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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Use Picards method to obtain the solution of $\frac{dy}{dx} = e^x - y$, $y(0) = 1$ and hence find $y(0.2)$ considering upto third approximation. **(06 Marks)**

b. Using Runge-Kutta method of fourth order find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.2$. **(07 Marks)**

c. Find $y(0.2)$ using modified Euler's method correct to four decimal places for the equation $\frac{dy}{dx} = x - y^2$, $y(0) = 1$, taking $h = 0.1$. **(07 Marks)**

2 a. Solve $\frac{dy}{dx} = 1 + zx$, $\frac{dz}{dx} = -xy$ with $y(0) = 0$, $z(0) = 1$ at $x = 0.3$ by applying Runge-Kutta method of fourth order. **(06 Marks)**

b. Obtain the solution of the equation $2y'' = 4x + y'$ with initial conditions $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.464$, $y(1.3) = 2.7514$ and $y'(1) = 2$, $y'(1.1) = 2.3178$, $y'(1.2) = 2.6725$ and $y'(1.3) = 3.0657$ by computing $y(1.4)$ applying Milne's method. **(07 Marks)**

c. Use Picard's method to obtain the second approximation to the solution of $\frac{d^2y}{dx^2} - x^3\frac{dy}{dx} - x^3y = 0$ given $y(0) = 1$, $y'(0) = \frac{1}{2}$ and hence find $y(0.1)$. **(07 Marks)**

3 a. State and prove Cauchy-Riemann equations in polar form. **(06 Marks)**

b. Find the analytic function $f(z)$ whose imaginary part is $\left(r - \frac{k^2}{r}\right)\sin\theta$, $r \neq 0$ and hence find the real part of $f(z)$. **(07 Marks)**

c. If $f(z)$ is a regular function of z, show that $\left[\frac{\partial}{\partial x}|f(z)|\right]^2 + \left[\frac{\partial}{\partial y}|f(z)|\right]^2 = |f'(z)|^2$. **(07 Marks)**

4 a. Find the image of the triangular region bounded by the lines $x = 1$, $y = 1$, $x + y = 1$ under the transformation $W = Z^2$. **(07 Marks)**

b. If $f(z)$ is analytic within and on C (simple closed curve) and 'a' is a point within 'c' prove that $f(a) = \frac{1}{2\pi i}\int_C \frac{f(z)}{z-a}dz$. **(06 Marks)**

c. Evaluate $\int_C \frac{e^{2z}}{(z+1)^2(z-2)}$ where C is the circle $|z| = 3$. **(07 Marks)**

PART – B

5 a. Obtain the series solution of Bessel's differential equation. **(07 Marks)**

b. Derive the Rodrigues formula. **(06 Marks)**

c. If $x^3 + 2x^2 - x + 1 = aP_0(x) + bP_1(x) + cP_2(x) + dP_3(x)$ using Rodrigue's formula find the values of a, b, c, d. **(07 Marks)**

6 a. If A and B are events with $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{3}{4}$, $P(\overline{B}) = \frac{5}{8}$ find $P(A \cap B)$, $P(\overline{A} \cap \overline{B})$, $P(\overline{A} \cup \overline{B})$ and $P(\overline{A} \cap B)$. **(06 Marks)**

b. In a college boys and girls are equal in proportion. It was found that 10 out of 100 boys and 25 out of 100 girls were referring same author text book. If a student using that was selected at random, what is the probability of being a boy? **(07 Marks)**

c. A bag contains three coins, one of which is two headed and the other two are normal and fair. A coin is chosen at random from the bag and tossed four times in Succession if head turns up each time, what is the probability that this is the two headed coin. **(07 Marks)**

7 a. Find the value of 'K' such that the following distribution represents a finite probability distribution. Hence find the mean (μ) and standard deviation (σ). Also find $P(X \leq 1)$, $P(X>1)$ and $P(-1 < X \leq 2)$. **(06 Marks)**

X	-3	-2	-1	0	1	2	3
P(X)	k	2k	3k	4k	3k	2k	k

b. If the mean and standard deviation of the number of correctly answered questions in a test given to 4096 students are 2.5 and $\sqrt{1.875}$, find an estimate of the number of candidates answering correctly (i) 8 or more questions (ii) 2 or less (iii) 5 questions. **(07 Marks)**

c. Derive the expressions for the mean and standard deviation of exponential distribution. **(07 Marks)**

8 a. Certain tubes manufactured by a company have mean life time of 800 hours and standard deviation of 60 hours. Find the probability that a random sample of 16 tubes taken from the group will have mean life time, (i) between 790 hours and 810 hours. (ii) less than 785 hours. **(06 Marks)**

b. Two horses A and B were tested according to the time (in seconds) to run a particular race with the following result.

