Marks)**

OR

10 a. Explain the wheat stone bridge arrangement for strain measurement. **(08 Marks)**

b. What is Thermocouple? State and explain the laws of thermo couple. **(08 Marks)**

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