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17MATDIP41

Fourth Semester B.E. Degree Examination, July/August 2022
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Find the rank of a matrix $A = \begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$ by reducing to echelon form. (07 Marks)

b. Use Cayley-Hamilton theorem to find the inverse of a matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$. (07 Marks)

c. Solve the following system of equation of Gauss Elimination method:
$x + y + z = 9$
$x - 2y + 3z = 8$
$2x + y - z = 3.$ (06 Marks)

OR

2 a. Test for consistency and solve
$5x_1 + x_2 + 3x_3 = 20$
$2x_1 + 5x_2 + 2x_3 = 18$
$3x_1 + 2x_2 + x_3 = 14.$ (07 Marks)

b. Find all the Eigenvalues of the matrix
$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$. (07 Marks)

c. Find the rank of the matrix $A = \begin{bmatrix} 2 & 3 & 4 \\ -1 & 2 & 3 \\ 1 & 5 & 7 \end{bmatrix}$. (06 Marks)

Module-2

3 a. Solve $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 8y = 0$. (07 Marks)

b. Solve $y'' - 4y' + 13y = \cos 2x$. (07 Marks)

c. Solve $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^3$. (06 Marks)

OR

4 a. Solve by the method of variation of parameters, $y'' - 2y' + y = e^x \log x$. (07 Marks)

b. Solve by the method of undetermined coefficients $(D^2 + 1)y = \sin x$. (07 Marks)

c. Solve $\frac{d^2y}{dx^2} - 4y = 3^x$. (06 Marks)

Module-3

5 a. Find the Laplace transform of cost × cos2t.cos3t. **(07 Marks)**

b. Find the Laplace transform of e^{3t} sin5t.sin3t. **(07 Marks)**

c. Find the Laplace transform of t^3 sint. **(06 Marks)**

OR

6 a. If f(t) is a periodic function of period T > 0, then prove that $L\{f(t)\} = \frac{1}{1-e^{-sT}}\int_0^T e^{-st} f(t)dt$. **(07 Marks)**

b. Find the Laplace transform of f(t) = Esinwt, $0 < t < \pi/w$ having period π/w. **(07 Marks)**

c. Express $f(t) = \begin{cases} \cos t & 0 < t < \pi \\ \cos 2t & \pi < t < 2\pi \\ \cos 3t & t > 2\pi \end{cases}$ as a unit step function and hence find its Laplace transform. **(06 Marks)**

Module-4

7 a. Find the Laplace of $\frac{1}{(s-1)(s+1)(s+2)}$. **(07 Marks)**

b. Solve $y''' + 2y'' - y' - 2y = 0$ given y(0) = y'(0) = 0 and y''(0) = 6 by using Laplace transform. **(07 Marks)**

c. Find: $L^{-1}\left[\frac{3s+2}{(s-2)(s+1)}\right]$. **(06 Marks)**

OR

8 a. Find $L^{-1}[\cot^{-1}(s/a)]$. **(07 Marks)**

b. Employ Laplace transform to solve the equation $y'' + 5y' + 6y = 5e^{2x}$, y(0) = 2, y'(0) = 1. **(07 Marks)**

c. Find the inverse Laplace transform of $\log\left[\frac{s+4}{s-4}\right]$. **(06 Marks)**

Module-5

9 a. State and prove Bayes theorem. **(07 Marks)**

b. Prove that
$P(A \cup B \cup C) = P(A) + P(B) + P(C) + P(A \cap B \cap C) - P(A \cap B) - P(B \cap C) - P(C \cap A)$. **(07 Marks)**

c. A pair of dice is tossed twice. Find the probability of scoring 7 points
i) Once ii) atlesat once iii) twice. **(06 Marks)**

OR

10 a. If A and B are two events having P(A) = 1/2, P(B) = 1/3 and P(A∩B) = 1/4 compute
i) P(A/B) ii) P(B/A) iii) $P(\overline{A}/\overline{B})$. **(07 Marks)**

