IV ME, CV (5)

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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Using Taylor series method, solve $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$ at $x = 0.2$. **(06 Marks)**

b. Using Runge – Kutta method of fourth order solve for $y(0.1)$, $y(0.2)$ given that $\frac{dy}{dx} = y(x + y)$, $y(0) = 1$. **(07 Marks)**

c. Given $\frac{dy}{dx} = x^2 (1 + y)$ and $y(1) = 1$, $y(1.1) = 1.233$, $y(1.2) = 1.548$, $y(1.3) = 1.979$, evaluate $y(1.4)$ by Milne's Predictor – Corrector method. **(07 Marks)**

2 a. Approximate y and z at $x = 0.1$, using Picard's method for the solution of the equations $\frac{dy}{dx} = z$, $\frac{dz}{dx} = x^3 (y + z)$, given that $y(0) = 1$ and $z(0) = ½$. **(06 Marks)**

b. Using Runge – Kutta fourth order method to solve $y'' = xy' - y$, $y(0) = 3$, $y'(0) = 0$, find y and z at $x = 0.1$. **(07 Marks)**

c. Apply Milne's method to compute $y(0.4)$ given that $y'' + xy' + y = 0$ and the values $y(0) = 1$, $y(0.1) = 0.995$, $y(0.2) = 0.9801$, $y(0.3) = 0.956$, $y'(0) = 0$, $y'(0.1) = -0.0995$, $y'(0.2) = -0.196$, $y'(0.3) = -0.2867$. **(07 Marks)**

3 a. Prove that the C – R equations in polar form. **(06 Marks)**

b. Show that $f(z) = z^n$, where n is a positive integer is analytic and hence find its derivative. **(07 Marks)**

c. If $\phi + i\Psi$ represents the complex potential of an electrostatic field where $\Psi = x^2 - y^2 + \frac{x}{x^2 + y^2}$, find ϕ. **(07 Marks)**

4 a. Find the Bilinear transformation which maps the points $1, i - 1$ into $0, 1, \infty$. **(06 Marks)**

b. State and prove the Cauchy's integral formula. **(07 Marks)**

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

PART – B

5 a. Find the solution of the Laplace's equation in cylindrical system leading to Bessel's differential equation. **(06 Marks)**

b. Derive Rodrigue's formula $P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n} (x^2 - 1)^n$. **(07 Marks)**

c. Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms Legendre polynomials. **(07 Marks)**

6 a. Define the Empherical and Axiomatic definition of probability and give an example of each. **(06 Marks)**

b. Of the cigarette smoking population 70% are men and 30% are women, 10% of these men and 20% of these women smoke wills. What is the probability that person seen smoking a wills will be a man? **(07 Marks)**

c. The chance that a doctor will diagnose a disease correctly is 60%. The chance that a patient will die after correct diagnose is 40% and the chance of death by wrong diagnosis is 70%. If a patient dies, what is the chance that his disease was correctly diagnosed? **(07 Marks)**

7 a. Derive the mean and variance of Binomial distribution. **(06 Marks)**

b. If x is an exponential distribution with mean 4, evaluate i) $P(0 < x < 1)$ ii) $P(x > 2)$ and iii) $P(-\infty < x < 10)$. **(07 Marks)**

c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be i) less than 65 ii) More than 75 and iii) between 65 and 75. **(07 Marks)**

8 a. Define the following terms :
i) Type I – error and Type II – error ii) Level of significance. **(06 Marks)**

b. A certain stimulus administered to each of the 12 patients resulted in the following :
Change in blood pressure 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4, can it be concluded that the stimulus will increase the blood pressure? (t. 05 for 11 d.f = 2.201). **(07 Marks)**

c. The theory predicts the proportion of beans in the four groups G_1, G_2, G_3, G_4 should be in the ratio 9:3:3:1. In an experiment with 1600 beans the numbers in the four groups were 882, 313, 287 and 118. Does the experimental result support the theory? (at 5% LOS for 3 d.f = 7.815). **(07 Marks)**

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10ME/AU42A

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Material Science & Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What is atomic packing factor? Calculate APF for FCC structure. **(10 Marks)**
b. What is diffusion? Write the Fick's first law of diffusion also benefits of diffusion. **(06 Marks)**
c. Write the difference between edge dislocation and screw dislocation. **(04 Marks)**