Horse A:	28	30	32	33	29	34
Horse B:	29	30	30	24	27	29

Test whether you can discriminate between the two horses. Use $t_{0.05} = 2.2$ and $t_{0.02} = 2.72$ **(07 Marks)**

c. A die is thrown 264 times and the number appearing on the face (x) follows the frequency distribution as mentioned below:

x	1	2	3	4	5	6
f	40	32	28	58	54	60

Calculate the value of χ^2. **(07 Marks)**

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10ME42A/AU42A

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Draw neat sketch wherever necessary.

PART – A

1 a. With sketch, explain the following: (i) Body centered cubic (ii) Face centered cubic and (iii) Hexagonal close packed structure. **(08 Marks)**

b. Differentiate between line and screw dislocation. **(06 Marks)**

c. The diffusivity of copper atoms in FCC copper lattice is 8.0×10^{-21} m^2/sec at 400°C and 6.0×10^{-15} m^2/s at 800°C. Calculate the activation energy in J/mole for diffusion of copper atoms in FCC copper lattice. Consider R = 8.314 J/mole. **(06 Marks)**

2 a. Draw the conventional stress-strain diagram for ductile material under tensile load and explain the different properties of the material. **(08 Marks)**

b. Derive an expression for the critical resolved shear stress for slip in a single crystal. **(06 Marks)**

c. What is strain hardening? Explain the reasons for the same. **(06 Marks)**

3 a. What are the two major types of fractures of metals? Differentiate between them. **(08 Marks)**

b. Draw S-N diagram showing the fatigue limit and explain briefly. **(06 Marks)**

c. How would you conduct a test to assess the fatigue life of a material? Explain briefly. **(06 Marks)**

4 a. Derive critical radius of homogeneous nucleation. **(08 Marks)**

b. Explain with sketch nucleation and growth of dendrites. **(06 Marks)**

c. List and explain different types of substitutional solid solutions. **(06 Marks)**

PART – B

5 a. Sketch and explain the equilibrium diagram, when two components A and B are completely soluble in liquid state and partially soluable in solid state. Also mention an example. **(08 Marks)**

b. Draw "Iron-Iron carbide" phase diagram and show the region where the following reactions take place (i) Eutectic (ii) Peritectic and (iii) Eutectoid. Explain the structural changes taking place at 0.6% carbon. **(12 Marks)**

6 a. With the help of TTT diagram and super imposed cooling curves and the heat treatment ranges represented on the relevant portion of the iron carbon equilibrium diagram, explain (i) Process annealing and (ii) Quench hardening. Clearly state the process, changes in micro structure and changes in properties. **(08 Marks)**

b. Explain the effect of carbon on the shape of the TTT diagram and the hardenability of the steel. **(06 Marks)**

c. Explain the process of flame hardening. **(06 Marks)**

7 a. Mention at least three different types of cast iron. How do they differ with respect to composition and structure? **(08 Marks)**

b. Write composition, properties and uses of, (i) Stainless steel (ii) High speed steel and (iii) Brass. **(08 Marks)**

c. Write a note on Al-Si alloys. **(04 Marks)**

8 a. Explain the following composite material with examples: (i) Agglomerated composites and (ii) Reinforced composites. **(08 Marks)**

b. List the different methods of manufacturing fiber reinforced plastic. Explain any two of them. **(08 Marks)**

c. Explain the advantages and limitations of composite materials in practice. **(04 Marks)**

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10ME42B

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Mechanical Measurements & Metrology