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

c. In a school 25% of the students failed in first language, 15% of the students failed in second language and 10% of the students failed in both. If a student is selected at random find the probability that.
i) He failed in first language if he had failed in the second language.
ii) He failed in second language if he had failed in the first language.
iii) He failed in either of the two languages. **(06 Marks)**

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CBCS SCHEME

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17ME42

Fourth Semester B.E. Degree Examination, July/August 2022
Kinematics of Machinery

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following :
(i) Link (ii) Kinematic Pair (iii) Kinematic Chain
(iv) Mechanism (v) Structure (vi) Degree of freedom **(06 Marks)**

b. Explain with a neat sketch crank and slotted lever mechanism. **(06 Marks)**

c. Explain with a neat sketch Peaucellier mechanism. **(08 Marks)**

OR

2 a. Explain with a neat Ackerman steering mechanism mention condition for correct steering. **(10 Marks)**

b. Draw a neat proportionate sketch of Whitworth mechanism and explain. **(10 Marks)**

Module-2

3 In a four bar mechanism ABCD, AD is fixed and crank AB rotates at 200 rpm in clockwise direction. [Refer Fig.Q3]. The dimensions of versions links are as follows:
BC = AD = 150mm, CD = 80mm, AB = 40 mm.
(i) Find angular velocity of link BC and CD
(ii) Find angular acceleration of link BC and CD

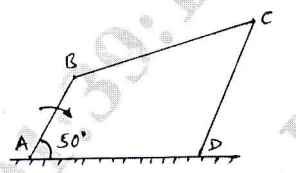

Fig.Q3 **(20 Marks)**

OR

4 a. State and prove Kennedy's theorem. **(08 Marks)**

b. Explain the procedure to construct Klein's construction to determine the velocity and acceleration of slider crank mechanism in which crank is rotating uniformly. **(12 Marks)**

Module-3

5 The four bar mechanism ABCD is shown in Fig.Q5 which is driven by link 2 at w_2 = 45 rad/sec counter clockwise. Find the angular velocities of links 3 and 4 by using complex algebra method. Take AB = 100 mm, CD = 300mm, AD = 250mm.

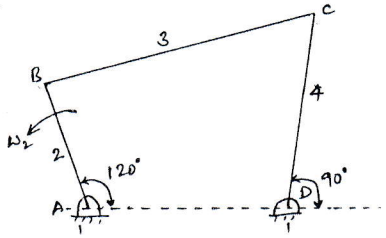

Fig.Q5 **(20 Marks)**

OR

6 a. Derive Freudenstein's equation for slider crank mechanism. **(08 Marks)**

b. Design a four link mechanism if the motion of the input and output links are governed by a function $y = x^{1.5}$ and x varies from 1 to 4. Assume θ to vary from 30° to 120° and ϕ from 60° to 130°. The length of the fixed link is 30mm. Use Chebychev spacing of accuracy points. **(12 Marks)**

Module-4

7 a. Define Pitch circle, Circular Pitch, diametral Pitch and module. **(08 Marks)**

b. Obtain an expression for the minimum number of teeth on pinion to avoid interferences. **(12 Marks)**

OR

8 a. Explain with neat sketch:
(i) Single gear train (ii) Compound gear train
(iii) Reverted gear train (iv) Epicyclic gear train **(08 Marks)**

b. The arm of an epicyclic gear train rotates at 100 rpm in anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B if the wheel A instead of being fixed, makes 200 rpm clockwise? [Refer Fig.Q8(b)]

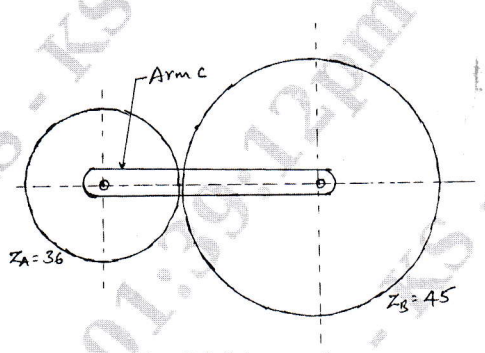

Fig.Q8(b) **(12 Marks)**

Module-5

9 Draw the profile of a cam to raise a valve with SHM through 40mm in $1/4^{th}$ of revolution, keep it fully raised though $1/10^{th}$ revolution and to lower it with uniform acceleration and retardation in $1/6^{th}$ revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20mm and minimum radius of the cam to be 30mm. The axis of the valve rod passes through the axis of cam shaft. The cam shaft rotates at 360 rpm clockwise. Determine maximum velocity and acceleration of the following during outstroke and return stroke. **(20 Marks)**

