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06MAT41

Fourth Semester B.E. Degree Examination, December 2011
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Given $\frac{dy}{dx} = \frac{1}{1+x^2} - 2y^2$, y(0) = 0. Find y(0.5) in two steps, using the modified Euler's method. **(07 Marks)**

b. Using the 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 = 0.1. **(07 Marks)**

c. Given $2dy/dx = (1+x^2)y^2$ and y(0) = 1, y(0.1) = 1.06, y(0.2) = 1.12, y(0.3) = 1.21. Evaluate y(0.4) by Milne's method. **(06 Marks)**

2 a. Obtain the necessary conditions in the Cartesian system, for a function f(z) to be analytic in a region R. **(07 Marks)**

b. Find the analytic function f(z) = u + iv, given $u - v = e^x(\cos y - \sin y)$. **(07 Marks)**

c. Find the bilinear transformation that maps the points 0, -i, -1 of z-plane onto the points i, 1, 0 of w-plane respectively. **(06 Marks)**

3 a. State and prove Cauchy's integral formula. **(07 Marks)**

b. Obtain the power series which represents the function $f(z) = \frac{z^2-1}{z^2+5z+6}$, in the following regions: i) $|z| < 2$ ii) $2 < |z| < 3$ iii) $|z| > 3$ **(07 Marks)**

c. Using the Cauchy's residue theorem, evaluate the integral $\int_C \frac{z^2}{(z-1)^2(z+2)} dz$, where c is the circle $|z| = 5/2$. **(06 Marks)**

4 a. Solve in series the equation, $\frac{d^2y}{dx^2} + x^2y = 0$. **(07 Marks)**

b. Solve the Bessel's equation of order n given by, $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0$ where n is a non-negative real constant. **(07 Marks)**

c. With the usual notations, show that

$$x^4 - 3x^2 + x = \frac{8}{35}P_4(x) - \frac{10}{7}P_2(x) + P_1(x) - \frac{4}{5}P_0(x)$$ **(06 Marks)**

PART – B

5 a. The pressure and volume of a gas are related by the equation $PV^\gamma = k$, γ and k being constants. Fit this equation for the following set of observations:

P(kg/cm²)	0.5	1.0	1.5	2.0	2.5	3.0
V(litres)	1.62	1.00	0.75	0.62	0.52	0.46

(07 Marks)

b. While calculating correlation coefficient between two variables x and y from 25 pairs of observations, the following results were obtained:

$n = 25$, $\Sigma x = 125$, $\Sigma x^2 = 650$, $\Sigma y = 100$, $\Sigma y^2 = 460$, $\Sigma xy = 508$.

Later it was discovered at the time of checking that the pairs of values.

x	y
8	12
6	8

were copied down as

x	y
6	14
8	6

Obtain the correct value of correlation coefficient. **(07 Marks)**

c. A box contains 500 IC chips of which 100 are manufactured by company X and the rest by company Y. It is estimated that 10% of the chips made y company X and 5% made by company Y are defective. If a randomly selected chip is found to be defective, find the probability that it came from company X. **(06 Marks)**

6 a. A die is tossed thrice. A success is getting 1 or 6 on a toss. Find the mean and variance of the number of successes. **(07 Marks)**

b. For the Poisson distribution, prove that, $P(r) = \frac{e^{-m}m^r}{r!}$, where m is the mean of distribution. **(07 Marks)**

c. Fit a normal distribution to the following data:

x :	1	3	5	7	9
y :	2	2	3	2	1

(06 Marks)

7 a. Explain the meanings of i) Null hypothesis type-I and type-II errors ii) Level of significance. **(07 Marks)**

b. Eleven school boys were given a test in drawing. They were given months further tuition and a second test of equal difficulty was held at the end of it. Do the following marks give evidence that the students have benefited by extra coaching? **(07 Marks)**

Boys	1	2	3	4	5	6	7	8	9	10	11
Marks I test	23	20	19	21	18	20	18	17	23	16	19
Marks II test	24	19	22	18	20	22	20	20	23	20	17

c. A survey of 64 families with 3 children each is conducted and the number of male children in each family is noted. The results are tabulated as follows:

