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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Using Taylor series method, solve $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$ at the point $x = 0.2, 0.3$ consider up to 4^{th} degree term. **(06 Marks)**

b. Using Runge Kutta method of order 4, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ at $x = 0.2, 0.4$ by taking step length $h = 0.2$. **(07 Marks)**

c. Given $\frac{dy}{dx} = \frac{1}{2}xy$, $y(0) = 1$, $y(0.1) = 1.0025$, $y(0.2) = 1.0101$, $y(0.3) = 1.0228$. Compute y at $x = 0.4$ by Adams – Bash forth predictor – corrector method use corrector formula twice. **(07 Marks)**

2 a. Evaluate y and z at $x = 0.1$ from the Picard's second approximation to the solution of the following system of equations given by $y = 2$ and $z = 1$ at $x = 0$ initially $\frac{dy}{dx} = x + z$

$\frac{dz}{dx} = x - y^2$. **(06 Marks)**

b. Given $y'' = x^3(y + y')$ with the initial condition $y(0) = 1$ $y'(0) = 0.5$ compute $y(0.1)$ by taking $h = 0.1$ and using 4^{th} order Runge Kutta method. **(07 Marks)**

c. Applying Milne's method compute $y(0.4)$ Given that y satisfies the equation $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$ and y and y′ are governed by the following values

$y(0) = 1$, $y(0.1) = 1.03995$, $y(0.2) = 1.138036$
$y(0.3) = 1.29865$, $y'(0) = 0.1$, $y'(0.1) = 0.6955$
$y'(0.2) = 1.258$, $y'(0.3) = 1.873$. **(07 Marks)**

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

b. Prove that for every analytic function $f(z) = u + iv$ the two families of curves $u(x,y) = C_1$ and $v(x,y) = C_2$ form an orthogonal system. **(07 Marks)**

c. If $u - v = (x - y)(x^2 + 4xy + y^2)$ and $f(z) = u + iv$ is analytic function of $z = x + iy$ find $f(z)$ interms of $f(z)$. **(07 Marks)**

4 a. Find the bilinear transformation that maps the points $z = 0, i, \infty$ onto the points $w = 1, -i, -1$ respectively, find the invariant points. **(06 Marks)**

b. Discuss the transformation $w = e^z$. **(07 Marks)**

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

PART – B

5 a. Starting from Laplace differential equation. Obtain Bessel's differential equation as $xy'' + xy' + (x^2 - n^2)y = 0$ **(08 Marks)**

b. If $x^3 + 2x^2 - x + 1 = a\,P_0(x) + b\,P_1(x) + c\,P_2(x) + d\,P_3(x)$ find the value of a, b, c, d. **(06 Marks)**

c. Derive Rodrigue's formula $P_n(x) = \frac{1}{2^n n!}\frac{dy}{dx^n}(x^2-1)^n$ **(06 Marks)**

6 a. Define axioms of probability. Prove that,
$P(A \cup B \cup C) = P(A) + P(B) + P(C) + P(A \cap B \cap C) - P(A \cap B) - P(B \cap C) - P(C \cap A)$ **(06 Marks)**

b. A solar water heater manufactured by a company consists of two parts the heating panel and the insulated tank. It is found that 6% of the heaters produced by the company have defective heating panels and 8% have defective tank. Find the percentage of non defective heaters produced by the company. **(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 by 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. **(07 Marks)**

7 a. A random variables X takes the values $-3, -1, 2$ and 5 with respective probabilities $\frac{2k-3}{10}, \frac{k-2}{10}, \frac{k-1}{10}, \frac{k+1}{10}$. Find the value of k and i) $p(-3 < x \leq 4)$ ii) $p(x \leq 2)$. **(06 Marks)**

b. Find the mean and variance of binomial distribution. **(07 Marks)**

c. In an examination 7% of students scores less than 35% marks and 89% of students score less than 60% marks. Find the mean and standard deviation of the marks are normally distribute, it is given that $P(0 < z < 1.2263) = 0.39$ and $P(0 < z < 1.4757) = 0.43$. **(07 Marks)**

