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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of statistical tables is permitted.***

PART – A

1 a. Using Taylor series method, solve the problem $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$ at the point $x = 0.2$. Consider upto 4^{th} degree terms. **(06 Marks)**

b. Using R.K. method of order 4, solve $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0) = 1$ at the points $x = 0.1$ and $x = 0.2$ by taking step length $h = 0.1$. **(07 Marks)**

c. Given that $\frac{dy}{dx} = x - y^2$, $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$. Compute y at $x = 0.8$ by Adams-Bashforth predictor-corrector method. Use the corrector formula twice. **(07 Marks)**

2 a. Evaluate y and z at $x = 0.1$ from the Picards second approximation to the solution of the following system of equations given by $y = 1$ and $z = 0.5$ at $x = 0$ initially.

$$\frac{dy}{dx} = z, \quad \frac{dz}{dx} = x^3(y + z)$$ **(06 Marks)**

b. Given $y'' - xy' - y = 0$ with the initial conditions $y(0) = 1$, $y'(0) = 0$. Compute $y(0.2)$ and $y'(0.2)$ by taking $h = 0.2$ and using fourth order Runge-Kutta method. **(07 Marks)**

c. Applying Milne's method compute $y(0.8)$. Given that y satisfies the equation $y'' = 2yy'$ and y and y′ are governed by the following values. $y(0) = 0$, $y(0.2) = 0.2027$, $y(0.4) = 0.4228$, $y(0.6) = 0.6841$, $y'(0) = 1$, $y'(0.2) = 1.041$, $y'(0.4) = 1.179$, $y'(0.6) = 1.468$. (Apply corrector only once). **(07 Marks)**

3 a. Derive Cauchy Riemann equations in Cartesian form. **(06 Marks)**

b. Find an analytic function $f(z) = u + iv$. Given $u = x^2 - y^2 + \frac{x}{x^2 + y^2}$. **(07 Marks)**

c. If f(z) is a regular function of z, show that $\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right] |f(z)|^2 = 4\,|f'(z)|^2$ **(07 Marks)**

4 a. Find the bilinear transformation that maps the points $z = -1, i, -1$ onto the points $w = 1, i, -1$ respectively. **(06 Marks)**

b. Find the region in the w-plane bounded by the lines $x = 1$, $y = 1$, $x + y = 1$ under the transformation $w = z^2$. Indicate the region with sketches. **(07 Marks)**

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

PART – B

5 a. Solve the Laplaces equation in cylindrical polar coordinate system leading to Bessel differential equation. **(06 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$ then prove that $\int_0^1 x\, J_n(\alpha x)\, J_n(\beta x)\, dx = 0$ if $\alpha \neq \beta$. **(07 Marks)**

c. Express the polynomial, $2x^3 - x^2 - 3x + 2$ interms of Legendre polynomials. **(07 Marks)**

6 a. State and prove addition theorem of probability. **(06 Marks)**

b. Three students A, B, C write an entrance examination. Their chances of passing are ½, ⅓, ¼ respectively. Find the probability that,
i) Atleast one of them passes.
ii) All of them passes.
iii) Atleast two of them passes. **(07 Marks)**

c. Three machines A, B, C produce respectively 60%, 30%, 10% of the total number of items of a factory. The percentages of defective outputs of these three machines are respectively 2%, 3% and 4%. An item is selected at random and is found to be defective. Find the probability that the item was produced by machine C. **(07 Marks)**

7 a. The pdf of a random variable x is given by the following table:

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

Find: i) The value of k ii) $P(x > 1)$ iii) $P(-1 < x \leq 2)$
iv) Mean of x v) Standard deviation of x. **(06 Marks)**

b. In a certain factory turning out razar blades there is a small probability of 1/500 for any blade to be defective. The blades are supplied in packets of 10. Use Poisson distribution to calculate the approximate number of packets containing, i) One defective, ii) Two defective, in a consignment of 10000 packets. **(07 Marks)**

c. In a normal distribution 31% of items are under 45 and 8% of items are over 64. Find the mean and standard deviation of the distribution. **(07 Marks)**