Male children	0	1	2	3	Total
Families	6	19	29	10	64

Apply Chi-square test of goodness of fit to test whether male and female children are equiprobable. **(06 Marks)**

8 a. Compute i) $P(x = 1, y = 2)$ ii) $P(x \geq 1, y \leq 2)$ iii) $P(x \leq 1, y \leq 2)$ iv) $P(x + y \geq 2)$, using the following joint probability distribution for x and y. **(07 Marks)**

x \ y	0	1	2	3	Sum
0	0	1/8	1/4	1/8	1/2
1	1/8	1/4	1/8	0	1/2
Sum	1/8	3/8	3/8	1/8	1

b. Discuss : i) Absorbing state ii) Transient state iii) Recurrent state iv) Periodic state. **(07 Marks)**

c. A software engineer goes to his work place every day by motor bike or by car. He never goes by bike on two consecutive days but it he goes by car on a day then he is equally likely to go by car or by bike on the next day. Find the transition matrix for the chain of the mode of transport he uses. If car is used on the first day of week, find the probability that i) bike is used ii) car is used on the fifth day. **(06 Marks)**

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06ME42A

Fourth Semester B.E. Degree Examination, December 2011
Materials Science and Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define atomic packing factor. Draw the sketch of HCP unit cell. Determine its atomic packing factor. **(08 Marks)**

b. State and explain the Fick's first law of diffusion. Discuss the various factors affecting atomic diffusion. **(08 Marks)**

c. The density of iron is 7.86 g/cm^3 and its atomic weight is 55.85. Calculate its atomic radius. **(04 Marks)**

2 a. Define hardness. Explain in detail, the Brinell hardness testing, with a sketch. **(08 Marks)**

b. Derive an expression for the critical solved shear stress for slip, with a sketch. **(06 Marks)**

c. A 15 mm diameter tensile bar of aluminum alloy is pulled in tension. It has a gauge length of 60mm. The load corresponding to 0.2% offset is 37500 N and the maximum load is 45,000 N. frcture take place at 44290 N. The diameter after fracture is 14.5 mm and gauge length of fracture is 63.9 mm. Calculate the i) 0.2% proof stress ii) tensile strength iii) the % of elongation iv) the % of reduction in area v) engineering stress at the fracture. **(06 Marks)**

3 a. Define creep and explain a typical creep curve. **(08 Marks)**

b. Explain briefly the ducttle to brittle transition. **(06 Marks)**

c. Explain the factors affecting the fatigue life. **(06 Marks)**

4 a. Define solid solutions. Explain the different types of solid solutions, with neat sketches. **(08 Marks)**

b. State and explain Gibb's phase rule and lever rule. **(06 Marks)**

c. A binary alloy A – 50 % B contains, at a particular temperature, two solid phases α and β. The composition of α and β are 5% B and 95% B respectively. Calculate the amount of α and β in the alloy. **(06 Marks)**

PART – B

5 a. Draw the phase diagram for the Fe – Fe_3C system. Label all the phase fields and write down the three invariant reactions involved in the Fe – Fe_3C system. **(10 Marks)**

b. What are TTT curves? Explain with a neat sketch, the same, for eutectiod steel. Also explain the various transformed products of austenite, on cooling. **(10 Marks)**

6 Write a brief note on the following : a. Jorminy end quench test b. Carburizing c. Heat treatment of non –ferrous alloys d. Induction hardening. **(20 Marks)**

7 a. Compare the microstrucutre, composition, properties and application of SG iron and gray CI. **(10 Marks)**

b. Explain the modification of Al – Si alloy. **(05 Marks)**

c. Explain the effect of alloying elements on the properties of steel. **(05 Marks)**