8 a. Explain the following terms :
i) Null hypothesis
ii) Type I and Type II error
iii) Confidence limits. **(06 Marks)**

b. A coin is tossed 1000 times and it turn up head 540 times decide on the hypothesis that the coin is unbiased. **(07 Marks)**

c. A certain stimulus administered to each of the 12 patients resulted is the following change is blood pressure 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4 can it be calculated that the stimulus will increase the blood pressure ($t_{0.05}$ for 11 df 2.201.) **(07 Marks)**

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10ME/AU43

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

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Draw P-V and T-S diagrams for a Diesel cycle. Derive an expression for air-standard efficiency in terms of compression ratio and cut off ratio. **(10 Marks)**

b. The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke, the pressure is 0.1 MPa and the temperature is 15°C. The heat transfer to the air per cycle is 1800 kJ/kg of air. Determine
(i) Maximum pressure and temperature in cycle
(ii) The thermal efficiency
(iii) The mean effective pressure. **(10 Marks)**

2 a. With the help of a neat sketch, explain the exhaust gas analysis using Orsat apparatus. **(10 Marks)**

b. Methane (CH_4) is burned with atmospheric air. The analysis of the products on a dry basis is as follows:

$CO_2 = 10\%$; $O_2 = 2.37\%$; $CO = 0.53\%$; $N_2 = 87.1\%$

Calculate : i) Air-fuel ratio ii) Percent theoretical air iii) Combustion equation. **(10 Marks)**

3 a. With the help of a suitable graph, explain 'Willan's line method' of determining friction power in I.C. engines. **(10 Marks)**

b. The air flow to a 4 cylinder, 4 stroke oil engine is measured by means of a 5 cm diameter orifice having a coefficient of discharge of 0.6. During a test on the engine the following data were recorded : Bore = 10 cm; stroke = 12 cm ; speed = 1200 rpm ; brake torque = 120 Nm ; fuel consumption = 5 kg/h ; calorific values of fuel = 42000 kJ/kg ; pressure drop across orifice = 4.6 cm of water ; ambient temperature and pressure are 17°C and 1 bar respectively. Calculate : (i) Brake thermal efficiency (ii) Brake mean effective pressure (iii) Volumetric efficiency. **(10 Marks)**

4 a. With the help of a block diagram and T-S diagram, explain simple steam power plant that operates on the Rankine cycle. **(10 Marks)**

b. In a Rankine cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. The condenser pressure is 10 kPa.
(i) Determine the cycle efficiency
(ii) If the plant has to produce 500 MW of power, determine mass flow rate of water in kg/h. **(10 Marks)**

PART – B

5 a. With the help of a block diagram, P-V and T-S diagrams, explain simple gas turbine power plant that operates on the Brayton cycle. Derive an expression for thermal efficiency in terms of pressure ratio. **(10 Marks)**

b. In an air-standard Brayton cycle the air enters the compressor at 0.1 MPa and 15°C. The pressure leaving the compressor is 1 MPa. The maximum temperature in the cycle is 1100°C. Determine : (i) Pressure and temperature at each point in the cycle (ii) The compressor work, turbine work and cycle efficiency (iii) If an ideal regenerator is introduced into the cycle, determine the thermal efficiency of the cycle. **(10 Marks)**

6 a. Obtain an expression for optimum intermediate pressure in case of a 2 stage reciprocating compressor with perfect intercooling. Also derive an expression for minimum work for the same. **(10 Marks)**

b. A 2 stage air compressor receives 0.238 m^3/s of air at 100 kPa and 27°C and discharges it at 1000 kPa. The value of n for the compression is 1.35. Determine : (i) the minimum power necessary for compression (ii) the power for compression to the same pressure for one stage compression. (iii) Maximum temperature for both (i) and (ii). (iv) the heat removed in intercooler. **(10 Marks)**

7 a. With the help of block diagram, T-S and P-h diagram, explain the vapour compression refrigeration cycle. Write an expression for C.O.P. in terms of enthalpies at various state points. **(10 Marks)**

b. An ammonia ice plant operates between a condensers temperature of 35°C and as evaporator temperature of – 15°C. It produces 10 tons of ice per day from water at 30°C to ice at – 5°C. Assuming simple vapour compression refrigeration cycle, using only tables of properties of ammonia, determine : (i) Capacity of the refrigeration plant (ii) Mass flow rate of refrigerant (iii) Compressor power if adiabatic efficiency = 0.85 and mechanical efficiency = 0.95 (iv) Theoretical COP (v) Actual C.O.P. Assume Cp_N = 4.1868 kJ/kgK, Cp_{ice} = 1.94 kJ/kg K, Latent heat of fusion at 0°C = 335 kJ/kg. **(10 Marks)**

