CBCS SCHEME

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15MAT41

Fourth Semester B.E. Degree Examination, June/July 2019
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Employ Taylor's series method, find y(0.1) considering upto third degree term if y(x) satisfies the equation $\frac{dy}{dx} = x - y^2$, $y(0) = 1$. **(05 Marks)**

b. Using Runge-Kutta method of fourth order, find y(0.1) for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.1$. **(05 Marks)**

c. Apply Milne's method to compute y(1.4) correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and following the data : $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$. **(06 Marks)**

OR

2 a. Use Taylor's series method to find y(4.1) given that $(x^2 + y)y' = 1$ and $y(4) = 4$. **(05 Marks)**

b. Find y at $x = 0.8$, given $y' = x - y^2$ and $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$. Using Adams – Bashforth method. Apply the corrector formula. **(05 Marks)**

c. Using Modified Euler's method find y at $x = 0.1$ given $y' = 3x + \frac{y}{2}$ with $y(0) = 1$ taking $h = 0.1$. **(06 Marks)**

Module-2

3 a. Obtain the solution of the equation $2y'' = 4x + y'$ with initial conditions $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$ and $y'(1) = 2$, $y'(1.1) = 2.3178$, $y'(1.2) = 2.6725$, $y'(1.3) = 3.0657$ by computing y(1.4) applying Milne's method. **(05 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$ then prove that $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx = 0$ if $\alpha \neq \beta$. **(05 Marks)**

c. Show that $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$ **(06 Marks)**

OR

4 a. Given $y'' - xy' - y = 0$ with the initial conditions $y(0) = 1$, $y'(0) = 0$. Compute y(0.2) and y'(0.2) by taking $h = 0.2$ using Runge - Kutta method of fourth order. **(05 Marks)**

b. If $x^3 + 2x^2 - x + 1 = aP_0(x) + bP_1(x) + cP_2(x) + dP_3(x)$ then, find the values of a, b, c, d. **(05 Marks)**

c. Derive Rodrigue's formula

$$P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}\left[(x^2-1)^n\right]$$ **(06 Marks)**

Module-3

5 a. State and prove Cauchy-Reimann equation in polar form. **(05 Marks)**

b. Discuss the transformation $w = z^2$. **(05 Marks)**

c. Find the bilinear transformation which maps the points $z = 1, i, -1$ into $w = 2, i, -2$. **(06 Marks)**

OR

6 a. Find the analytic function whose real part is

$$\frac{x^4 - y^4 - 2x}{x^2 + y^2}$$ **(05 Marks)**

b. State and prove Cauchy Integral formula. **(05 Marks)**

c. Evaluate $\int_c \frac{e^{2z}}{(z+1)(z-2)} dz$ where c is the circle : $|z| = 3$ using Cauchy's Residue theorem. **(06 Marks)**

Module-4

7 a. The probability function of a variate x is :

x	0	1	2	3	4	5	6	7
p(x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

(i) Find k (ii) Evaluate $p(x < 6)$, $p(x \geq 6)$ and $p(3 < x \leq 6)$. **(05 Marks)**

b. Obtain mean and standard deviation of Binomial distribution. **(05 Marks)**

c. The joint distribution of two discrete variables x and y is $f(x, y) = (2x + y)$ where x and y are integers such that $0 \leq x \leq 2$; $0 \leq y \leq 3$.

Find : (i) Marginal distribution of x and y.

(ii) Are x and y independent. **(06 Marks)**

OR

8 a. 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 (iii) between 65 and 75 [Given $\phi(1) = 0.3413$] **(05 Marks)**

b. If the probability of a bad reaction from a certain injection is 0.001, determine the chance that out of 2000 individuals, more than two will get a bad reaction. **(05 Marks)**

c. The joint distribution of the random variables X and Y are given. Find the corresponding marginal distribution. Also compute the covariance and the correlation of the random variables X and Y. **(06 Marks)**