8 a. Explain the general methods of corrosion control and prevention. **(10 Marks)**

b. What is corrosion? Explain with a sketch the galvanic cell. **(10 Marks)**

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06ME42B

Fourth Semester B.E. Degree Examination, December 2011
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Describe the procedure for deriving the end standard form the line standard. **(08 Marks)**

b. Three 100 mm gauges are measured on a level comparator by first wringing them together and then comparing with 300 mm gauge and intercomparing them. The 300 mm gauge actually measures 300.0025 mm and three gauges together have a combination length of 300.0035 mm. Gauge A is 0.0020 mm longer than gauge B but shorter than gauge C by 0.0010 mm. Determine the corrected length of each gauge. **(08 Marks)**

c. Build up a dimension of 128.45 mm and 67.465 mm using two protector slips of 2.5 mm at both sides. Use M – 112 slip gauge set. **(04 Marks)**

2 a. With a neat sketch, explain the hole basis system and the shaft basis system of fits. Which system is prefered and why? **(10 Marks)**

b. Design GO and NOGO gauges to control the production of 25 H_7f_8, being given with usual notation $i = 0.45\sqrt[3]{D} + 0.001D$ microns. Fundamental deviation for f shaft is $-5.5D^{0.41}$ microns. 25 mm lies in step of 18 – 30 mm. Multipliers for IT_7 and IT_8 grades are 16i and 25i respectively. **(10 Marks)**

3 a. Differentiate measuring instruments, gauges and comparators. **(06 Marks)**

b. Describe the construction and working of a sigma comparator with the help of a neat sketch. Mention its advantages. **(10 Marks)**

c. Build up the following angles :
i) $57^\circ 34'9''$; ii) $31^\circ 49'24''$ **(04 Marks)**

4 a. With a neat sketch, explain the working principle of an auto collimator. **(06 Marks)**

b. With the set up, explain how the effective diameter of screw thread is measured using the 3 wire method. **(08 Marks)**

c. Explain with a neat sketch, the gear tooth vernier calliper. **(06 Marks)**

PART – B

5 a. Explain the working of generalized measurement system with a block diagram, taking a suitable example. **(08 Marks)**

b. Explain any three system response characteristics. **(06 Marks)**

c. Explain the basic principle of capacitive transducers. With a neat sketch, explain the changing dielectric constant type capacitive transducer. **(06 Marks)**

6 a. Explain the inherent problems associated with a mechanical intermediate modifying system. **(06 Marks)**

b. Explain with a neat sketch/circuit diagram, i) Ballast circuit ; ii) Electronic amplifiers. **(08 Marks)**

c. With a neat sketch, explain the light beam oscillagraph. **(06 Marks)**

7 a. Sketch and explain the working principle of a proving ring. **(06 Marks)**

b. Explain with a neat sketch the wooden block proney brake dynamometer. **(06 Marks)**

c. With a neat sketch, explain the Bridgeman gauge, used for pressure measurement. **(08 Marks)**

8 a. State the laws of thermocouple. **(06 Marks)**

b. With a neat sketch, explain the optical pyrometer. **(08 Marks)**

c. Write a note on the following, with respect to strain gauges : i) Gauge factor ; ii) Temperature compensation. **(06 Marks)**

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06ME43

Fourth Semester B.E. Degree Examination, December 2011
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/charts/tables is permitted.
3. Any missing data may be assumed suitably.

PART – A

1 a. Distinguish between: i) Theoretical air and excess air
ii) Higher calorific value and lower calorific value. **(04 Marks)**

b. Define the terms: i) Enthalpy of formation ii) Enthalpy of combustion
iii) Adiabatic flame temperature iv)Combustion efficiency **(04 Marks)**

c. Find the stoichiometric air for the combustion of gaseous propane (C_3H_8) on mass basis and molar basis. **(04 Marks)**

d. 4.4 kg propane gas is burnt completely with 3.0 kmol of air. Find the excess air and the molar analysis of the dry combustion products. **(08 Marks)**

2 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle. **(08 Marks)**

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

c. A four stroke, four cylinder petrol engine of 250mm bore and 375mm stroke works on the Otto cycle. The clearance volume is $0.01052m^3$. The initial pressure and temperature are 1 bar and 47°C. If the maximum pressure is limited to 25bar, find the following:
i) Air standard efficiency ii) Mean effective pressure. **(08 Marks)**