8 a. A mixture of dry air and water vapour is at a temperature of 21°C under a total pressure of 98.2 kPA (736mm of Hg). The dew point temperature is 15°C. Find : (i) Partial pressure of water vapour (ii) Relative humidity (iii) Specific humidity (iv) Enthalpy of air per kg of dry air (v) Specific volume of air per kg of dry air. Do not use psychrometric chart. **(10 Marks)**

b. The air handling unit of an air conditioning plant supplies a total of 4500 m^3/min of dry air which comprises by mass 20% fresh air at 40°C DBT and 27°C WBT and 80% recirculated air at 25°C DBT and 50% R.H. The air leaves the cooling coil at 13°C saturated state. Calculate the total cooling load and room heat gain. **(10 Marks)**

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10ME/AU44

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

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. What is inversion? Explain its importance. **(04 Marks)**

b. Differentiate between machine and mechanisms. **(04 Marks)**

c. Describe with neat sketches two inversions of double slider crank chain. **(12 Marks)**

2 a. Explain the whitworth quick return motion mechanism with a sketch. **(08 Marks)**

b. Explain the following with sketches and state its applications:
i) Pantograph
ii) Geneva wheel
iii) Robert mechanism **(12 Marks)**

3 A double slider crank mechanism is shown in Fig.Q3. The crank OA rotates at a constant angular velocity of 10 rad/sec. The links OA, AB and AC are 100 mm, 200 mm and 200 mm long respectively. By drawing the acceleration and velocity polygon, determine:
i) Velocity and acceleration of each slider.
ii) Angular velocity and angular acceleration of each connecting rod.

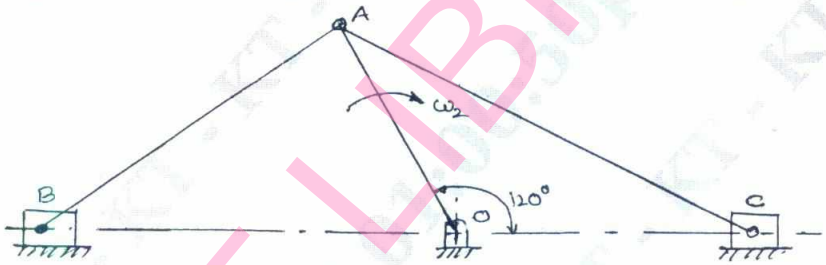

Fig.Q3 **(20 Marks)**

4 a. In a four bar mechanism, the crank AB is 300 mm long, BC = CD = 360 mm and AD the fixed link is 600 mm long. The crank makes an angle of 60° with fixed link and it rotates uniformly at 100 rpm. Locate all the instantaneous centres and find the angular velocity of link BC. **(10 Marks)**

b. Determine the velocity and acceleration of the piston by Klien's constructions to the following specification:
Stroke = 300 mm
Ratio of length of connecting rod to crank length = 4
Speed of the engine = 300 rpm
Position of the crank = 45° with IDC **(10 Marks)**

PART – B

5 If the crank an connecting rod are 150 mm and 600 mm long respectively and the crank rotates at uniform speed of 100 rpm clockwise, determine by using analytical expressions the (i) angular velocity and angular acceleration of connecting rod (ii) velocity and acceleration of the piston. The angle when the crank makes with IDC is 30°. **(20 Marks)**

6 a. State and explain 'law of gearing'. **(06 Marks)**

b. Compare cycloidal and involute gear tooth forms. **(04 Marks)**

c. Two spur gear wheels have 23 and 57 teeth. The profile of the gear is involute with a pressure angle of 20° and the module 8 mm and the addendum of gears is 1 module. Calculate:

i) Length of path of contact

ii) Length of Arc of contact

iii) Number of pairs of teeth in contact **(10 Marks)**

7 An epicyclic gear train of sun and planet type is shown in Fig.Q7. The pitch diameter of internally toothed ring D is approximately 228 mm and the module is 4 mm. When the ring is stationary the spider A which carries three planet wheels C of equal size is to make one revolution for every five revolution of the spindle carrying the sun wheel B. Determine the suitable number of teeth for all the wheel and the exact pitch circle of ring D. If a torque of 30 N-m is applied to the sun wheel B. What is the torque required to keep the ring stationary?