X \ Y	1	3	9
2	1/8	1/24	1/12
4	1/4	1/4	0
6	1/8	1/24	1/12

Module-5

9 a. Explain the terms: (i) Null hypothesis (ii) type-I and type-II errors (iii) Significance level **(05 Marks)**

b. In 324 throws of a six faced 'die', an odd number turned up 181 times. Is it reasonable to think that 'die' is an unbiased one? **(05 Marks)**

c. Three boys A, B, C are throwing ball to each other. A always throws the ball to B and B always throws the ball to C. C is just as likely to throw the ball to B as to A. If C was the first person to throw the ball find the probabilities that after three throws (i) A has the ball (ii) B has the ball (iii) C has the ball. **(06 Marks)**

OR

10 a. Find the unique fixed probability vector for the matrix

$$P = \begin{bmatrix} 0 & 2/3 & 1/3 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{bmatrix}$$ **(05 Marks)**

b. A random sample for 1000 workers in company has mean wage of Rs. 50 per day and standard deviation of Rs. 15. Another sample of 1500 workers from another company has mean wage of Rs. 45 per day and standard deviation of Rs. 20. Does the mean rate of wages varies between the two companies? **(05 Marks)**

c. A die is thrown 264 times and the number appearing on the face (x) follows the following frequency distribution.

x	1	2	3	4	5	6
f	40	32	28	58	54	60

Calculate the value of χ^2. **(06 Marks)**

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15ME42

Fourth Semester B.E. Degree Examination, June/July 2019
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define: i) Kinematic chain ii) Mechanism iii) Machine iv) Degree of freedom **(08 Marks)**

b. Sketch and explain crank and slotted lever mechanism. **(08 Marks)**

OR

2 a. Explain Peaucelliers' exact straight line mechanism with a line diagram. **(06 Marks)**

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

Module-2

3 A four bar mechanism ABCD is made up of four links, pin jointed at the ends. AD is a fixed link which is 180 mm long. the links AB, BC and CD are 90 mm, 120 mm and 120 mm long respectively. At certain instant, the link AB makes an angle of 60° with the link AD. If the link AB rotates at a uniform speed of 100 rpm clockwise, determine, (i) Angular velocity of the links BC and CD, (ii) Angular acceleration of the links CD and CB. Solve by relative method. **(16 Marks)**

OR

4 a. State and prove Kennedy's theorem. **(06 Marks)**

b. Determine the velocity and acceleration of the piston by Klein's construction to the following specifications of a single slider crank mechanism.
Stroke = 300 mm
Ratio of length of connecting rod to crank length = 4
Speed of the engine = 300 rpm
Position of crank = 45° with inner dead center. **(10 Marks)**

Module-3

5 a. State loop-closure equation and explain in brief. **(04 Marks)**

b. In a reciprocating engine, the length of the crank is 250 mm and length of connecting rod is 1000 mm. The crank rotates at a uniform speed of 300 rpm clockwise. Crank is at 30° from inner dead center. Determine:
i) Velocity of piston and angular velocity of connecting rod
ii) Acceleration of piston and angular acceleration of connecting rod by complex algebra method from first principle. **(12 Marks)**

OR

6 a. Derive the Freudenstein's equation for four bar mechanism. **(10 Marks)**

b. Explain function generation in four bar mechanism. **(06 Marks)**

Module-4

7 a. Derive an expression for path of contact for two meshing spur gears having involute profile. **(08 Marks)**

b. A pair of spur gears has 16 teeth and 18 teeth, a module 12.5mm, an addendum 12.5 mm and a pressure angle 14.5 degrees. Prove that the gears have interference. Determine the minimum number of teeth and the velocity ratio to avoid the interference. **(08 Marks)**

OR

8 An epicyclic gear train as shown in Fig.Q8 consists of a sunwheel(S), a stationary internal gear (E) and three identical planet wheels (P) carried on a star shaped planet carrier(C). The size of different toothed wheels are such that the planet carrier C rotates at $\left(\frac{1}{5}\right)$ of the speed of the sun wheel. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 Nm. Determine:

i) Number of teeth on different wheels of train

ii) Torque necessary to keep the internal gear stationary.