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define metrology. State and explain the objectives of metrology. **(07 Marks)**

b. Define metre in terms of wave length standard and enumerate the advantages of using wavelength standard. **(05 Marks)**

c. Four end bars A, B, C and D are to be calibrated using a calibrated length bar of 400 mm whose actual length is 399.9998 mm. The bar B is longer than bar A by 0.0004 mm, bar C is longer than bar A by 0.0003 mm, while bar D is shorter than bar A by −0.0001 mm. The four gauges together have a combination length of 400.0002 mm. Determine the corrected (actual) length of each end bar. **(08 Marks)**

2 a. Write a short notes on:
(i) Interchangeability (ii) Selective assembly **(10 Marks)**

b. Design the general type Go and NO-Go gauge for components having 20 H_7/f_8 fit. Given
(i) $i\,(\text{micron}) = 0.45\sqrt[3]{D} + 0.001D$
(ii) Upper deviation of 'f' shaft $= -5.5D^{0.41}$.
(iii) 20 mm falls in the diameter step of 18 and 30 mm .
(iv) $IT_7 = 16i$
(v) $IT_8 = 25i$
(vi) Wear allowance 10% of gauge tolerance. **(10 Marks)**

3 a. Explain with neat sketch, Zeiss ultra optimeter. **(06 Marks)**

b. Explain with sketch, the principle of Back pressure type pneumatic comparator. **(06 Marks)**

c. Give the combination of angle gauges to obtain the following angles: (i) 37°16′42″ (ii) 102°8′36″ **(04 Marks)**

d. Write a note on clinometers. **(04 Marks)**

4 a. Illustrate the principle of Interferrometry with sketches. **(05 Marks)**

b. What is best size wire? Derive an expression for the same. **(05 Marks)**

c. With the help of neat sketch, explain the method of determining the chordal thickness of a gear tooth using Vernier gear tooth caliper. **(10 Marks)**

PART – B

5 a. Explain with sketches : (i) Hysteresis (ii) Threshold (iii) Repeatability (iv) Sensitivity **(10 Marks)**

b. Mention any five mechanical and five electrical transducer elements. **(04 Marks)**

c. With a neat sketch explain electronic transducers. **(06 Marks)**

6 a. Briefly explain Inherant problems (any five) associated with mechanical intermediate modifying system. **(10 Marks)**

b. What are X-Y plotters? With a block diagram, explain its working. **(10 Marks)**

7	a.	Explain with a sketch working of proving ring.	**(06 Marks)**
	b.	Explain hydraulic dynamometer with a neat sketch.	**(06 Marks)**
	c.	Explain with a neat sketch pirani gauge.	**(08 Marks)**
8	a.	State the laws of thermocouples with sketch.	**(06 Marks)**
	b.	Describe the construction and working of optical pyrometer.	**(08 Marks)**
	c.	Write a note on preparation and mounting of strain gauges.	**(06 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of thermodynamic data handbook is permitted.

PART – A

1 a. With a neat sketch, explain the analysis of exhaust gases by Orsat apparatus. **(10 Marks)**

b. Methane (CH_4) is burned with atmospheric air. The analysis of the products on a 'dry' basis is as follows: CO_2 = 10%, O_2 = 2.37%, CO = 0.53%, N_2 = 87.10%.

i) Determine the combustion equation.
ii) Calculate the air-fuel ratio.
iii) Percent theoretical air. **(10 Marks)**

2 a. Derive the expression for the air standard efficiency of a diesel cycle with usual notations. State the assumptions made and represent the process on P-V and T-S diagram. **(10 Marks)**

b. A 4-stroke dual fuel cycle operates on 10 liters of air at 1 bar and 27°C per cycle. The addition of heat at constant volume is adjusted for a maximum pressure in the cycle of 70 bar. The heat addition continuous for 5% of the stroke. Calculate:

i) Pressure ratio ii) Heat added per cycle
iii) Cut-off ratio iv) Heat rejected per cycle
v) Net work done vi) Thermal efficiency
vii) Power developed, when engine runs at 200 rpm. **(10 Marks)**

3 a. Briefly explain how the indicated power of a multi-cylinder is measured. **(06 Marks)**

b. Write a short note on heat balance sheet. **(04 Marks)**

c. In a constant speed CI engine operating on 4-stroke cycle and fitted with a hand brake. The following observations were taken:

Brake wheel diameter = 600 mm
Band thickness = 5 mm
Speed = 450 rpm
Load on band = 200 N
Spring balance reading = 30 N
Area of indicator diagram = 415 mm^2
Length of the indicated diagram = 63 mm
Spring number = 0.11 N/mm^2 per mm
Bore = 100 mm
Stroke = 150 mm
Specific fuel consumption = 0.22 kg/KW-hr
Calorific value of fuel = 42000 kJ/kg.