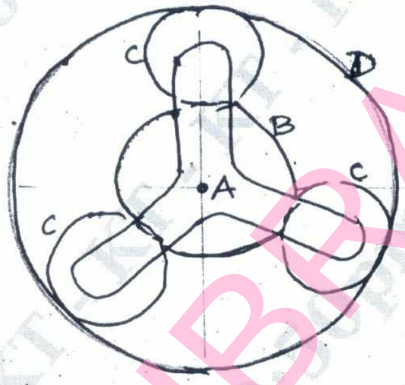

Fig.Q7 **(20 Marks)**

8 Draw the profile of cam operating a reciprocating follower carrying a roller of diameter 15 mm. The minimum radius of cam is 25 mm. Lift = 30 mm. the cam lifts the follower for 120° of cam rotation with SHM, followed by a dwell period of 30°, then the follower returns to starting position through 150° of cam rotation with UARM and then dwells for the rest of the period of cam rotation. The cam rotates at a uniform speed of 150 rpm (clockwise). The axis of the follower passes through the axis of cam shaft. **(20 Marks)**

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10AU/ME45

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Manufacturing Process – II

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Differentiate between orthogonal and oblique cutting with sketches. **(06 Marks)**

b. With a neat sketch, give the nomenclature of single point cutting tool. **(07 Marks)**

c. What are the factors that affect tool-life? Briefly describe their influences. **(07 Marks)**

2 a. Briefly explain the desirable properties and purposes of cutting fluids. **(07 Marks)**

b. With a neat sketch, explain different heat affected zones during orthogonal cutting. **(07 Marks)**

c. Discuss the salient features of the following cutting tool materials:
i) CBN ii) Ceramics. **(06 Marks)**

3 a. Differentiate between a capstan and a turret lathe. **(06 Marks)**

b. With the help of neat sketch, explain Whitworth quick return mechanism of a shaper. **(08 Marks)**

c. Give the comparision between shaper and planner. **(06 Marks)**

4 a. Explain with a neat sketch of radial drilling machine. **(08 Marks)**

b. Sketch and explain the nomenclature of a twist drill. **(04 Marks)**

c. Explain with a neat sketch of basic components of CNC. **(08 Marks)**

PART – B

5 a. What is indexing? Name different methods of indexing. Briefly explain compound indexing. **(10 Marks)**

b. Explain the following:
i) Upmilling and down milling
ii) Face milling and end milling. **(10 Marks)**

6 a. Explain with a neat sketch the principle of working of a centre type cylindrical grinding machine. **(08 Marks)**

b. Explain the following grinding wheel parameters: i) Grit ii) Grade iii) Structure. **(06 Marks)**

c. Explain the factors to be considered for selection of grinding wheels. **(06 Marks)**

7 a. Explain briefly the honing process with a neat sketch. State its advantages and disadvantages. **(10 Marks)**

b. With a neat sketch, explain the lapping process. State its advantages and disadvantages. **(10 Marks)**

8 a. Explain AJM with a neat sketch. **(10 Marks)**

b. List out limitations and applications:
i) Laser beam machine
ii) Plasma arc machine. **(10 Marks)**

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10ME/AU42B/10MEB/AUB402

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. What is metrology? Compare line standard with end standard with suitable examples. **(08 Marks)**

b. What is wringing? Explain the procedure for wringing of slip gauges. **(06 Marks)**

c. Three 100 mm end bars are measured using a Brooke's level comparator by first wringing them together and comparing with a 300 mm bar and then inter comparing them. The 300 mm bar actually measures 300.042 mm and the three bars together measures 0.064 mm less than 300 mm bar. Bar A is 0.018 mm longer than bar B and 0.023 mm longer than bar C. Find actual length of each bar. **(06 Marks)**

2 a. Explain principles of interchangeability and selective assembly with suitable example. **(06 Marks)**

b. Explain Taylor's principle in the design of limit gauges. **(06 Marks)**

c. With the help of neat sketches explain ring gauge and plug gauge. **(08 Marks)**