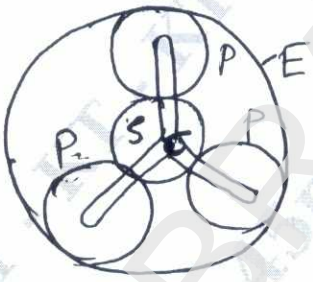

Fig.Q.8 **(16 Marks)**

Module-5

9 A roller follower is raised through a distance of 35 mm in 120° rotation of the cam, remains at rest for the next 30° and is lowered during further 120° rotation of cam, The raising of the follower takes place with cycloidal motion and the lowering with uniform acceleration retardation motion. However the uniform acceleration period is 2/3 of the uniform retardation period. The least radius of the cam is 25 mm and the roller radius is 10 mm. Draw the cam profile. Also determine the maximum velocity and acceleration during rise and return. Speed of the cam is 200 rpm and rotates in clockwise direction. **(16 Marks)**

OR

10 A symmetrical circular arc cam operating a flat faced follower has the following particulars. Least radius of the cam is 30 mm, lift is 20 mm, angle of lift is 75°, nose radius is 5 mm, speed is 600 rpm; find:

i) The principal dimensions of the cam

ii) The acceleration of the follower at the beginning of lift, at the end of contact with the circular flank, at the beginning of contact with nose and at the apex of nose. **(16 Marks)**

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15ME43

Fourth Semester B.E. Degree Examination, June/July 2019
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Thermodynamic Data handbook / Steam tables / Mollier chart are permitted.***

Module-1

1 a. What is an Air Standard efficiency? Derive an expression for Air Standard efficiency of a Diesel cycle. **(08 Marks)**

b. An engine of 250mm bore and 375mm stroke works on Otto cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1 bar and 50^0C. If the maximum pressure is limited to 25 bar, find the following i) The air standard efficiency of cycle ii) The mean effective pressure for the cycle. **(08 Marks)**

OR

2 a. Discuss briefly any two methods employed for improvement of thermal efficiency of open cycle gas turbine plant. **(06 Marks)**

b. State the working difference between Turbo Jet and Turbo – prop engines. **(04 Marks)**

c. A gas turbine has a pressure ratio of 6 and a maximum cycle temperature of 600^0C. The Isentropic efficiencies of compressor and turbine are 0.82 and 0.85 respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15^0C at the rate of 15 kgs. Take $C_p = 1.005$ kJ/kg K and $\gamma = 1.4$ for compression process and $C_p = 1.11$ kJ.kg K and $\gamma = 1.333$ for the expansion process. **(06 Marks)**

Module-2

3 a. Describe the different processes of Rankine cycle. Derive also an expression for its efficiency. **(08 Marks)**

b. A simple Rankine cycle works between 28 bar and 0.06 bar, the initial condition of steam is being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption. **(08 Marks)**

OR

4 a. Explain with the help of neat T – S diagram and block diagram a practical regenerative cycle and also derive and expression for its thermal efficiency with one open feed water heater. **(08 Marks)**

b. A turbine is supplied with steam at a pressure of 32 bar and a temperature of 410^0C. If the steam is reheated at 5.5 bar to a temperature of 395^0C and then expanded isentropically to a pressure of 0.08 bar, what will be the dryness fraction at the exit of turbine and thermal efficiency of the cycle? **(08 Marks)**

Module-3

5 a. Define the following : i) Stoichiometric air fuel Ratio ii) Excess air iii) Enthalpy of Reaction iv) Enthalpy of Formation. **(08 Marks)**

b. The following is the volumetric analysis of the dry exhaust from an I.C. Engine $CO_2 = 8.9\%$, $CO = 8.2\%$, $H_2 = 4.3\%$, $CH_4 = 0.5\%$, $N_2 = 78.1\%$. If the Fuel used is Octane C_8H_{18}. Determine the air Fuel Ratio on mass basis. **(08 Marks)**