2 a. Explain the following:
(i) Secant modulus (ii) Tangent modulus (iii) Resilience. **(06 Marks)**
b. Explain with neat sketch of Vicker hardness test. **(04 Marks)**
c. A 12.5 mm dia aluminium alloy test bar is subjected to a load of 2 tons. If the dia of the bar is 12.4 mm at this load, calculate engineering stress and strain, true stress and true strain. Assume no change in volume. **(10 Marks)**

3 a. What is fracture? Explain different types of fracture. **(04 Marks)**
b. Explain with neat sketch of RR Moore fatigue test with S-N curve of mild steel and Al alloy. **(10 Marks)**
c. Explain different types of mechanism used in Creep. **(06 Marks)**

4 a. Write GIBB's phase rule, also write the phase and DOF. **(04 Marks)**
b. Explain with neat sketch of solid solution phase diagram for Ni-Cu. **(06 Marks)**
c. What is Nucleation? Explain briefly homogeneous and heterogeneous nucleation. **(10 Marks)**

PART – B

5 a. Draw the iron-carbon equilibrium diagram and explain briefly. **(10 Marks)**
b. With neat sketch, explain TTT diagram for hypo-eutecoid and hyper-eutecoid steel. **(10 Marks)**

6 a. Explain briefly Jominy-End quench test. **(08 Marks)**
b. Differentiate normalizing and annealing. **(06 Marks)**
c. Explain with neat sketch of flame hardening process. **(06 Marks)**

7 a. Explain with micro structure of different types of carbon steels. **(10 Marks)**
b. Write the characteristics, applications and types of Titanium alloys. **(10 Marks)**

8 a. What is composite material? Discuss the roles of the matrix and reinforcements in a composite material. **(10 Marks)**
b. What are the advantages, disadvantages and applications of composite materials? **(10 Marks)**

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10ME/AU42B

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. What is metrology? Explain with necessary sketch the imperial standard yard and high light the significance of Airy points. **(09 Marks)**

b. Four length bars A, B, C, D of approximately 250mm each are to be calibrated with standard metre bar which is actually 0.0008mm less than a metre. It is also found that bar B is 0.0002mm longer than bar A, Bar 'C' is 0.0004mm longer than bar A and bar D is 0.0001mm shorter than bar A. **(07 Marks)**

c. Build up slip gauges for 92.357mm. **(04 Marks)**

2 a. Explain briefly the difference between the inter changeable manufacture and selective assembly. **(04 Marks)**

b. Calculate the dimensions of plug and ring gauges to control the production of 50mm shaft and hole pair of H_7d_8 as per IS specifications. The following assumptions may be made: 50mm lies in diameter step of 30 to 50mm and the upper deviation for 'd' shaft is given by $-16\ D^{0.44}$ and lower deviation for hole H is zero. Tolerance unit i(micron) $= 0.45\sqrt[3]{D} + 0.001D$ and IT6 = 10i above IT6 grade the tolerance magnitude is multiplied by 10 at each fifth step. **(16 Marks)**

3 a. Explain with necessary sketch the working principle of solex pneumatic comparator. **(08 Marks)**

b. List the advantages and disadvantages of mechanical comparator. **(05 Marks)**

c. Explain with neat sketches the use of sine bar for measuring known and unknown angles. **(07 Marks)**

4 a. Explain the procedure to measure the tooth thickness of a spur gear using a gear tooth vernier caliper. **(08 Marks)**

b. Explain with necessary sketch the working principle of optical flat. **(06 Marks)**

c. Derive an expression for best size wire. **(06 Marks)**

PART – B

5 a. Differentiate between accuracy and precision. **(04 Marks)**

b. Explain with necessary block diagram the elements of generalized measurement system. **(08 Marks)**

c. Explain the following with respect to measuring instrument: i) Calibration; ii) Threshold; iii) Sensitivity; iv) Hysterisis. **(08 Marks)**