3 a. Derive an expression for the optimum pressure ratio, for the maximum network output, in an Brayton cycle. What is the corresponding cycle efficiency? **(06 Marks)**

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

c. In a reheat gas turbine cycle, comprising one compressor and two turbines, air is compressed from 1 bar, 27°C to 6 bar. The highest temperature in the cycle is 900°C. The expansion in the first stage turbine is such that the work from it just equals the work required by the compressor. Air is reheated between the two stages of expansion to 850°C. Assume that the isentropic efficiency of the compressor, the first stage and the second stage turbines are 85% each and that the working substance is air. Calculate the cycle efficiency. **(12 Marks)**

4 a. Discuss the effect of i) Boiler pressure and ii) Condenser pressure, on the performance of a Rankine cycle. **(04 Marks)**

b. Explain the working of the regenerative Rankine cycle with one feed-water heater. **(04 Marks)**

c. In a reheat cycle, steam at 500°C expands in a HP turbine till it is saturated vapour. It is then reheated at constant pressure to 400°C and then expanded in a LP turbine to 40°C. If the maximum moisture content at the turbine exhaust is limited to 15% find, i) the reheat pressure, ii) the pressure of steam at the inlet to the HP turbine. iii) the net specific work output iv) the cycle efficiency v) the steam rate. Assume all the ideal processes. **(12 Marks)**

PART – B

5 a. What are the drawbacks of a single stage compressor for producing high pressure? How are these overcome by multistage compression? **(05 Marks)**

b. Derive an expression for the condition for the minimum work input, required for a two stage compressor, with perfect intercooling. **(07 Marks)**

c. A two stage, single acting reciprocating air compressor, with complete intercooling atmospheric air at 1 bar and 15°C, compresses it polytropically (n = 1.3) to 30 bar. If both cylinders have the same stroke, calculate the diameter of the HP cylinder. The diameter of the LP cylinder is 300mm. **(08 Marks)**

6 a. Explain the effect of superheat and subcooling on the vapour compression cycle with the help of T-S and p-h diagrams. **(06 Marks)**

b. With a neat sketch, explain the working of vapour absorption refrigeration system. **(07 Marks)**

c. In a saturated vapour compression refrigeration cycle operating between an evaporator temperature of -10°C and a condenser temperature of 40°C, the enthalpy of the refrigerant , Freon-12 at the end of compression is 220 kJ/kg. Show the cycle on T-S and p-h planes. Calculate i) COP ii) refrigerating capacity and compressor power assuming a refrigerating flow rate of 1 kg/min. **(07 Marks)**

7 a. Define: i) Relative humidity ii) Specific humidity iii) Dew point temperature iv) Enthalpy of humid air v) Degree of saturation. **(05 Marks)**

b. With a schematic diagram, explain the summer air conditioning system, for hot and wet weather. **(07 Marks)**

c. For a hall to be air-conditioned, the following conditions are given:
Outdoor conditions: 40° DBT, 20°C WBT, required comfort condition - 20°C WBT, 60% RH. Seating capacity of the hall is 1500, amount of outdoor air supplied = 0.3 m^3/min per person. If the required condition is achieved first by adiabatic humidification and then by cooling, estimate i) the capacity of the cooling coil in tones and ii) the capacity of the humidifier in kg/h. **(08 Marks)**

8 a. Describe the principle of conducting Morse test on IC engines. **(04 Marks)**

b. A single cylinder four stroke diesel engine works on the following data:
Cylinder bore = 15cm, stroke = 25cm, speed = 250 rpm, area of indicator diagram = 6 cm^3, length of the indicator diagram = 9 cm, spring constant = 7.5 bar/cm, brake specific fuel consumption = 0.24 kg/kWhr, calorific value = 42000 kJ/kg, diameter of brake wheel = 70cm, rope diameter = 3.5cm, brake load = 40kg. Calculate i) brake power ii) indicated mean effective pressure iii) Indicated power iv) Mechanical efficiency v) Indicated thermal efficiency. **(08 Marks)**

c. The following data were obtained from a Morse test on a 4-cylinder, 4-stroke cycle SI engine coupled to a hydraulic dynamometer, operating a constant speed of 1500 rpm.