OR

10 a. Define the following terms related to cam:
(i) Lift (ii) Dwell (iii) Pressure angle (iv) Base angle **(08 Marks)**

b. Obtain expression for displacement, velocity and acceleration for a flat faced follower in contact with circular flank of a cam. **(12 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, July/August 2022
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of thermodynamics data handbook is permitted.*

Module-1

1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of diesel-cycle. **(10 Marks)**

b. An air standard diesel cycle has a compression ratio of 18 and the heat transferred to the working fluid per cycle is 2000 kJ/kg. At the beginning of the compression stroke, the pressure is 1 bar and temperature is 300°K. Calculate the thermal efficiency. **(10 Marks)**

OR

2 a. With a neat sketch, explain the working principle of Ramjet engine. **(10 Marks)**

b. A gas turbine plant works between the temperature limits of 300°K and 1000°K and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect inter-cooling in-between. Calculate the netpower of the plant per kg of air circulation. C_p = 1 kJ/kg°K; γ = 1.4 for air. **(10 Marks)**

Module-2

3 a. Discuss the effect of :
(i) Condenser pressure (ii) Boiler pressure performance of Rankine cycle. **(10 Marks)**

b. In a Rankine cycle, the maximum pressure of steam supplied is 6 bar. The dryness fraction is 0.9. The exhaust pressure is 0.7 bar. Find the theoretical work-done and Rankine efficiency. **(10 Marks)**

OR

4 a. With a schematic diagram, explain the working principle of reheat vapour cycle. **(10 Marks)**

b. Steam enters a steam turbine using reheat cycle at 150 bar, 350°C, the reheat pressure is 25 bar and exhaust pressure is 0.05 bar. The temperature of reheated steam is 300°C. Calculate the cycle efficiency and power developed for a steam flow rate is 3000 kg/hr. Consider the pump work. **(10 Marks)**

Module-3

5 a. Define the following terms with reference to a combustion process:
(i) Stiochiometric air (ii) Excess air (iii) Air-fuel ratio
(iv) Enthalpy of formation (v) Combustion efficiency **(10 Marks)**

b. A fuel has following composition by mass. C – 82% , H_2 – 13% and remaining is oxygen. Calculate the minimum air required per kg of fuel for its complete combustion. Also calculate mass of product of combustion per kg of fuel. **(10 Marks)**

OR

6 a. Define the following:
(i) Indicated power (ii) Brake power (iii) Friction power
(iv) Mechanical efficiency (v) Specific fuel consumption **(10 Marks)**

b. The following particulars refer to a 2-stoke oil engine.
Bore = 20 cm, stroke = 30 cm, speed = 350 rpm. Indicated mean effective pressure = 275 kN/m^2. Net brake load = 610 N, dia of brake drum = 1 m, oil consumption = 4.25 kg/hr, calorific value of fuel is 44,000 kJ/kg.
Determine: (i) I.P. (ii) B.P. (iii) η_{mech} (iv) Indicated thermal efficiency
(v) Brake thermal efficiency **(10 Marks)**

Module-4

7 a. With a neat sketch, explain the working principle of vapour absorption refrigeration system. **(10 Marks)**

b. In an air-standard refrigeration cycle, air enters the compressor at 1 bar and 10°C and leaves at 5.1 bar. Air enters the expander at 30°C. Find COP for the cycle. Calculate the rate at which air must enter the compressor to produce a refrigerating effect of 1 ton refrigeration. **(10 Marks)**

OR

8 a. Define the following:
(i) Dry bulb temperature (ii) Wet bulb temperature (iii) Dry air
(iv) Saturated air (v) Moisture **(10 Marks)**

b. Explain the following:
(i) Sensible heating or cooling (ii) Dehumidification
(iii) Psychrometric chart (iv) Relative humidity **(10 Marks)**