6 a. Explain the inherent problems observed in mechanical type intermediate modifying devices. **(06 Marks)**

b. Explain with necessary circuit the following electrical intermediate modifying devices: i) Input circuitry; ii) The Ballast circuit. **(08 Marks)**

c. With a neat sketch explain the working of oscillograph. **(06 Marks)**

7 a. With a neat sketch, explain the working principle of analytical balance. **(08 Marks)**

b. Explain with a neat sketch the working of hydraulic dynamometer. **(08 Marks)**

c. Explain with a neat sketch the working of proving ring. **(04 Marks)**

8 a. Explain two laws of thermocouple governing the working of thermocouple. **(06 Marks)**

b. Explain with basic wheat stone bridge circuit the methods of strain measurement. **(08 Marks)**

c. Explain the steps in strain gauge mounting. **(03 Marks)**

d. What is gauge factor? **(03 Marks)**

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10ME/AU43

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017

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 handbook and charts is permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Explain the following terms with reference to a combustion process:
i) Enthalpy of formation ii) Adiabatic flame temperature
iii) Enthalpy of combustion iv) Heat of reaction **(08 Marks)**

b. The products of combustion of an unkown hydrocarbon C_xH_y have the following composition as measured by an orsat apparatus: CO_2 = 8.0%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine,
i) The composition of the fuel,
ii) The air fuel ratio,
iii) The percent excess air used. **(12 Marks)**

2 a. Derive with usual notations an expression for the air standard efficiency of a diesel cycle. Represent the cycle on P-V and T-S diagrams. **(10 Marks)**

b. An engine working on the otto cycle has an air standard cycle efficiency of 56% and rejects 544 kJ/kg of air. The pressure and temperature of air at the beginning of compression are 0.1 MPa and 60°C respectively. Compute:
i) The compression ratio
ii) The work done/kg of air
iii) The pressure and temperature at the end of compression,
iv) The maximum pressure in the cycle. **(10 Marks)**

3 a. Describe Morse test. What are the assumptions made in this test? **(08 Marks)**

b. A gas engine working on constant volume cycle the following results during a one hour test run. Cylinder diameter 24 cm, stroke 48 cm, effective diameter of brake wheel 1.25 m. Net load on brake 1236 N. Average speed 226.7 revolution per minute. Average explosions per minute 77, MEP 7.5 bar, gas used 13 m^3 at 15°C and 771 mm of mercury pressure. Lower calorific value of gas 22000 kJ/m^3 at NTP. Cooling water used 625 kg. Rise in temperature of cooling water 35°C. NTP conditions are 760 mm of Hg and 0°C. Determine:
i) Mechanical efficiency
ii) The specific fuel consumption in m^3/I.P. hour.
iii) Indicated and brake thermal efficiencies.
Draw up a heat balance for the engine on minute basis. **(12 Marks)**

4 a. Explain the effect of: i) Maximum pressure, ii) Exhaust pressure, iii) Superheat, on the simple Rankine cycle. **(06 Marks)**

b. A regenerative cycle operates with steam supplied at 30 bar and 300°C and condenser of 0.08 bar. The extraction points for two heaters (open type) are at 3.5 bar and 0.7 bar. Calculate thermal efficiency of the plant, neglecting pump work. Show the T-S diagram. **(14 Marks)**

PART – B

5 a. Obtain an expression for the volumetric efficiency of a single stage air compressor in terms of pressure ratio, clearance and 'n' the polytropic index. **(06 Marks)**

b. Why inter-cooling is necessary in multistage compression? **(04 Marks)**

c. A two stage air compressor with perfect inter-cooling takes in air at 1 bar and 27°C. The law of compression in both the stages is $pu^{1.3}$ = constant. The compressed air is delivered at 9 bar. Calculate for unit mass flow rate of air the minimum work done and the heat rejected to inter-cooler. Compare the values if compression is carried out in single stage compressor with after-cooler. **(10 Marks)**

6 a. Explain how inter-cooling increases thermal efficiency of gas turbine plant with block diagram and T-S diagram. **(06 Marks)**

b. With a neat sketch, explain working of Ramjet. **(04 Marks)**

c. A gas turbine power plant operates on the simple Brayton cycle with air as the working fluid and delivers 32 MW of power. Minimum and maximum temperatures in the cycle are 310 K and 900 K, and the pressure of air at the compressor exit is 8 times the value at the compressor inlet. Assuming an isentropic efficiency of 80% for the compressor and 86% for the turbine, determine the mass flow rate of air through the cycle. **(10 Marks)**