OR

6 a. Explain the phenomenon of knocking in SI engine. What are the different factors which influence the knocking? **(08 Marks)**

b. During a 60 minute trail of a single cylinder four stroke engine the following observations were recorded. Bore = 0.3m , Stroke = 0.45m , Fuel consumption = 11.4kg , Calorific value = 42000 kJ/kg , IMEP = 6 bar , Net load on brake = 1500N , Speed = 300 rpm , Brake drum diameter = 1.8m , Rope diameter = 20mm , Quantity of Jacket cooling water = 600kg , Rise in temperature of Jacket cooling water = 55^0C, Quantity of air = 250 kg Exhaust gas temperature = 420^0C , Ambient temperature = 20^0C , C_p for gases = 1kJ/kg K. Find IP, BP, mechanical efficiency and draw heat balance sheet on minute basis. **(08 Marks)**

Module-4

7 a. Discuss the effect of following on the performance of a vapour compression system :
i) Effect on suction pressure ii) Effect of super heating iii) Effect of subcooling. **(08 Marks)**

b. A refrigeration system of 10.5 tonnes capacity at an evaporator temperature of -12^0C and a condenser temperature of 27^0C is needed in a food storage locker. The Refrigerant Ammonia is sub cooled by 6^0C before entering the expansion valve. The vapour is 0.95 dry as it leaves the evaporator coil. Find C.O.P and power required in KW. **(08 Marks)**

OR

8 a. Define Specific humidity and derive an expression for the specific humidity. **(08 Marks)**

b. It is required to design an air conditioning plant for a small office for following conditions : Outdoor condition = 14^0C DBT and 10^0C WBT , Required conditions = 20^0C DBT and 60% RH ; Amount of air circulated = 0.3m^3/min/person , Seating capacity = 60.
The required condition is achieved first by heating and then by adiabatic humidifying. Determine i) Heating capacity of coil in KW and its surface temperature if the by pass factor of coil is 0.4 ii) Capacity of the humidifier. **(08 Marks)**

Module-5

9 a. Define volumetric efficiency of an air compressor and derive an expression for volumetric efficiency. **(08 Marks)**

b. An air compressor takes in air at 1 bar and 20^0C and compresses it according to law $PV^{1.2}$ = constant. It is then delivered to a receiver at a constant pressure of 10 bar. Determine i) Temperature at the end of compression ii) Work done iii) Heat transferred during the compression per kg of air. **(08 Marks)**

OR

10 a. What is the effect of friction on the flow through a steam nozzle? Explain with the help of h – s diagram. **(08 Marks)**

b. Steam is expanded in a set of nozzles from 10 bar 200^0C to 5 bar. Neglecting the initial velocity, find the minimum area of the nozzle required to allow a flow of 3kg/s under the given conditions. Assume that expansion of steam to be isentropic. **(08 Marks)**

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15ME44

Fourth Semester B.E. Degree Examination, June/July 2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following terms:
i) Mass density ii) Dynamic viscosity
iii) Capillarity iv) Surface tension **(04 Marks)**

b. State and prove Pascal's law. **(06 Marks)**

c. A steel shaft of 30 mm diameter rotates at 240 rpm, in a bearing of diameter 32 mm. Lubricant oils of viscosity 5 poise used for lubrication of shaft in the bearing. Determine the torque required at the shaft and power lost in maintaining the lubrication. Length of bearing is 90 mm. **(06 Marks)**

OR

2 a. Derive an expression for total pressure force and position of centre of pressure for a vertical surface submerged in water. **(08 Marks)**

b. A cylindrical buoy is 2m in diameter 2.5 m 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. **(08 Marks)**

Module-2

3 a. Distinguish between:
i) Steady and unsteady flow
ii) Laminar and turbulent flow **(04 Marks)**

b. Derive the continuity equation in three dimensional Cartesian coordinates for a steady incompressible flow. **(06 Marks)**

c. A stream function for a 2D flow is given by $\psi = 8xy$. Calculate the velocity at a point P(4, 5). Find also the velocity potential function ϕ. **(06 Marks)**