3 a. What is a comparator? With a neat sketch explain the working of reed-type mechanical comparator. **(08 Marks)**

b. Explain the principle and working of a sine bar. **(08 Marks)**

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

4 a. With a neat sketch explain the principle of working of an auto collimator. **(07 Marks)**

b. Describe the two-wire method of measuring effective diameter and derive the equation for the same. **(07 Marks)**

c. With a neat sketch explain the terminology of a screw thread. **(06 Marks)**

PART – B

5 a. With the help of a block diagram, explain generalized measuring system. Give suitable example. **(08 Marks)**

b. Explain the following with respect to an instrument; (i) sensitivity (ii) threshold (iii) hysteresis (iv) loading effect. **(12 Marks)**

6 a. List the advantages and disadvantages of telemetry system. **(04 Marks)**

b. Explain the working of vacuum tube amplifier with the help of a circuit diagram. **(08 Marks)**

c. What are XY plotters? With a block diagram, explain its working. **(08 Marks)**

7 a. Explain with a sketch, the working of proving ring. **(06 Marks)**

b. With a neat sketch, explain prony brake dynamometer. List its limitations. **(08 Marks)**

c. With a sketch explain pirani thermal conductivity gauge. **(06 Marks)**

8 Write short notes for any FOUR of the following:

a. Thermocouples

b. Electrical strain gauges

c. Radiation pyrometer

d. Gauge factor

e. Calibration of strain gauges **(20 Marks)**

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10MEB/AUB406

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

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. Give reasons for the following:
i) Viscosity of gases increases with rise in temperature
ii) Rise of water level in a capillary tube
iii) Cavitation in a pipe flow
iv) Thin objects can float on film membrane or free surface of liquids
v) Mercury is used as manometric liquid and also in thermometers. **(10 Marks)**

b. Derive an expression for pressure intensity in a soap bubble. **(05 Marks)**

c. The surface tension of a spherical water droplet in contact with air at 25°C is 0.072 N/m. If the diameter of the droplet is 1.5 mm, determine the pressure within the droplet. Find also absolute pressure. **(05 Marks)**

2 a. Derive the expression for hydrostatic force and centre of pressure on a submerged plane surface, inclined at an angle 'θ' to the free surface of liquid with specific weight 'ω_L'. **(10 Marks)**

b. Pressure measured at base and top of a mountain are 90 cm and 70 cm of mercury respectively. Calculate height of the mountain, if air has a specific weight of 12.23 N/m^3. **(05 Marks)**

c. A simple manometer is used to measure pressure of oil (sp.gr. 0.90) flowing in a pipe of diameter 50 cm. Its right limb is open and left limb is connected to pipe. Centre of pipe is 15 cm below the level of mercury in right limb and difference in mercury levels is 25 cm. Determine the absolute pressure of oil. **(05 Marks)**

3 a. Differentiate between the following:
i) Rotational flow and irrotation flow
ii) Steady flow and laminar flow
iii) Stream line and path line
iv) Metacentre and centre of Baoyancy
v) Stable and unstable equilibrium **(10 Marks)**

b. A metallic body floats at interface of mercury (13.6) and water in such a way that 30% of its volume is submerged in mercury and 70% in water. Find density of the metallic body. **(05 Marks)**

c. A stream function is given by $\psi = 2x^2 - y^3$. Find the velocity components and resultant velocity at a point P(4, 5). **(05 Marks)**

4 a. State the assumptions made in derivation of Bernoulli's equation for a fluid flow. Represent the Bernoulli's equation for practical fluid flow with losses between two points, with a neat sketch. **(06 Marks)**

b. A pipeline carries oil of specific gravity (0.90) changes in diameter from 200 mm at point A to 400 mm diameter at point B, which is 4 meters higher than point A. If the pressure intensity at points A is 9.81 N/cm^2 and point B is 4.5 N/cm^2 respectively, and the discharge is 200 kg/sec, determine the loss of head and direction of flow. **(14 Marks)**

PART – B

5 a. Differentiate between orifice meter and venturimeter with neat sketches and working. **(04 Marks)**

b. Explain working of V-Notch and derive a relation for discharge of fluid. **(06 Marks)**

c. Using Buckingham's π-theorem, show that the velocity of flow through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VD}\right]$, where H is Head causing flow, D is diameter of the orifice, μ is dynamic viscosity, ρ specific density and 'g' is gravitational acceleration. **(10 Marks)**