8 a. A sample of 100 tyres is taken from a lot. The mean life of tyres is found to be 39350 kilometers with a standard deviation of 3260. Can it be considered as a true random sample from a population with mean life of 40000 kilometers? (Use 0.05 level of significance) Establish 99% confidence limits within which the mean life of tyres expected to lie. (Given that $Z_{0.05} = 1.96$, $Z_{0.01} = 2.58$) **(06 Marks)**

b. Ten individuals are chosen at random from a population and their heights in inches are found to be 63, 63, 66, 67, 68, 69, 70, 70, 71, 71. Test the hypothesis that the mean height of the universe is 66 inches. (Given that $t_{0.05} = 2.262$ for 9 d.f.) **(07 Marks)**

c. Fit a Poisson distribution to the following data and test the goodness of fit at 5% level of significance. Given that $\psi^2_{0.05} = 7.815$ for 4 degrees of freedom.

x	0	1	2	3	4
Frequency	122	60	15	2	1

(07 Marks)

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10ME/AU42A

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define "Bravais" space lattice. Describe with neat sketches, all the 14 possible arrangements of lattice points in the space by giving the following parameters in tabular form.
(i) The lattice points (Atoms)
(ii) The lattice constants
(iii) The lattice angles. **(08 Marks)**

b. Define co-ordination number. Calculate the APF (Atomic Packing Factor) of SCC (Simple Cubic Structure). **(04 Marks)**

c. Find out APF of HCP with neat sketch by calculating the c/a value. Where 'c' is the height of HCP structure and 'a' is the side of the base. **(08 Marks)**

2 a. Differentiate between elastic and plastic deformation. With neat graph explain about linear and non-linear elastic behavior of a material. **(04 Marks)**

b. With neat graph explain stiffness and resilience. **(04 Marks)**

c. A tensile test bar of 12.5 mm diameter and gauge length of 60 mm. failed at 7800 kgs. The load exerted at upper yield point is 4800 kgs and lower yield point is 4500 kgs. It fractures at 5000 kgs. The gauge length after fracture was measured 75 mm and diameter at fracture 8 mm. Hence find out the following.
(i) Lower yield stress (ii) Upper yield stress (iii) UTS (Ultimate Tensile Strength)
(iv) Fracture stress (v) Percentage (%) of elongation. **(12 Marks)**

3 a. Define fatigue. Explain with neat sketch and graphs all the three types of fatigue. **(04 Marks)**

b. What do you understand by "Mechanism of Fatigue"? Explain it with neat figure. Explain with neat figure three stages of fatigue failure. **(04 Marks)**

c. With neat sketch, explain the RR Moore reversed bending fatigue test. Draw S-N curve of mild steel and alloy, and explain it in detail. **(12 Marks)**

4 a. Define solidification. What is the mechanism of solidification? Explain both the stages. **(04 Marks)**

b. Explain by drawing a neat graph of free energy change v/s radius of the nucleus. Explain heterogeneous nucleation by drawing a neat figure. **(04 Marks)**

c. Explain in detail the phase diagram-I interstitial solid solution and Gibb's phase rule. **(12 Marks)**

PART – B

5 a. Draw the iron-carbon equilibrium diagram. Show all the phases. Write in detail about all the different phases. **(15 Marks)**

b. Write the different invariant reactions containing different % of carbon. **(05 Marks)**

6 a. Define TTT diagram, with examples. **(05 Marks)**

b. With neat figure draw TTT diagram for 0.8% carbon eutectoid steel with different phases. **(15 Marks)**

7 a. Write notes on grey cast iron, white cast iron, malleable cast iron and spheroidal graphite iron. **(10 Marks)**

b. Explain in detail about copper and its alloys. **(10 Marks)**

8 a. Define composite material. Write its different classifications. **(10 Marks)**

b. With a neat sketch, explain the vacuum bag moulding process of fabrication of composite material. **(10 Marks)**