Determine:
i) Brake power ii) Indicated power iii) Mechanical efficiency
iv) Indicated thermal efficiency v) Brake thermal efficiency **(10 Marks)**

4 a. With the help of a schematic diagram and T-S diagram, explain the working of a regenerative vapour power cycle and derive an expression for its overall efficiency. **(12 Marks)**

b. In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiency of the cycle. Neglect pump work. **(08 Marks)**

PART – B

5 a. Derive the expression for the work done for a single stage single acting reciprocating compressor with clearance volume. **(06 Marks)**

b. Discuss applications of compressed air, and derive an expression for the volumetric efficiency of reciprocating air compressor. **(06 Marks)**

c. A single stage double acting air compressor is required to deliver 14 m^3 of air per minute measured at 1.013 bar and 15°C. The delivery pressure is 7 bar and the speed is 300 rpm. Take the clearance volume as 5% of the swept volume with compression and expansion index of n = 1.3. Calculate:
i) Swept volume of the cylinder
ii) The delivery temperature
iii) Indicated power. **(08 Marks)**

6 a. Derive an expression for the work output of a gas turbine in terms of pressure ratio and maximum and minimum temperature T_3 and T_1. Hence show that the pressure ratio for maximum specific work output is given by $R_p = \left[\frac{T_3}{T_1}\right]^{\frac{\gamma}{2(\gamma-1)}}$. **(12 Marks)**

b. In a simple gas turbine cycle, the compressor pressure ratio is 8:1. The maximum cycle temperature is 827°C. If the compressor inlet conditions are 1 bar and 27°C. Determine per unit mass of air.
i) Compressor work ii) Turbine work iii) Work ratio
iv) Cycle efficiency v) Specific air consumption in kg/hr. **(08 Marks)**

7 a. With a neat sketch describe clearly the working of a vapour absorption refrigeration system. **(08 Marks)**

b. Write a brief note on properties of refrigerants. **(04 Marks)**

c. A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor, and at exit from the condenser are 183.19, 209.41 and 74.59 kJ/kg respectively. Estimate:
i) The refrigerant flow rate
ii) The COP
iii) The power required to drive the compressor and
iv) The rate of heat rejection to the condenser. **(08 Marks)**

8 a. Define: i) Saturated air ii) Dry bulb temperature iii) Dew point temperature
iv) Relative humidity v) Specific humidity **(05 Marks)**

b. Explain briefly:
i) Summer air conditioning
ii) Winter air conditioning **(08 Marks)**

c. The sling psychrometer in a laboratory test recorded the following readings: Dry bulb temperature = 35°C, wet bulb temperature = 25°C. Calculating the following:
i) Specific humidity
ii) Relative humidity
iii) Vapour density in air.
Take atmosphere pressure = 1.0132 bar. **(07 Marks)**

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10ME/AU44

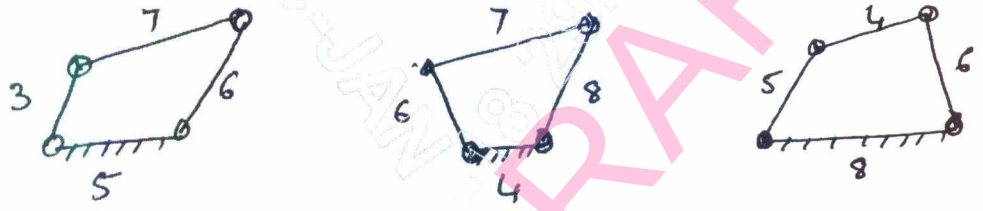
Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Fig. Q1 shows four link mechanism is which the figure indicates the dimensions in standard units of length. Indicate the type of each mechanism whether crank rocker or double crank or double rocker. **(09 Marks)**