Brake load with all four cylinders firing = 296 N
Brake load with cylinder No.1 not firing = 201 N
Brake load with cylinder No.2 not firing = 206 N
Brake load with cylinder No.3 not firing = 192 N
Brake load with cylinder No.4 not firing = 200 N

The brake power in kW is calculated using the equation BP = WN/42300, where W is the brake load in Newtons and N is the speed of the engine in rpm. Calculate
i) Brake power ii) Indicated power iii) Friction power iv) Mechanical efficiency.
(08 Marks)

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06ME44

Fourth Semester B.E. Degree Examination, December 2011
Kinematics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following, with sketches:
i) Link ii) Mechanism iii) Machine iv) Inversion. **(08 Marks)**

b. Explain: i) Lower pairs ii) Higher pairs. **(06 Marks)**

c. Describe with a neat sketch, the crank and slotted lever mechanism, an inversion of a slider crack mechanism. **(06 Marks)**

2 a. Explain the Whitworth quick return motion mechanism, with a neat sketch. **(10 Marks)**

b. Derive the expression for necessary condition of correct steering. Explain with a neat sketch, the Ackerman steering gear mechanism. **(10 Marks)**

3 A single slider crank mechanism shown in Fig.Q3, has the crank CB = 100mm and connecting rod BA = 300mm, with centre of gravity G 100mm from B. The crankshaft has a speed of 75 rad/sec and an angular acceleration of 1200 rad/sec^2. Find
i) The velocity of G and the angular velocity of AB.
ii) The acceleration of G and angular acceleration of AB. **(20 Marks)**

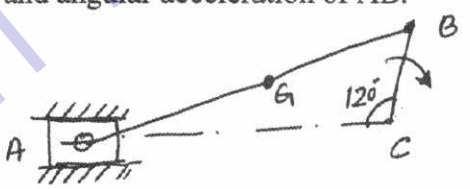

Fig.Q3

4 a. Locate all the instantaneous centres and find the angular velocity of the link BC. The link dimensions of the mechanism are AB = 300mm, BC = BD = 360mm and AD = 600mm. The angle BAD = 60°. The crank rotates at 100 rpm. [Refer Fig.Q4(a)] **(10 Marks)**

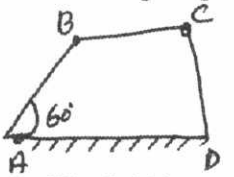

Fig.Q4(a)

b. The lengths of the crank and the connecting rod of a reciprocating engine are 200mm and 700mm respectively. The crank rotates in clockwise direction at 120 rad/sec. When the crank is at 30°C to TDC, by using the Klein's construction, determine
i) The velocity and acceleration of the piston ii)Angular velocity and acceleration of the CR. **(10 Marks)**

PART – B

5 The crank and connecting rod of an engine are 0.3m and 1.5 in length respectively. The crank rotates at 180 rpm clockwise. Determine the velocity and acceleration of the piston when the crank is 40° from TDC. Also determine the position of the crank for zero acceleration of the piston. **(20 Marks)**

6 a. Derive the expression for the length of arc of contact in a pair of spur gears in a mesh. **(08 Marks)**

b. Two mating gears have 20 and 40 involute teeth of module 10mm and 20° pressure angle. The addendum of each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum length for each wheel, length of path of contact, arc of contact and contact ratio. **(12 Marks)**

7 a. Explain with a neat sketch the "Sun & planet wheel". **(04 Marks)**

b. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth, respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of gear A which is fixed, determine the speed of the gear B, if the gear A instead of being fixed, makes 300 rpm in the clockwise direction. [Refer Fig.Q7(b)]. **(16 Marks)**

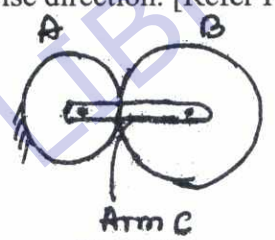

Fig.Q7(b)

8 Construct the profile of a cam to suit the following specifications:

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

No. of pauses are two of equal interval between motion.