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10ME/AU42B

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Mechanical Measurements and 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 the term "metrology" as applied to engineering industry. State and explain the objectives of metrology. **(06 Marks)**

b. Explain with an illustration how end standard can be derived from the line standards. **(08 Marks)**

c. Build following dimensions using M112 set: i) 35.4875 mm, ii) 78.3665 mm. M112 slip gauge set contain following:

Ranges	Steps	Pieces
1.0005	-	1
1.001 – 1.009	0.001	9
1.01 – 1.49	0.01	49
0.5 – 24.5	0.5	49
25.0 – 100.0	25.0	4

(06 Marks)

2 a. What are the concepts of interchangeability and selective assembly? Which is advantageous? **(06 Marks)**

b. Design the general type GO and NOGO gauges for the component having 25 H_7/f_8 fit. Given the following with usual notations:

i) i in microns = $0.45\sqrt[3]{D} + 0.001\,D$

ii) Upper deviation for f shaft = $-5.5\,D^{0.41}$ in microns

iii) 25 mm falls in the diameter step of 18-30 mm. IT7 = 16i, IT8 = 25i.

Take wear allowance as 10% of gauge tolerance. Name the fit and mention the allowances of above fit. **(14 Marks)**

3 a. Explain with a neat sketch, construction and working of "Johnson Mikrokator" comparator. **(08 Marks)**

b. Explain the principle and working of "Zeiss Ultra Optimeter" with a neat sketch. **(08 Marks)**

c. Build an angle of 35°32′36″ from the following set of angle gauges:

Series I : 1°, 3°, 9°, 27° and 41°

Series II : 1′, 3′, 9′ and 27′

Series III : 3″, 6″, 18″ and 30″. **(04 Marks)**

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

b. What is the principle of interferometry? How is it adapted in optical interferometer? **(07 Marks)**

c. What are the uses of (i) sine centre, (ii) clinometers, (iii) angle gauges? **(05 Marks)**

PART – B

5 a. Explain the following:

i) Hysterisis ii) Accuracy and precision

iii) Sensitivity iv) Repeatability and linearity **(08 Marks)**

b. State the advantages of electric transducer over other transducers. **(04 Marks)**
c. Discuss with a block diagram generalized measurement system with examples for each stage elements. **(08 Marks)**

6 a. Explain ballast circuit with a neat sketch. **(06 Marks)**
b. Explain the working principle of CRO and give its applications. **(10 Marks)**
c. State the advantages of electrical signal conditioning elements. **(04 Marks)**

7 a. Explain with a neat sketch, the working of hydraulic dynamometer. **(10 Marks)**
b. Explain with a neat sketch, McLeod Vacuum gauge. **(10 Marks)**

8 a. What are the necessary precautions to be taken while mounting strain gauges? **(06 Marks)**
b. Explain with a neat sketch any one type of mechanical strain gauge. **(08 Marks)**
c. What is a thermocouple? State the laws of thermocouple. **(06 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Applied Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of thermodynamic data hand book / charts / tables is permitted.***

PART – A

1 a. Define the terms: i) Stoichiometric air ii) Enthalpy of formation iii) Enthalpy of combustion iv) Adiabatic flame temperature v) Combustion efficiency. **(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. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a petrol cycle (Otto cycle). **(08 Marks)**

b. Compare the Otto and diesel cycle, on the basis of same compression ratio and same heat input, with the help of T-S and P-V diagrams. **(04 Marks)**

c. The stroke and cylinder diameters of a compression ignition engine are 250 mm and 150 mm respectively. If the clearance volume is 0.0004 m^3 and fuel injection takes place at constant pressure for 5 percent of the stroke determine the efficiency of the engine. Assume the engine working on the diesel cycle. **(08 Marks)**