7 a. Draw a neat diagram of vapour-absorption refrigeration system with auxiliaries to improve its performance. Explain its principle of working briefly. **(08 Marks)**

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

c. An ammonia vapour compression refrigerator works between an evaporator pressure of 1.2 bar and a condenser pressure of 12 bar. The refrigerant leaves the evaporator at –20°C and leaves the condenser at +20°C. Determine the COP of the system and the power required per ton of refrigeration. **(08 Marks)**

8 a. Define the following terms:
i) Dry bulb temperature (DBT)
ii) Wet bulb temperature (WBT)
iii) Specific humidity (SH)
iv) Relative humidity (RH)
v) Degree of saturation (DS) **(10 Marks)**

b. For a hall to be air-conditioned, the following conditions are given:
Outdoor conditions 40°C DBT, 20°C WBT
Required comfort conditions 20°C DBT, 60% RH
Seating capacity of hall = 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) Capacity of the cooling coil in tonnes, and
ii) The capacity of the humidifier in kg/hr. **(10 Marks)**

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10ME/AU44

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017

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 with suitable examples:
i) Structure ii) Machine
iii) Mechanism iv) Lower pair **(08 Marks)**

b. Sketch and explain the inversions of double slider crank chain. **(12 Marks)**

2 a. Sketch and explain the crank and slotted lever mechanism. **(06 Marks)**

b. Sketch and explain Geneva wheel mechanism. **(07 Marks)**

c. Sketch Ackerman steering mechanism and obtain condition for correct steering. **(07 Marks)**

3 a. Define the following:
i) Linear and angular velocity.
ii) Linear and angular acceleration **(06 Marks)**

b. The crank of a slider crank mechanism is 480 mm long and rotates uniformly at 20 rad/sec in the counter clockwise direction. It has a connecting rod of 1600 mm long. Determine the following when the crank is at 60° from the inner dead centre.
i) Velocity of slider
ii) Angular velocity of connecting rod and
iii) The position and velocity of a point 'p' on the connecting rod having least absolute velocity. **(14 Marks)**

4 a. Define instantaneous centre and state the types of instantaneous centres. **(04 Marks)**

b. In a slider crank mechanism the crank OA = 300 mm and connecting rod AB = 1200 mm. The crank OA is turned 30° from inner dead centre. Locate all the instantaneous centres. If the crank rotates at 15 rad/sec clockwise, find: i) velocity of slider, B; ii) angular velocity of connecting rod AB. **(08 Marks)**

c. Explain Klein's construction for slider-crank mechanism. **(08 Marks)**

PART – B

5 Using complex algebra, derive expression for velocity and acceleration of the piston and angular acceleration of connecting for a reciprocating engine mechanism. Use these expressions to find the above, if the crank length is 50 mm, connecting rod is 200 mm long, crank angle is 30°, the crank rotates at a constant speed of 3000 rpm. **(20 Marks)**

6 a. Compare cycloidal and involute gear tooth profile. **(04 Marks)**

b. Derive an equation to determine the length of path of contact by a pair of mating spur gear. **(08 Marks)**

c. Two mating gears with module pitch 6 mm have 20 and 50 teeth of pressure angle 20° and addendum 6 mm. Determine the number of pairs of teeth in contact. **(08 Marks)**

7 a. Sketch and explain:
i) Compound gear train,
ii) Epicyclic gear train. **(06 Marks)**

b. A fixed annular gear A and a smaller concentric rotating gear B are connected by a compound gear C and D. The gear C mesh with gear A and D with B. The compound gears revolved in a pin on the arm R, which revolves about the axis of A and B. The number of teeth on gears A, B and D are 150, 40 and 100 respectively. Determine the number of teeth on gear C, if the gear A and C have twice the module of gear B and D. How many revolutions will B make for one complete revolution of the arm R? **(14 Marks)**