During the lift the motion is SHM. During the fall motion is UARM. The speed of camshaft is uniform. The line of stroke is offset to 12.5mm from the centre of the cam. **(20 Marks)**

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06ME45

Fourth Semester B.E. Degree Examination, December 2011
Manufacturing Processes – II

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With neat sketches, explain the difference between orthogonal cutting and oblique cutting. **(06 Marks)**

b. With a neat sketch, briefly explain the following, for a single point cutting tool :
i) Back rake angle ; ii) End clearance angle ; iii) Side rake angle ; iv) Side relief angle. **(08 Marks)**

c. The following are the details during turning of a mild steel work piece :
feed = 0.19mm/rev , chip thickness = 0.385mm , depth of cut = 2mm.
Calculate : i) Chip thickness ratio ; ii) shear angle. **(06 Marks)**

2 a. Briefly explain the desirable properties of a cutting tool material. **(05 Marks)**

b. Write short notes on the following cutting tool materials :
i) Cemented tungsten carbide ; ii) HSS. **(05 Marks)**

c. List any five factors for selecting a cutting fluid. **(05 Marks)**

d. Write short notes on the heat generated during metal cutting. **(05 Marks)**

3 a. Explain with a neat sketch, the main parts of a turret lathe. **(08 Marks)**

b. Explain with a neat sketch, hydraulic shaper quick return mechanism. **(08 Marks)**

c. A shaping machine is used to machine a rectangular piece 18cm long and 35cm width, with cutting speed being 26 m/min. Feed is 0.8 mm/cycle. Cutting stroke is adjusted to 20cm. Time for cutting to return stroke is 3:2. Find the time required for machining the whole surface. **(04 Marks)**

4 a. With simple sketches, explain : i) Reaming ; ii) Boring. **(04 Marks)**

b. With a neat sketch, explain the radial drilling machine. **(06 Marks)**

c. Explain with a neat sketch, the geometry of a twist drill. **(04 Marks)**

d. A 12mm hole is to be drilled through a 20mm thick plate. The cutting speed is 12mm/min and the feed rate is 0.12 mm/rev. Estimate the machining time. Take the over travel plus the clearance of the tool as 5mm. **(06 Marks)**

PART – B

5 a. Differentiate between upmilling and down milling. Show the chip cross section with figures for both the operations. **(06 Marks)**

b. Sketch and explain the slabmilling and gang milling operations. **(08 Marks)**

c. Classify milling machines, briefly. **(06 Marks)**

6 a. Explain the different types of abrasives. **(06 Marks)**

b. Differentiate between traverse and plunge grinding. **(06 Marks)**

c. Explain with neat sketches : i) Centreless grinding ; ii) Internal grinding. **(08 Marks)**

7 a. Sketch and explain the process of lapping on a lapping machine. **(10 Marks)**

b. What is honing? Explain the vertical honing process. **(07 Marks)**

c. List the advantages and applications of honing. **(03 Marks)**

8 a. With a neat sketch, briefly explain the operation of cutting, using a laser beam. **(10 Marks)**

b. With a neat sketch, briefly explain the principle involved in water jet machining. **(10 Marks)**

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06ME46B

Fourth Semester B.E. Degree Examination, December 2011
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. Define the following properties of a fluid and mention the phenomena associated with each property i) Capillarity and ii) Surface tension. **(04 Marks)**

b. Define compressibility. Derive an expression for the bulk modulus of elasticity for a perfect gas, undergoing the isothermal process. **(06 Marks)**

c. Calculate the capillary effect in mm in a glass tube of 3mm diameter, when, immersed in mercury. The value of the surface tension for mercury at 20°C in contact with air is 0.51 N/m. Contact angle for mercury = 130°. Also sketch the mercury surface inside and outside the tube indicating the angle of contact clearly. **(06 Marks)**

d. If the equation of velocity profile over a flat plate is $V = 2y^{2/3}$ where 'v' is the velocity in m/s and 'y' is the distance in m, determine shear stress at y = 75 mm. Take $\mu = 8.35$ poise. **(04 Marks)**