3 a. Explain briefly the following frictional power determination methods: i) William's line method ii) Morse test method. **(08 Marks)**

b. Define following terms : i) Indicated power ii) Brake power iii) Mechanical efficiency iv) Specific fuel consumption v) Relative efficiency. **(05 Marks)**

c. The following observations were recorded in a test of one hour duration on a single cylinder oil engine working on four stroke cycle. Bore = 300 mm, Stroke = 450 mm, Fuel used = 8.8 kg, Calorific value of fuel = 41800 kJ/kg, Average speed = 200 rpm, m.e.p. = 5.8 bar, Brake friction load = 1860 N, Quantity of cooling water = 650 kg. Temperature rise = 22°C, Diameter of the brake wheel = 1.22 m, calculate : i) Mechanical efficiency ii) Draw the heat balance sheet. **(07 Marks)**

4 a. Why is Carnot cycle not practicable for a steam power plant? Briefly explain. **(04 Marks)**

b. Discuss the effect of, i) Boiler pressure ii) Condenser pressure iii) Superheat on the performance of a Rankine cycle. **(06 Marks)**

c. 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 T-S and h-S diagrams. Find i) Quality of steam at turbine exhaust ii) Cycle efficiency iii) Steam rate in kg/kwh. **(10 Marks)**

PART – B

5 a. What are the different methods to increase isothermal efficiency of air compressor? **(04 Marks)**

b. What are the advantages of multi-stage compression? **(04 Marks)**

c. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m^3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a final pressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both stages is 1.25 and the compressor runs at 600 rpm. Neglecting clearance determine i) The intermediate pressure ii) The total volume of each cylinder iii) Power required to drive the compressor and iv) The rate of heat rejection in the intercooler take $C_p = 1.005$ kJ/kgK and R = 0.287 kJ/kgK. **(12 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 $R_P = \left[\frac{T_3}{T_1}\right]^{\frac{\gamma}{2(\gamma-1)}}$. **(10 Marks)**

b. In a regenerative gas turbine cycle air enters the compressor at 1 bar, 15°C, pressure ratio 6. The isentropic efficiencies of compressor and turbine are 0.8 and 0.85 respectively. The maximum temperature in the cycle is 800°C. The regenerator efficiency is 0.78. Assume $C_P = 1.1$ KJ/kgK, $\gamma = 1.32$ for the combustion products find the cycle efficiency. **(10 Marks)**

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

b. With a neat sketch, describe clearly the working of a Bell-Coleman cycle. **(06 Marks)**

c. A refrigeration system of 10.5 Tonnes capacity at a evaporator temperature of -12°C and a condenser temperature of 27°C is needed in a food storage locker. The refrigerant Ammonia is sub cooled by 6°C before entering the expansion valve. The vapour is 0.95 dry as it leaves the evaporator coil. The compression in the compressor is of adiabatic type. Using P-H chart find i) Condition of vapour at the outlet of the compressor ii) Condition of vapour at entrance to evaporator iii) COP iv) Power required in kW Neglecting valve Throttling and clearance effect. **(10 Marks)**

8 a. Define the following clearly: i) Dry bulb temperature ii) Wet bulb temperature iii) Specific humidity. **(06 Marks)**

b. With a neat sketch, briefly describe a Summer-air conditioning system. **(06 Marks)**

c. It is required to design an air conditioning plant for a small office room for following winter conditions: Outdoor conditions: 14°C DBT and 10°C WBT, Required conditions = 20°C DBT and 60% RH, Amount of air circulation = 0.30 m^3/min/person, Seating capacity of office = 60.

The required condition is achieved first by heating and then by adiabatic humidifying. Determine the following: i) Heat capacity of the coil in kW and the surface temperature required if the by-pass factor of coil is 0.4 ii) The capacity of the humidifier using psychrometric chart. **(08 Marks)**

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10ME/AU44

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

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. Define the following, giving one example for each:
i) Kinematic chain ii) Mechanism iii) Structure
iv) Inversions v) Degree of freedom **(10 Marks)**

b. Explain with a neat sketch, the double slider crank chain mechanism and its inversions (any two inversions with application). **(10 Marks)**

2 a. Explain with a neat sketch crank and slotted lever quick return motion mechanism. **(08 Marks)**

b. Sketch Peaucellier's mechanism, and prove that it can trace a straight line. **(06 Marks)**

c. With a neat sketch, explain the condition for correct steering for Ackermann's mechanism. **(06 Marks)**