(i) (ii) (iii)

Fig Q1(a)

b. Differentiate between: i) Lower pair and higher pair ii) Closed pair and unclosed pair iii) Turning pair and rolling pair. **(06 Marks)**

c. What is meant by Inversion? Discuss any one inversion of a double slider crank chain. **(05 Marks)**

2 a. Sketch a Paucellier mechanism, show that it can be used to trace a straight line on the movement of links. **(10 Marks)**

b. With help of a neat diagram, discuss the working of Toggle mechanism. **(08 Marks)**

c. Differentiate between exact straight line and approximate straight line mechanism. **(02 Marks)**

3 A crank and rocker mechanism ABCD has the following dimensions :
AB = 0.75m, BC = 1.25m, CD = 1m, AD = 1.5m, BE = 437.5mm CE = 875mm. E is the point on coupler link BC, AD is fixed link, BEC is read clockwise, crank AB has an angular velocity of 20.94r/s counterclockwise and retardation of 280 r/s^2 at the instant $\angle DAB = 60°$, find :

i) The instantaneous velocity and acceleration of point C and E

ii) Angular velocity and acceleration of link BC. **(20 Marks)**

4 a. What is instantaneous centre of rotation of a body? Discuss different types of instantaneous centers. **(06 Marks)**

b. The lengths of the crank and connecting rod of a horizontal reciprocating engine are 100mm and 500mm respectively. The crank is rotating at 400rpm. Using Klein's construction, find : i) Velocity and acceleration of piston ii) angular velocity and angular acceleration of connecting rod when the crank has turned 30° from the inner deed centre. **(14 Marks)**

PART – B

5 In a four bar mechanism the dimensions of the links are as under AB = 50mm, BC = 66mm, CD = 56mm, AD = 100mm (fixed link).

At an instant when $D\hat{A}C = 60°$ the angular velocity of the input link AB is 10.5 rad/sec is the counterclockwise direction with an angular retardation of 26 rad/s^2. Determine analytically the angular displacement, angular velocity and angular acceleration of link DC and BC. **(20 Marks)**

6 a. What do you mean by the phenomenon, 'Interference' between two mating gears? **(02 Marks)**

b. Find the expression for the minimum number to teeth on the wheel if interference is to be avoided between two mating gears. **(12 Marks)**

c. A pinion and rack are is mesh. The rack is driven by a pinion of 125mm pitch circle diameter. The numbers of involute teeth on the pinion are 20. The addendum of both pinion and rack is 6.25mm. If interference is to be avoided, determine pressure angle. **(06 Marks)**

7 Fig Q7 shows epicyclic gear train pinion A has 15 teeth, and rigidly fixed to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular wheel D which is fixed. Pinion C is having 15 teeth and is integrated with B (B and C are compound wheel) Gear C meshes with the annular wheel E which is keyed to the machine shaft. The arm rotates about the same shaft on which A is fixed and carries the compound wheel B and C. If motor runs at 1000rpm find the speed of machine shaft and the torque exerted on the machine shaft if motor develops a torque of 100 Nm. **(20 Marks)**

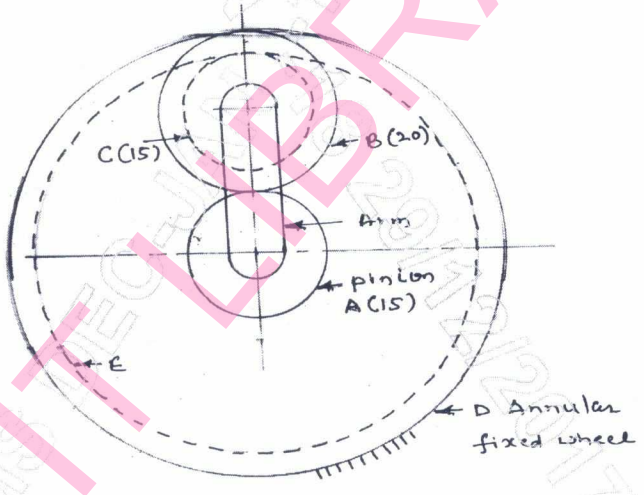


Fig Q7

8 a. Define and explain :
i) Cam profile ii) Base circle iii) Prime circle iv) Pitch curve. **(04 Marks)**