8 The following data relate to a cam profile in which the follower moves with UARM during ascent and descent.
Minimum radius of the cam = 25 mm
Roller diameter = 10 mm
Lift = 30 mm
Offset of follower axis = 10 mm towards right
Angle of ascent = 60°
Angle of descent = 90°
Angle of dwell between ascent and descent = 45°
Speed of the cam = 200 rpm
Draw the profile of the cam. **(20 Marks)**

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10ME/AU45

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Manufacturing Process – II

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With neat sketches, explain the different types of chips produced during metal cutting. **(06 Marks)**

b. Draw Merchant's circle diagram and derive the Ernst-Merchant's solution, $2\phi + \beta - \alpha = \pi/2$ where ϕ = shear plane angle, β = friction angle, α = rake angle. **(10 Marks)**

c. While turning a mild steel rod with a HSS tool, a tool life of 15min was obtained at the cutting speed of 400m/min. When the cutting speed was reduced to 200m/min, tool life obtained was 90min. Determine the constants in the tool life equation. **(04 Marks)**

2 a. Explain the properties that are to be considered during the selection of a cutting tool material. **(08 Marks)**

b. Briefly explain the different types of cutting fluids. **(06 Marks)**

c. With a neat sketch, explain the zones of heat generation in metal cutting. **(06 Marks)**

3 a. With a neat sketch, explain the constructional feature of a turret lathe. **(10 Marks)**

b. With a neat sketch, explain open and cross belt drive mechanism of a planer. **(10 Marks)**

4 a. With a neat sketch, explain the constructional features of a radial drilling machine tool. **(08 Marks)**

b. With neat sketches explain any four operations performed on a drilling machine tool. **(08 Marks)**

c. Differentiate between absolute coordinate system and incremental coordinate system. **(04 Marks)**

PART – B

5 a. With a neat sketch, explain the constructional features of a horizontal spindle column and knee milling machine tool. **(10 Marks)**

b. Show the calculations to index 51 divisions by compound indexing method on a universal dividing head. Consider a index plate with circles of holes – 15, 16, 17, 18, 19, 20. **(10 Marks)**

6 a. Write a note on grade and structure of grinding wheel. **(05 Marks)**

b. With a neat sketch, explain the constructional features of a centreless grinding machine. **(09 Marks)**

c. Explain the factors to be considered while selecting a grinding wheel. **(06 Marks)**

7 a. With a neat sketch, explain the constructional features of a continuous surface broaching machine. **(08 Marks)**

b. With a neat sketch, explain the principle of lapping. **(06 Marks)**

c. With a neat sketch, explain the principle of honing. **(06 Marks)**

8 a. With a neat sketch, explain the working principle of ultrasonic machining process and state its advantages. **(10 Marks)**

b. With a neat sketch, explain the working principle of electron beam machining process and state its advantages. **(10 Marks)**

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10ME46B/AU46B

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Fluid Mechanics

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 fluid properties:
   i) Density
   ii) Weight density
   iii) Specific volume
   iv) Specific gravity
   v) Surface tension. **(05 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a liquid. **(08 Marks)**

c. A vertical cylinder of diameter 180mm rotates concentrically inside another cylinder of diameter 181.2mm. Both the cylinders are 300mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20Nm is required to rotate the inner cylinder at 120rpm. **(07 Marks)**

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

b. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(10 Marks)**

3 a. Explain the following terms:
   i) Buoyancy
   ii) Centre of Buoyancy
   iii) Meta centre
   iv) Meta centric height. **(04 Marks)**

b. A cylindrical body is 2m in diameter, 2.5m long and weighs 2.2 metric tonnes. The density of sea water is 1025 kg/m^3. Show that the body cannot float with its axis vertical. **(06 Marks)**

c. Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional steady incompressible flow. **(10 Marks)**

4 a. Derive Bernoulli's equation from fundamentals. List all the assumptions made. **(10 Marks)**

b. A non-uniform part of a pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20N/cm^2 and 12.5N/cm^2. If the diameters at the upper and lower ends are 15cm and 10cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