2 a. Define : i) Buoyancy and centre of buoyancy ; ii) Metacentre and metacentric height. **(04 Marks)**

b. Show that the centre of pressure lies below the centre of gravity of the vertical surface submerged in a liquid. **(08 Marks)**

c. As shown in the Fig.Q.2(c), pipe M contains carbon tetrachloride of specific gravity 1.594 under a pressure of 1.05 bar and pipe N contains oil of specific gravity 0.8. If the pressure in the pipe N is 1.75 bar and the manometric fluid is mercury, find the difference x between the levels of mercury. **(08 Marks)**

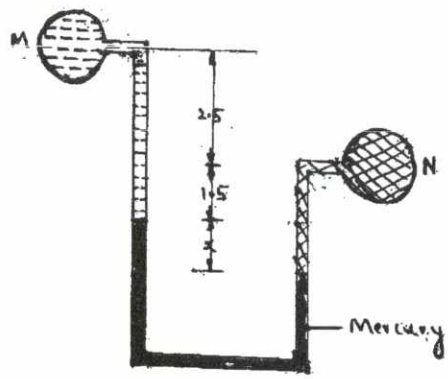

Fig.Q.2(c)

3 a. Differentiate between :
i) Lagrangian approach and Eulerian approach.
ii) Steady flow and uniform flow. **(04 Marks)**

b. Derive with usual notations, the continuity equation for 3 – D flow in the form $\frac{\partial \rho}{\partial t}+\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}=0$. Modify the equation for steady flow and incompressible flow. **(10 Marks)**

c. Sketch the streamlines represented by $\psi = x^2 + y^2$. Also find out the velocity and its direction at the point (1, 2). **(06 Marks)**

4 a. Explain the dimensional homogeneity, with an example. **(04 Marks)**

b. Define the following dimensionless numbers and mention their significance in fluid flow problems :

i) Reynold's no. ; ii) Froude's no. ; iii) Mach no. **(06 Marks)**

c. Prove that the discharge over a spillway is given by the relation using Buckingham's II – theorem.

$$Q = VD^2 \ f\left(\frac{\sqrt{gD}}{v}, \frac{H}{D}\right)$$

Where V = velocity of flow, D = Depth at the throat, H = Head of water, g = Acceleration due to gravity. **(10 Marks)**

PART – B

5 a. State Bernoulli's theorem for the steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from the first principles. **(10 Marks)**

b. Gasoline (sp.gr = 0.8) is flowing upwards through a vertical pipe, which tapers in diameter from 30cm to 15 cm. A gasoline mercury differential manometer is connected between 30cm and 15cm pipe section to measure the rate of flow. The distance between the manometer tapping is 1m and gauge reading is 50 cm of mercury.

i) Find the differential gauge reading in terms of gasoline head.

ii) Using Bernoulli's equation and the equation of continuity, find the rate of flow. Neglect the losses between tappings. **(10 Marks)**

6 a. Explain how velocity of flow at any point in a pipe or a channel can be measured, with a pitot tube. **(06 Marks)**

b. At a sudden enlargement of a water line from 240 mm to 480 mm diameter pipe, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. **(08 Marks)**

c. An orifice meter with orifice diameter 10cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. C_d for the meter is 0.6. Find the discharge of water through the pipe. **(06 Marks)**

7 a. There is a horizontal crack 40 mm wide and 2.5 mm deep in a wall of thickness 100 mm. Water leaks through the crack. Find the rate of leakage of water through the crack, if the difference of pressures between the two ends of the crack (fixed plates) is 0.02943 N/cm^2. Take the viscosity of water equal to 0.01 poise. **(06 Marks)**

b. Sketch the shear stress and velocity profile across a section of a circular pipe, for the viscous flow. Derive the expressions governing shear stress and velocity profile. **(14 Marks)**