b. Draw the profile of cam to raise a valve with harmonic motion through 40mm is $\frac{1}{4}^{th}$ of revaluation, keep it fully raised through $\frac{1}{10}^{th}$ of the revolution and to lower with uniform acceleration and retardation motion is $\frac{1}{6}^{th}$ of revolution. The valve remains closed during rest of the revolution. The diameter of the roller is 20mm, minimum radius cam is 30mm. The axis of the valve rod passes through the axis of cam shaft. Assume that cam rotates is counterclockwise. **(16 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Manufacturing Process - II

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. What is Rake angle? Explain the significance of positive and negative rake angles with suitable sketches. **(04 Marks)**

b. Derive an expression for the shear angle in orthogonal cutting in terms of rake angle and chip thickness ratio. **(08 Marks)**

c. A Lathe turning at a particular speed is cutting MS work piece with HSS tool. The speed – life relationship for the tool is given by $VT^{0.4} = 400$. Determine the percentage increase in the tool life, if the cutting speed is reduced by 20%. **(08 Marks)**

2 a. Briefly explain the salient points of following cutting tool materials i) HSS ii) CBN. **(06 Marks)**

b. What is Coolant? Explain why coolant is used in metal cutting. **(06 Marks)**

c. With neat sketch, explain different zones of heat generation in metal cutting. **(08 Marks)**

3 a. With suitable sketch, explain the typical layout for producing hexagonal bolt and nut on Capstan Lathe. **(08 Marks)**

b. A cast iron plate of dimensions 600mm × 300mm × 60mm is to be rough shaped along its wider face. Calculate the machining time, if cutting speed is 9m/min. The return time to cutting time ratio is 1:4 and the feed is 3mm. The clearance at each end is 75mm. **(06 Marks)**

c. What are the differences between Planet and Shaper? **(06 Marks)**

4 a. With neat sketch, explain the spindle drive mechanism in bench drilling machine. **(04 Marks)**

b. With sketches, explain the following drilling operations : i) Reaming operation ii) Boring operation iii) Tapping operation and v) Trapanning operation. **(12 Marks)**

c. What are the advantages and disadvantages of CNC machine? **(04 Marks)**

PART – B

5 a. Explain briefly how milling machines are classified. **(06 Marks)**

b. With suitable sketch, label all the important parts of plain milling cutter. **(06 Marks)**

c. List out the differences between conventional milling and climb milling with suitable sketches. **(08 Marks)**

6 a. Briefly explain different abrasive materials used for making grinding wheel. **(06 Marks)**

b. List and explain the factors considered in the selection of grinding wheel. **(08 Marks)**

c. What is the function of bonds in grinding wheel? Briefly explain different bonding processes used. **(06 Marks)**

7 a. What is Broaching? Explain different types of broaching based in method of operation. **(05 Marks)**

b. List the advantages and limitations of broaching. **(05 Marks)**

c. Explain the following surface finishing processes : i) Honing ii) Buffing. **(10 Marks)**

8 a. With suitable sketch, explain Abrasive jet machining. What are the advantages and disadvantages of abrasive jet machining? **(10 Marks)**

b. List and explain the parameters which affect the cutting rate in the Ultrasonic machining. **(06 Marks)**

c. What are the Applications of EDM? **(04 Marks)**

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10MEB406/10AUB406

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Distinguish between dynamic viscosity and kinematic viscosity and explain the effect of temperature on viscosity of liquids and gases. **(06 Marks)**

b. Explain:
i) Why in a capillary tube meniscus of water is concave upwards while the meniscus of mercury is convex upwards?
ii) Why concept of surface tension is not applied to gases? **(06 Marks)**

c. A stationary bearing of length 30 cm and internal radius 8.025 cm has been used to provide lateral stability to a 8 cm radius shaft rotating at constant speed of 200 rpm. The space between the shaft and the bearing is filled with a lubricant of viscosity 2.5 poise. Find the power utilized in overcoming the frictional torque. Take the velocity profile as linear. **(08 Marks)**