Module-5

9 a. Derive the expression, condition for minimum work-done in a 2-stage compressor with perfect intercooling. **(10 Marks)**

b. A single stage reciprocating compressor takes 1 m^3 of air per minute at 1.013 bar and 15°C and delivers it at 7 bar. Assuming that the law of compression is $PV^{1.35} = C$ and clearance is negligible. Calculate the indicated power. **(10 Marks)**

OR

10 a. Explain the following:
(i) Isentropic flow
(ii) Flow with friction
(iii) Super saturated flow **(10 Marks)**

b. Air expands reversibly and adiabatically in a nozzle from 15 bar and 150°C to pressure of 7 bar. The inlet velocity of nozzle is very small and process occurs under steady state flow condition. Calculate the exit velocity of nozzle. **(10 Marks)**

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CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, July/August 2022
Fluids Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the following terms with SI units : i) Weight density ii) Specific gravity iii) Dynamic viscosity. **(06 Marks)**

b. Define Capillarity and derive an expression for Capillary rise. **(08 Marks)**

c. If the velocity distribution over a plate is given by $u = \frac{2}{3} y - y^2$ in which u is the velocity in meter per second at a distance y meter above the plate. Determine the shear stress at y = 0 and y = 0.15m. Take dynamic viscosity of fluid as 8.63 poises. **(06 Marks)**

OR

2 a. State and prove Hydrostatic Law. **(06 Marks)**

b. Define i) Buoyancy ii) Metacentre iii) Metacentric height. **(06 Marks)**

c. A rectangular pontoon is 5m long, 3m wide and 1.20m high. The depth of immersion of pontoon is 0.80m in sea water. If the centre of gravity is 0.6m above the bottom of the pontoon , determine the meta centric height. The density of sea water = 1025 kg/m^3. **(08 Marks)**

Module-2

3 a. Differentiate between :
i) Steady flow and Unsteady flow ii) Laminar flow and Turbulent flow. **(04 Marks)**

b. Derive the Continuity equation for 3 – Dimensional flow in Cartesian co-ordinates. **(08 Marks)**

c. The velocity components in a two dimensional flow are

$u = y^3/3 + 2x - x^2y$ and $v = xy^2 - 2y - x^3/3$.

Show that these components represents a possible case of an irrotational flow. **(08 Marks)**

OR

4 a. Derive an expression for discharge through venturimeter. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100m having diameters 600mm at the upper end and 300mm at the lower end, at the rate of 50 litre/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(10 Marks)**

Module-3

5 a. Define Reynolds number. What is its significance? List the characteristic of laminar flow. **(08 Marks)**

b. A crude oil of viscosity 0.97 poise and specific gravity 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of pipe, if 100kg of the oil is collected in a tank in 30 seconds. **(12 Marks)**

OR

6 a. Derive the Darcy Weisbach equation. **(08 Marks)**

b. Define Hydraulic gradient line and Total energy line. **(04 Marks)**

c. Find the head lost due to friction in a pipe of diameter 300mm and length 50m through which water is flowing at a velocity of 3 m/s using
i) Darcy formula ii) Chezy's formula for which C = 60. **(08 Marks)**

Module-4

7 a. Define i) Boundary layer ii) Boundary layer thickness iii) Drag iv) Lift. **(08 Marks)**

b. Experiments were conducted in a wind tunnel with a wind speed of 50km/hour on a flat plat of size 2m long and 1m wide. The density of air is 1.15 kg/m^3. The coefficients of lift the drag are 0.75 and 0.15 respectively. Determine i) The lift force ii) The drag force iii) The resultant force iv) Direction and resultant force v) Power exerted by air on the plate. **(12 Marks)**

OR

8 a. Explain different types of Similitude. **(06 Marks)**

b. Explain Rayleighs method of dimensional analysis. **(06 Marks)**

c. Using Buckingham'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 coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(08 Marks)**