3 a. For the mechanism shown in Fig.Q3(a), the crank OA rotates at 20 rpm in CCW and gives motion to the blocks 'B' and 'D'. The dimensions of various links are OA = 300 mm, AB = 1200 mm, BC = 450 mm and CD = 450 mm. For the given configuration, determine:
i) velocity of the sliding block B and D.
ii) Angular velocity of CD
iii) Linear acceleration of 'D'

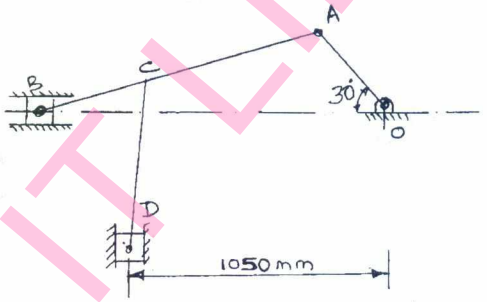


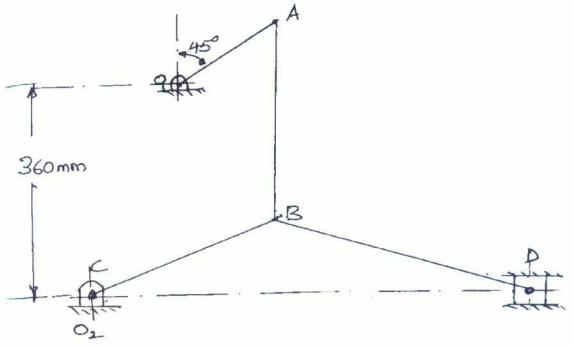
Fig.Q3(a) **(15 Marks)**

b. What is Corolis component of acceleration? Explain with an example and neat sketch. **(05 Marks)**

4 a. State and prove Kennedy's theorem. **(05 Marks)**

b. Explain the analysis of velocity and acceleration of a piston in a single slider crank mechanism using Klein's construction. **(05 Marks)**

c. Locate all the instantaneous centres of the mechanism shown in Fig.Q4(c). **(10 Marks)**



O_1A = 180 mm
CB = 240 mm
AB = 360 mm
BD = 540 mm

Fig.Q4(c)

PART – B

5 For an offset slider crank mechanism shown in Fig.Q5, write the loop close equation and determine the expression for,

i) Connecting rod angle and output displacement
ii) Angular velocity of connecting rod
iii) Angular acceleration of connecting rod
iv) Angular acceleration of piston.

(Use complex number method).

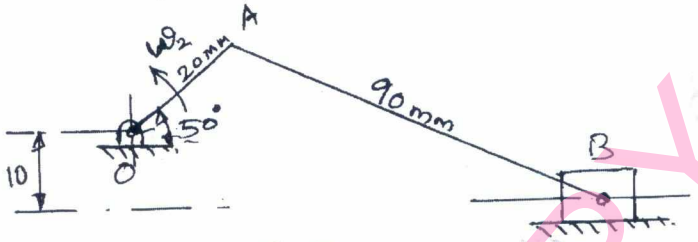


Fig.Q5

OA rotates with uniform angular velocity of 15 r/s.
OA = 20 mm AB = 90 mm **(20 Marks)**

6 a. Derive an expression to determine length of arc of contact for a pair of mating gears. **(10 Marks)**

b. A pair of gears having 40 and 30 teeth respectively are of 25 degree involute form. Addendum = 5 mm, module = 2.5 mm. If the smaller wheel is the driver and rotate at 1500 rpm, find the velocity of sliding at the point of engagement, at pitch point and at the point of disengagement, length of patch of contact and length of arc of contact. **(10 Marks)**

7 a. Explain with neat sketch, the classification of gear trains. **(06 Marks)**

b. The Fig.Q7(b) shows an epicyclic gear train where the arm 'A', the driver and annular gear 'D' is the follower. The wheel 'D' has 112 teeth and B has 48 teeth, 'B' runs freely on pin 'P' and 'D' is separately driven. The arm 'A' runs at 100 rpm and wheel 'D' at 50 rpm in same direction. Find the speed of wheel 'B' and 'C'.