2 a. Define:
i) Hydrostatic law
ii) Vacuum pressure
iii) Total pressure and centre of pressure **(06 Marks)**

b. A U-tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of pipe. If the pressure of water in the pipeline reduces to 10 kN/m^2. Calculate the new difference in the level of mercury. Take specific weight of water as 10 kN/m^3. **(08 Marks)**

c. A pipe line which is 4 m in diameter contains a gate valve. The pressure at the centre of the pipe 19.6 N/cm^2. If pipe is filled with oil of specific gravity 0.87, find the force exerted by the oil on the gate and position of centre of pressure. **(06 Marks)**

3 a. Derive an expression for metacentric height of a floating body. **(08 Marks)**

b. Define the terms:
i) Velocity potential function
ii) Stream function **(04 Marks)**

c. A fluid flow field is given by $V = x^2y\vec{z} + y^2z\vec{j} - (2xyz + yz^2)\vec{k}$. Prove that it is a possible case of steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3) **(08 Marks)**

4 a. Derive Euler's equation of motion along a stream line and obtain Bernoulli's equation from it. **(08 Marks)**

b. A jet of water from a 25 mm diameter nozzle is directed vertically upwards. Assuming that the jet remains circular and neglecting any loss of energy, what will be the diameter at a point 4.5 m above the nozzle, if velocity with which jet leaves the nozzle is 12 m/s? **(06 Marks)**

c. A 2m long pipe line tapers uniformly from 10 cm diameter to 20 cm diameter at its upper end. The centre line of pipe slopes upwards at an angle of 30° to the horizontal and flow direction is from smaller to bigger cross section. If the pressures at lower and upper end are 200 kPa and 230 kPa respectively, determine the flow rate and the fluid pressure at the mid length of the pipe line. Assume no energy losses. **(06 Marks)**

PART – B

5 a. Derive an expression for discharge through an orifice-meter. **(08 Marks)**

b. Define the following dimensionless numbers:
   i) Reynold's number
   ii) Froude's number **(04 Marks)**

c. The pressure difference 'Δp' in a pipe of diameter D and length 'l' due to viscous flow depends on velocity V, viscosity μ and density ρ. Using Buckingham's π theorem, obtain an expression for Δp. **(08 Marks)**

6 a. What do you understand by major energy loss and minor energy losses in pipes? **(04 Marks)**

b. Derive an expression for loss of head due to sudden enlargement. **(08 Marks)**

c. A pipe line 300 mm in diameter and 3200 m long is used to pump 50 kg/sec of an oil whose density is 950 kg/m^3, and whose kinematic viscosity is 2.1 stokes. The centre of the pipe line at the upper end is 40 m above the lower end. The discharge at the upper end is atmospheric. Find the pressure at the lower end and draw the hydraulic gradient and total energy line. **(08 Marks)**

7 a. Prove that velocity distribution for flow between two parallel stationary plates is parabolic and also prove that maximum velocity is equal to one and half times the average velocity. **(10 Marks)**

b. A laminar flow is taking place in a pipe of diameter of 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of the pipe. **(10 Marks)**

8 a. Explain the terms:
   i) Lift and drag
   ii) Momentum thickness
   iii) Sonic and subsonic flow **(06 Marks)**

b. Define Mach number. What is the significance of Mach number in compressible fluid flows? **(04 Marks)**

c. An aeroplane weighing 40 kN is flying in a horizontal direction at 360 km/hr. the plane has a wing surface area of 35 m^2. Determine the lift coefficient and the power required to drive the plane. Assume drag coefficient $C_D = 0.03$ and for air $\rho = 1.20$ kg/m^3. **(06 Marks)**

d. A projectile travels in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and Mach angle. Take K = 1.4 and R = 287 J/kgK. **(04 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions selecting atleast TWO questions from each part.***

PART – A

1 a. Find the direction cosines ℓ, m, n of the line :
$x + y + z + 1 = 0$
$4x + y - 2z + 2 = 0$. **(06 Marks)**

b. Show that the lines $\frac{x+4}{3} = \frac{y+6}{5} = \frac{z-1}{-2}$ and $3x - 2y + z + 5 = 0 = 2x + 3y + 4z - 4$ are coplanar. **(07 Marks)**

c. Find the angle between the line $\frac{x+4}{4} + \frac{y-3}{-3} = \frac{z+2}{1}$ and the plane $2x + 2y - z + 15 = 0$. **(07 Marks)**