6 a. List the types of losses with equations. **(04 Marks)**

b. Derive 'loss of head' expression for Sudden Enlargement of a pipe. **(06 Marks)**

c. Determine the difference in water level between two reservoirs which are connected by a horizontal pipe of dia 200 mm and 500 meters long. The rate of flow through the pipe is 45 ℓt/sec (0.045 m^3/s). Consider all the losses and assume f = 0.01. Neatly sketch HGL and TEL between the two reservoirs. **(10 Marks)**

7 a. Derive an expression for laminar flow through circular pipe. **(10 Marks)**

b. A fluid of viscosity 0.9 N.S/m2 and specific gravity 1.25 is flowing through two parallel plates 3 mm apart. Determine the following:

i) Maximum velocity

ii) Pressure drop per unit length

iii) Shear stress at the walls of plate if the average velocity is 0.2 m/sec.

Assume temperature is 20°C. **(10 Marks)**

8 a. Define Mach number and Mach angle. With neat sketch derive relation for velocity of sound in a compressible fluid. **(10 Marks)**

b. Define: (i) Lift (ii) Momentum thickness (iii) displacement thick (iv) Mach cone (v) Drag **(10 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Prove that the angle between two lines whose direction cosines are (l_1, m_1, n_1) and (l_2, m_2, n_2) is $\cos\theta = l_1l_2 + m_1m_2 + n_1n_2$ **(07 Marks)**

b. Find the value of K if the angle between the lines with direction ratios $-2, 1, -1$ and $1, -K, -1$ is $\frac{2\pi}{3}$. **(07 Marks)**

c. Find the projection of the line segment AB on CD where A = (3, 4, 5), B = (4, 6, 3), C = (−1, 2, 4), D = (1, 0, 5) **(06 Marks)**

2 a. Derive the equation of the plane in the intercept form $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **(07 Marks)**

b. Find the image of the point (2, −1, 3) in the plane $2x+4y+z-24=0$. **(07 Marks)**

c. Find the equation of the plane containing the line $\frac{x+1}{2}=\frac{y+2}{3}=\frac{z+3}{4}$ and is perpendicular to the line $x-2y+3z=4$. **(06 Marks)**

3 a. 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)**

b. Find the cosine and sine of the angle between the vectors $2i-j+3k$ and $i-2j+2k$. **(07 Marks)**

c. Find the value of λ such that the vectors $\vec{a}=\lambda i-5j-2k$, $\vec{b}=-7i+14j-3k$ and $\vec{c}=11i+4j+k$ are coplanar. **(06 Marks)**

4 a. A particle moves along a curve $x=t^3-4t$, $y=t^2+4t$, $z=8t^2-3t^3$. Determine its velocity and acceleration and also the magnitude of velocity and acceleration at t = 2. **(07 Marks)**

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

c. Find the directional derivative of the function $\phi = xyz$ along the direction of the normal to the surface $xy^2+yz^2+zx^2=3$ at the point (1, 1, 1) **(06 Marks)**

5 a. If $\vec{F}=\nabla(x^3+y^3+z^3-3xyz)$ find div $\vec{F}$ and curl $\vec{F}$. **(07 Marks)**

b. Show that curl(gradϕ) = 0. **(06 Marks)**

c. Show that $\vec{F}=\frac{xi+yj}{x^2+y^2}$ is both solenoidal and irrotational. **(07 Marks)**

6 a. Find the Laplace transform of t^n, where n is a positive integer. **(05 Marks)**

b. Find $L(\sin 5t \cos 2t)$. **(05 Marks)**

c. Find $L(t \cos at)$. **(05 Marks)**

d. Find $L\left(\frac{\cos at - \cos bt}{t}\right)$. **(05 Marks)**

7 a. Find $L^{-1}\left[\frac{s+5}{s^2-6s+13}\right]$. **(07 Marks)**

b. Find $L^{-1}\left[\frac{1}{s(s+1)(s+2)(s+3)}\right]$. **(07 Marks)**

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

8 a. Using Laplace transform solve $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}$, $y(0) = 0 = y'(0)$ **(10 Marks)**

b. Using Laplace transform solve $\frac{dx}{dt} + y = \sin t$, $\frac{dy}{dt} + x = \cos t$ given $x(0) = 1$, $y(0) = 0$ **(10 Marks)**

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