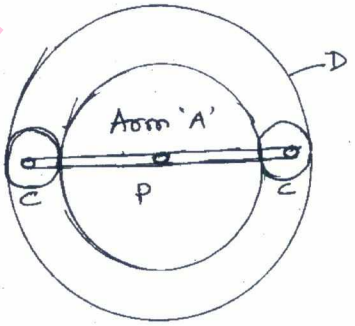


Fig.Q7(b) **(14 Marks)**

8 The following data relate to a cam profile in which, the roller follower moves with uniform acceleration and retardation motion during ascent and descent. Minimum radius of cam = 25 mm. Roller radius = 8 mm. Lift = 32 mm, offset of follower axis = 12 mm towards right, angle of ascent = 60°, angle of descent = 90°, angle of dwell between ascent and descent = 45°, speed of cam = 20 rpm clockwise. Draw the profile of cam. **(20 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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. Sketch a three principal views of a 25mm square tool bit having tool signature of 15, 15, 10, 10, 15, 10(3mm). Show the various angles over it. **(12 Marks)**

b. In an orthogonal cutting test with a tool of rake angle 10^0, the following observations were made : Chip thickness ratio = 0.3 ; Cutting force = 1290N ; Thrust force = 1650N. From Merchant's theory, calculate the Frictional force and Normal force on rake face, the shear force and Normal force on shear face and co-efficient of friction at the chip and tool interface. **(08 Marks)**

2 a. What are the desirable characteristics of a cutting tool material? Explain how these are satisfied in the case of HSS. **(10 Marks)**

b. With the help of sketch, explain the sources of heat generation in metal cutting. Show their approximate percentages. **(10 Marks)**

3 a. Differentiate between a Capstan and a turret lathes. **(06 Marks)**

b. A mild steel plate 500mm × 750mm × 25mm is to be shaped along its wider face by taking only one cut. The ratio of return time to cutting time is 2:3 and the feed per cycle is 3mm. Tool approach and the over travel are 40mm each. The cutting speed is 24m/min. The side clearance is 5mm on each side. Calculate the time required for machining the given plate on the shaper. **(08 Marks)**

c. Explain the following planer operations :
i) Planning horizontal surface ii) Planning vertical surface. **(06 Marks)**

4 a. Describe i) Gang drilling machine ii) Multi spindle drilling machine. **(08 Marks)**

b. Show with neat sketches, the constructional features of twist drill and label the important features. **(06 Marks)**

c. List the different types of holes commonly used in engineering components and processes used to produce them. **(06 Marks)**

PART - B

5 a. Explain the following Milling methods :
i) Peripheral milling ii) Face milling iii) End milling. **(09 Marks)**

b. Explain the principal parts of column and knee type of milling machine. **(05 Marks)**

c. With a neat sketch, explain the differential indexing mechanism. **(06 Marks)**

6 a. Describe the designation process of manufacture and properties of following grinding wheels with i) Vitrified bond ii) Rubber bond. **(12 Marks)**

b. Explain principle of centreless grinding machine and advantages of it. **(08 Marks)**

7 a. With the help of diagram, explain the construction of a pull broach. **(08 Marks)**

b. What is Lap? What for it is used and how does it differ from grinding. **(06 Marks)**

c. With the help of sketch, explain the construction of honing tool. **(06 Marks)**

8 a. List and explain the equipments of Ultrasonic machining. **(06 Marks)**

b. With a sketch, explain the laser beam machining. **(08 Marks)**

c. Describe the process parameters of Abrasive Jet machining. **(06 Marks)**

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10ME/AU46B

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. Define Fluid, Bringham plastic fluid and Newtonian fluid. Show the variation of Bringham fluid and Newtonian Fluid on Shear Stress – Strain Rate diagram. **(06 Marks)**