2 a. Find the equation of the plane which passes through the points A(0, 1, 1), B(1, 1, 2), C(–1, 2, –2). **(06 Marks)**

b. Find the equation of the plane which passes through the point(3, –3, 1) and normal to the line joining the points (3, 2, –1) and (2, –1, 5). **(07 Marks)**

c. Find the equations to the two planes which bisects the angle between the planes :
$3x - 4y + 5z = 3$
$5x + 3y - 4z = 9$. **(07 Marks)**

3 a. Find the sides and the angle A of the triangle whose vertices are $\overline{OA} = I - 2J + 2K$, $\overline{OB} = 2I + J - K$, $\overline{OC} = 3I - J + 2K$. **(06 Marks)**

b. Show that the points $-6I + 3J + 2K$, $3I - 2J + 4K$, $5I + 7J + 3K$ and $-13I + 17J - k$ are coplanar. **(07 Marks)**

c. Prove that : $\left[\bar{B} \times \bar{C}, \bar{C} \times \bar{A}, \bar{A} \times \bar{B}\right] = \left[\bar{A}\,\bar{B}\,\bar{C}\right]^2$. **(07 Marks)**

4 a. A particle moves along the curve $x = t^2 + 1$, $y = t^2$, $z = 2t + 3 + \sin(\pi t)$ where t is the time. Find the velocity and acceleration at t = 1. **(06 Marks)**

b. If $\bar{A} = (\cos t)I + (\sin t)J + (4t)K$ and $\bar{B} = (t^3 + 1)I + J + (8t^2 - 3t^3)K$ then find :
i) $\frac{d}{dt}(\bar{A} + \bar{B})$ ii) $\frac{d}{dt}(\bar{A} \cdot \bar{B})$. **(07 Marks)**

c. If $\phi = 3x^2y - y^3z^2$, find grad ϕ at (1, –2, 1). Also find a unit normal vector to the surface $3x^2y - y^3z^2 = 6$ at (1, –2, 1). **(07 Marks)**

PART – B

5 a. If $\bar{A} = xyz\,I + 3x^2y\,J + (xz^2 - y^2z)K$ then find curl $\bar{A}$ at (1, 2, 3). **(06 Marks)**

b. Find the directional derivative of the scalar function $f(x, y, z) = x^2 + xy + z^2$ at the point A(1, –1, –1) in the direction of $2\hat{i} + 3\hat{j} + 2\hat{k}$. **(07 Marks)**

c. If $u = x^2 + y^2 + z^2$ and $\bar{r} = xI + yJ + zK$ then find div $(u\bar{r})$ in terms of u. if $\vec{f} = \nabla(x^3 + y^3 + 2^3 - 3xyz)$ find $\nabla \cdot \vec{f}$ and $\nabla \times \vec{f}$. **(07 Marks)**

6 a. Find the Laplace transform of f(t) defined as :

$$f(t) = \begin{cases} \frac{t}{6}, & \text{when } 0 < t < 6 \\ 1, & \text{when } t < 6 \end{cases}.$$ **(05 Marks)**

b. Find : i) $L(\cos t^2 t)$ ii) $L(t \sin h\, at)$ iii) $L\left(\frac{1}{t}\sin 2t\right)$. **(15 Marks)**

7 a. Find : $L(e^{2t} \cos 3t)$. **(06 Marks)**

b. Find : $L^{-1}\left(\frac{2h-5}{9s^2-25}\right)$. **(07 Marks)**

c. Find : $L^{-1}\left(\frac{s^2+4}{x^2+9}\right)$. **(07 Marks)**

8 a. Using Laplace transforms, find the solution of the initial value problem $y''-4y'+4y=64 \sin 2t$, $y(0) = 0$, $y'(0) = 1$. **(10 Marks)**

b. Using Laplace transforms, solve $y'' + 9y = \cos 2t$, $y(0) = 1$, $y'(0) = \frac{12}{5}$. **(10 Marks)**

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