8 a. Derive an expression for the velocity of sound in terms of bulk modulus (k). **(06 Marks)**

b. Define the following :

i) Boundary layer thickness

ii) Displacement thickness

iii) Momentum thickness. **(06 Marks)**

c. A flat plate 1.5m × 1.5m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. If the co-efficients of drag and lift are 0.15 and 0.75 respectively, determine :

i) The lift force

ii) The drag force

iii) The resultant force

iv) The power required to keep the plate in motion. **(08 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, December 2011
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions***

1 a. If (ℓ, m, n) be the direction cosines of a line then prove that $\ell^2 + m^2 + n^2 = 1$. **(06 Marks)**

b. Find the angle between the two lines whose direction cosines satisfy the equations $\ell + m + n = 0$ and $2\ell + 2m - nm = 0$. **(07 Marks)**

c. Show that the angle between any two diagonals of a cube is $\cos^{-1}(1/3)$. **(07 Marks)**

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

b. Find the image of the point $(1, 1, 2)$ in the plane $2x + y + z - 3 = 0$. **(07 Marks)**

c. Find the shortest distance and equation between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and the x – axis. **(07 Marks)**

3 a. Find the value of λ so that the vectors $\vec{a} = 2i - 3j + k$, $\vec{b} = i + 2j - 3k$ and $\vec{c} = j + \lambda k$ are coplanar. **(06 Marks)**

b. Find $\vec{a} \cdot (\vec{b} \times \vec{c})$ and $\vec{b} \cdot (\vec{a} \times \vec{c})$, where $\vec{a} = i + j - k$, $\vec{b} = 2i - j + 2k$ and $c = 3i - j - k$. **(07 Marks)**

c. Show that the position vectors of the vertices of a triangle $2i - j + k$, $i - 3j - 5k$ and $3i - 4j - 4k$ form a right angled triangle. **(07 Marks)**

4 a. Find the unit tangent vector to the space curve $x = \cos t^2$, $y = \sin t^2$ and $z = 0$. **(06 Marks)**

b. A particle moves along a curve with parametric equations $x = t - \frac{t^3}{3}$, $y = t^2$ and $z = t + \frac{t^3}{3}$, where t is the time. Find the velocity and acceleration at any time t and also find their magnitudes at $t = 3$. **(07 Marks)**

c. Find the angle between the surfaces $x^2yz + 3xz^2 = 5$ and $x^2yz^3 = 2$ at $(1, -2, -1)$. **(07 Marks)**

5 a. Find the directional derivative of x^2yz^3 at $(1, 1, 1)$ in the direction of $i + j + 2k$. **(06 Marks)**

b. Find the constants a, b, c such that the vector $\vec{F} = (\sin y + a z)\, i + (b x \cos y + z)\, j + (x + c y)\, k$ is irrotational. **(07 Marks)**

c. Prove that $\text{dir}(\text{curl } \vec{A}) = 0$. **(07 Marks)**

6 a. Find the Laplace transform of t^n, where n is a +ve integer. **(06 Marks)**

b. Find $L[t\, e^{-2t} \cos 2t]$. **(07 Marks)**

c. Find $L\left[\frac{e^{-at} - e^{-bt}}{t}\right]$. **(07 Marks)**

7 Find the inverse Laplace transform for the following :

a. $\frac{s+2}{s^2+8s+25}$

b. $\frac{2s-1}{s^2-5s+6}$

c. $\frac{s}{(s^2+a^2)^2}$.

d. $\log\left(\frac{s+a}{s+b}\right)$.

(20 Marks)

8 a. Solve using Laplace transforms

$\frac{d^2y}{dt^2}-3\frac{dy}{dt}+2y=e^{3t}$, given that $y(0)=0$ and $y'(0)=0$. **(10 Marks)**

b. Solve the simultaneous equations using Laplace transforms $\frac{dx}{dt}+y=\sin t$ and $\frac{dy}{dt}+x=\cos t$ subject to the conditions $x(0)=2$ and $y(0)=0$. **(10 Marks)**

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