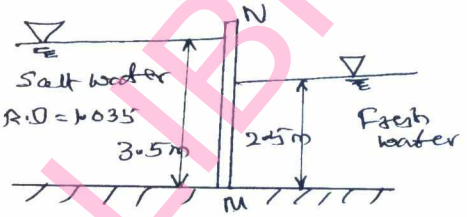
b. A 90N rectangular solid block slides down a 30^0 inclined plane. The plane is lubricated by 3mm thick film of oil of relative density 0.9 and viscosity 8 poise. If the contact area is $0.3m^2$, estimate the terminal velocity of the block. **(06 Marks)**

c. Derive an expression for bulk modulus of elasticity for gas undergoing compression by i) Isothermal process ii) Adiabatic process. **(08 Marks)**

2 a. For an inclined plane surface, submerged in liquid, show that the centre of pressure lies below the centre of gravity of the plane surface. **(08 Marks)**

b. A sheet piling holds fresh water and salt water (Relative Density = 1.035) on either side of it as shown in Q2(b). Find the moment about the base 'M' of the resultant force per unit length of piling. **(08 Marks)**

Fig.Q2(b)



c. State Hydrostatic law and Pascal's law. **(04 Marks)**

3 a. A wooden block in the form of rectangular prism floats with its shortest axis vertical. The block is 40cm long, 20 cm wide and 15cm deep with a depth of immersion of 12cm. Calculate the meta centre position and comment on the stability of the block. **(10 Marks)**

b. Verify whether the potential function $\phi = m\,\ell n(x)$ is valid or not. **(04 Marks)**

c. A flow is described by the stream function $\psi = 2\sqrt{3}\,(xy)$. Locate the point at which the velocity vector has a magnitude of 4 units and makes an angle of 150^0 with the X – axis. **(06 Marks)**

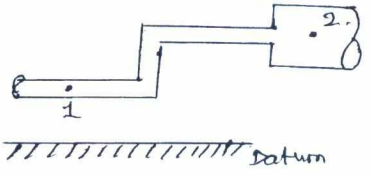
4 a. Stating the assumptions, derive an expression for Euler's equation of motion. **(06 Marks)**

b. For the pipe flow system shown in fig. Q4(b), the following data are available : **(08 Marks)**

Parameter	Point 1	Point 2
Diameter	20 cm	30 cm
Elevation	103m	106m
Pressure	55kPa	75kPa
Velocity	2.5M/s	---

Determine the direction of flow and the loss of energy between these two points.

Fig.Q4(b)



c. A conical tube of length 2.0m is fixed vertically with its smaller end upwards. The velocity of flow at smaller end is 5 m/s while at the lower end is 2m/s. Pressure head at the smaller end is 2.5m of the liquid. The loss of head in the tube is $0.35\frac{(V_1^2 - V_2^2)}{2g}$, where V_1 and V_2 are velocity of flow at smaller and larger end respectively. Determine the pressure head at the lower end. Flow occurs from smaller end to larger end. **(06 Marks)**

PART - B

5 a. Show that the theoretical discharge through the triangular notch is given by

$$\theta = \frac{8}{15}\tan\left(\frac{\theta}{2}\right)\sqrt{2g}\ H^{5/2}.$$ **(10 Marks)**

b. 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 ΔP. **(10 Marks)**

6 a. For a flow through pipe, derive Darcy – Weisbach equation. **(08 Marks)**

b. 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 $h_f = \frac{4fLV^2}{2gd}$. See the sketch Q6(b). **(08 Marks)**

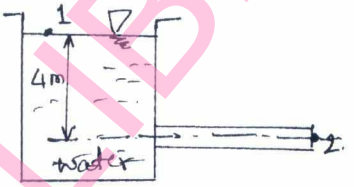


Fig.Q6(b)

c. Define and write expression for Hydraulic gradient line and Total Energy Line. **(04 Marks)**