PART – B

5 a. What is a venturimeter? Derive an expression for discharge through a venturimeter. **(10 Marks)**

b. Using Backingham's π-theorem, show that the velocity through a circular orifice is given by

$$V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right].$$

Where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(10 Marks)**

6 a. How will you determine the loss of head due to friction in pipes by using:
i) Darcy formula and ii) Chezy's formula. **(10 Marks)**

b. Three pipes of 400mm, 200mm and 30mm diameters have lengths of 400m, 200m and 300m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16m. If co-efficient of friction for these pipe is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. **(10 Marks)**

7 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(12 Marks)**

b. A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find:
i) The pressure gradient
ii) The average velocity and
iii) Reynold number of the flow. **(08 Marks)**

8 a. Explain lift and drag. **(06 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50km/hour in a stationary air of density 1.15kg/m^3. If the coefficients 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)**

c. Find the velocity of bullet fired in standard air if the mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Find the angle between any two diagonals of a cube. **(06 Marks)**

b. The direction cosines of three mutually perpendicular lines are l_1, m_1, n_1 l_2, m_2, n_2 and l_3, m_3, n_3. Show that the line with direction cosines $l_1+l_2+l_3$, $m_1+m_2+m_3$, $n_1+n_2+n_3$ is equally inclined to the above lines. **(07 Marks)**

c. Find the equations of the plane passing through the points (1, 2, 3) (0, 1, 4) and (0, 0, 1). **(07 Marks)**

2 a. Derive the equation to the plane in the intercept form $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **(06 Marks)**

b. Find the angle between the lines $\frac{x-1}{1}=\frac{y-5}{0}=\frac{z+1}{2}$ and $\frac{x+3}{3}=\frac{y}{5}=\frac{z-5}{2}$. **(07 Marks)**

c. Find the image of the point (1, 2, 3) in the line $\frac{x+1}{2}=\frac{y-3}{3}=-z$. **(07 Marks)**

3 a. Show that the position vectors of the vertices of a triangle $2i-j+k$, $i-3j-5k$, $3i-4j-4k$ form a right angled triangle. **(06 Marks)**

b. Find a vector of magnitude 12 units which is perpendicular to the vectors $\vec{a}=4i-j+3k$ and $\vec{b}=-2i+j-2k$. **(07 Marks)**

c. Find λ so that the points $A(-1,4,-3)$, $B(3,2,-5)$, $C(-3,8,-5)$ and $D(-3,\lambda,1)$ are coplanar. **(07 Marks)**

4 a. Find the unit tangent vector of the space curve $x=1+t^3$, $y=2t^3$, $z=2-t^3$ at $t=1$. **(06 Marks)**

b. Find the angle between the tangents to the curve $\vec{r}=\left(t-\frac{t^2}{2}\right)i+t^2j+\left(t+\frac{t^2}{2}\right)k$ at $t=\pm1$. **(07 Marks)**

c. A particle moves along the curve whose parametric equations are $x=t-\frac{t^3}{3}$, $y=t^2$ and $z=t+\frac{t^3}{3}$, where 't' is the time. Find the velocity and acceleration at any time 't'. Also find their magnitudes at $t=3$. **(07 Marks)**

5 a. Find the angle between the surfaces $x^2+y^2+z^2=9$ and $x=z^2+y^2-3$ at $(2,-1,2)$. **(06 Marks)**

b. Find the constants a, b, c such that the vector ,
$\vec{F}=(x+y+az)i+(bx+2y-z)j+(x+cy+2z)k$ is irrotational. **(07 Marks)**

c. If $\vec{A}=\text{grad}(x^3+y^3+z^3-3xyz)$ then find $\text{div}\,\vec{A}$ and $\text{curl}\,\vec{A}$. **(07 Marks)**

6 a. Find the expression for $L[\sin at]$. **(05 Marks)**

b. Find $L[t \sin at]$. **(05 Marks)**

c. Find $L\left[\frac{1-e^{at}}{t}\right]$. **(05 Marks)**

d. Find $L[e^t \cos^2 2t]$. **(05 Marks)**

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

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

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

8 a. Using Laplace transform solve:
$y'' - 2y' + y = e^{2t}$ with $y(0) = 0$ and $y'(0) = 1$. **(10 Marks)**

b. Solve using Laplace transformation, method $y'' + 2y' - 3y = \sin t$, $y(0) = y'(0) = 0$. **(10 Marks)**

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