Module-5

9 a. Define the following terms : i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow vi) Sonic flow. **(12 Marks)**

b. An Aeroplane is flying at an height of 15km where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg K. Find the speed of the plane. **(08 Marks)**

OR

10 a. Explain the meaning of CFD and its applications. **(06 Marks)**

b. Define the following terms and write the relevant equations for same :
i) Stagnation temperature ii) Stagnation pressure. **(06 Marks)**

c. Derive and expression for velocity of sound in a fluid. **(08 Marks)**

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CBCS SCHEME

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17ME46B/MEB406

Fourth Semester B.E. Degree Examination, July/August 2022
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. State the objectives of Metrology. (04 Marks)

b. What is Metrology? Explain with necessary sketch the imperial standard yard and highlight the significance of international prototype meter. (08 Marks)

c. Four length bars A, B, C and D each having a basic length 125mm are to be calibrated using a calibrated length bar of 500mm basic length. The 500mm bar has an actual length of 499.9991mm. Also it was found that

$L_B = L_A + 0.0001mm$

$L_C = L_A + 0.0005mm$

$L_D = L_A - 0.0002mm$

$L_A + L_B + L_C + L_D = L + 0.0003mm.$

Determine L_A, L_B, L_C and L_D. (08 Marks)

OR

2 a. Explain wringing of slip gauges with neat sketch. (04 Marks)

b. Explain construction and working of sine bar. (08 Marks)

c. Build the following lengths by using M-38 set of slip gauges and write their combinations:
i) 29.875mm ii) 101.345mm iii) 78.3665m.

Range (mm)	Steps (mm)	Pieces
1.005	-	1
1.01-1.09	0.01	9
1.1-1.9	0.1	9
1.0-9.0	1.0	9
10.0-100.0	10.0	10

(08 Marks)

Module-2

3 a. Define fit, explain different types of fits with sketches. (08 Marks)

b. Discuss the characteristics and symbols of Geometrical Dimensional Tolerances (GD and T) are used in Industries. (08 Marks)

c. Discuss the materials used for manufacturing of gauges. (04 Marks)

OR

4 a. Write short note on IS system of limits and fits. (04 Marks)

b. Classify the comparator and explain the sigma comparator with neat sketches. (08 Marks)

c. Determine the actual dimensions to be provided for a shaft and hole of 90mm size for H_8eq type clearance fit. Diameter steps are 80mm and 100mm.

$i = 0.45\sqrt[3]{D} + 0.001D$

Value of tolerances for IT8 = 25i and IT9 = 40i

FD for 'e' type shaft = $-11D^{0.41}$. (08 Marks)

Module-3

5 a. Explain the terminology of screw thread. (04 Marks)

b. Derive an equation for measuring effective diameter of screw thread by using 3-wire method. (08 Marks)

c. Illustrate the use of gear tooth vernier caliper to measure tooth thickness. (08 Marks)

OR

6 a. Explain the principle of Interferometry. (04 Marks)

b. Sketch and explain Parkinson's gear tester. (08 Marks)

c. With a neat sketch, explain the working of co-ordinate measuring machine. (08 Marks)

Module-4

7 a. List the terms used in measurements. (04 Marks)

b. What is Transducer? Sketch and explain the principle of electronic transducer. What are the advantage of electronic transducer? (08 Marks)

c. Explain in detail the various fundamental methods of measurements with suitable exmaple. (08 Marks)

OR

8 a. Explain the inherent problems present in mechanical modifying system. (04 Marks)

b. With block diagram explain a general telemetry system. (08 Marks)

c. Explain the working of cathode say oscilloscope. (08 Marks)

Module-5

9 a. State the laws of governing the functioning of the thermocouple. (04 Marks)

b. With a neat sketch, explain working of prony brake dynometer. Its limitations. (08 Marks)

c. Explain the working of McLeod gauge with neat sketch. (08 Marks)

OR

10 a. Differentiate between static and dynamic pressure. (04 Marks)

b. Define strain gauge with a neat sketch, explain wheat stone bridge circuit. (08 Marks)

c. Explain the construction and working principle of optical pyrometer. (08 Marks)

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