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

b. The flow of liquid in a circular pipe is laminar. At what radial distance from the wall of the pipe, the local velocity is half of the maximum velocity, if the diameter of the pipe is 50mm. **(06 Marks)**

c. There are two pipes A and B. Diameter of the pipe B is half of diameter of pipe A. Both pipes have same length and same fluid flows through each pipe. If volumetric flow rate is maintained same in both the pipes, compare the loss of head. Assume flow to be laminar. **(04 Marks)**

8 a. Define i) Boundary layer ii) Displacement thickness iii) Momentum thickness and iv) Energy thickness. **(08 Marks)**

b. Find the displacement thickness for the velocity distribution in the boundary layer given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$ **(04 Marks)**

c. Define Mach number. With neat sketches, explain the propagation of disturbance for M = 1 and M > 1. **(08 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Find the direction cosines of the line which is perpendicular to the lines with direction cosines (3, -1, 1) an (-3, 2, 4). **(06 Marks)**

b. If $\cos\alpha$, $\cos\beta$, $\cos\gamma$ are the direction cosines of a line, then prove the following:

i) $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$

ii) $\cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1$ **(07 Marks)**

c. Find the projection of the line AB on the line CD where A = (1, 2, 3), B = (1, 1, 1), C = (0, 0, 1), D = (2, 3, 0). **(07 Marks)**

2 a. Find the equation of the plane through (1, -2, 2), (-3, 1, -2) and perpendicular to the plane $2x - y - z + 6 = 0$. **(06 Marks)**

b. Find the image of the point (1, -2, 3) in the plane $2x + y - z = 5$. **(07 Marks)**

c. Find the shortest distance between the lines $\frac{x-8}{3} = \frac{y+9}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$. **(07 Marks)**

3 a. Find the constant 'a' so that the vectors $2i - j + k$, $i + 2j - 3k$ and $3i + aj + 5k$ are coplanar. **(06 Marks)**

b. Prove that $\left[\vec{a}+\vec{b},\ \vec{b}+\vec{c},\ \vec{c}+\vec{a}\right] = 2\left[\vec{a},\vec{b},\vec{c}\right]$. **(07 Marks)**

c. Find the unit normal vector to both the vectors $4i - j + 3k$ and $-2i + j - 2k$. Find also the sine of the angle between them. **(07 Marks)**

4 a. A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 5$ where t is the time. Find the components of its velocity and acceleration at time t = 1 in the direction of $2i + 3j + 6k$. **(06 Marks)**

b. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $x = z^2 + y^2 - 3$ at the point (2, -1, 2). **(07 Marks)**

c. Find the directional derivative of $\phi = xy^2 + yz^3$ at the point (1, -2, -1) in the direction of the normal to the surface $x\log z - y^2 = -4$ at (-1, 2, 1). **(07 Marks)**

5 a. Prove that $\text{div}(\text{curl}\,\vec{A}) = 0$. **(06 Marks)**

b. Find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. **(07 Marks)**

c. Show that the vector $\vec{F} = (3x^2 - 2yz)i + (3y^2 - 2zx)j + (3z^2 - 2xy)k$ is irrotational and find ϕ such that $\vec{F} = \text{grad}\,\phi$. **(07 Marks)**

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

b. Find: i) $L\{e^{-t}\cos^2 t\}$, ii) $L\{te^{-t}\sin 3t\}$. **(07 Marks)**

c. Find: $L\left\{\frac{\cos at - \cos bt}{t}\right\}$. **(07 Marks)**

7 a. Find: $L^{-1}\left\{\frac{4s+5}{(s-1)^2(s+2)}\right\}$. **(06 Marks)**

b. Find: i) $L^{-1}\left\{\frac{s+2}{s^2-4s+13}\right\}$, ii) $L^{-1}\left\{\log\left(\frac{s+a}{s+b}\right)\right\}$. **(07 Marks)**

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

8 a. Using Laplace transforms, solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^{2t}$ with $y(0) = 0$, $y'(0) = 1$. **(10 Marks)**

b. Using Laplace transformation method solve the differential equation $y'' + 2y' - 3y = \sin t$, $y(0) = y'(0) = 0$. **(10 Marks)**

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