OR

4 a. Derive the Euler's equation for ideal fluids and hence deduce Bernoulli's equation of motion. Mention the assumptions made. **(10 Marks)**

b. A rectangular channel 2m wide has a discharge of 0.25 m^3/s which is measured by a right angled V-Notch. Find the position of the apex of the notch from the bed of the channel, if maximum depth of water is not to exceed 1.3 m. Take $C_d = 0.62$. **(06 Marks)**

Module-3

5 a. Derive Hagen-Poiseuille equation for viscous flow through a circular pipe. **(10 Marks)**

b. Determine: (i) The pressure gradient along flow, (ii) The average velocity, (iii) The discharge for an oil of viscosity 0.02 N-S/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. **(06 Marks)**

OR

6 a. Derive the Darcy-Weisbach equation for the loss of head due to friction in a pipe. **(08 Marks)**

b. The diameter of a horizontal pipe which is 300 mm is suddenly enlarged to 600 mm. The rate of flow of water through this pipe is 0.4 m^3/s. If the intensity of pressure in the smaller pipe is 125 kPa. Determine:

i) Loss of head due to sudden enlargement
ii) Intensity of pressure in the larger pipe
iii) Power lost due to enlargement. **(08 Marks)**

Module-4

7 a. Define the following and write their equations:

i) Drag
ii) Lift
iii) Displacement thickness
iv) Momentum thickness. **(08 Marks)**

b. On a flat plate of 2m length and 1m width experiments were conducted in a wind tunnel with a wind speed of 50 km/hr, the plate is kept at such an angle that the coefficient of drag and lift are 0.18 and 0.9 respectively. Determine:

i) Drag force ii) Lift force
iii) Resultant force iv) Power exerted by the air stream on the plate.
Take density of air = 1.15 kg/m^3. **(08 Marks)**

OR

8 a. Define the following dimensionless numbers with equation:

i) Reynold's number ii) Froude's number
iii) Euler's number iv) Webber's number **(08 Marks)**

b. Torque developed by a disc of diameter D, rotating at a speed N is dependent on fluid viscosity μ and fluid density ρ. Obtain an expression for torque, $T = \rho N^2 D^5 \phi \left[\frac{\mu}{\rho N D^2}\right]$ using Buckingham's π - theorem. **(08 Marks)**

Module-5

9 a. Define the following:

i) Mach number ii) Mach angle iii) Mach cone
iv) Subsonic flow v) Supersonic flow **(10 Marks)**

b. A projectile travels in air of pressure 100 kPa at 10°C at a speed of 1500 km/hr. Find the mach number and the mach angle. Take K = 1.4 and R = 287 J/kg°K. **(06 Marks)**

OR

10 a. Mention the applications and limitations of CFD (Computational Fluid Dynamics). **(08 Marks)**

b. Define the following terms and write the relevant equations for the same:

i) Stagnation temperature
ii) Stagnation pressure **(08 Marks)**

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15ME46B/15MEB406

Fourth Semester B.E. Degree Examination, June/July 2019

Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Describe with a suitable sketch Imperial Standard Yard. **(06 Marks)**

b. Explain with a neat sketch, the use of sine bar for measurement of known angle. **(06 Marks)**

c. Build up the slip gauge combination using the M112 set for the following:
(i) 52.9875 mm (ii) 35.357 mm

M112 SET

Range	Steps	Pieces
1.0005	-	1
1.001 to 1.009	0.001	9
1.01 to 1.49	0.01	49
0.5 to 24.5	0.5	49
25, 50, 75, 100	25.0	4

(04 Marks)

OR

2 a. Explain briefly the wringing phenomenon in slip gauges. **(06 Marks)**

b. List some of the advantages of wavelength standards. **(04 Marks)**

c. Explain the principle of an autocollimator and list some of its applications. **(06 Marks)**

Module-2

3 a. Explain the different types of fits with suitable sketches. **(06 Marks)**

b. Define a comparator. With a neat sketch explain Solex pneumatic gauge. **(06 Marks)**

c. Determine the dimensions of hole and shaft assembly designated as 100 H_8e_9, fit given:
100 mm lies in the diameter step of 80 and 120 mm
$i = 0.45 (D)^{1/3} + 0.001D$, (D in mm, i value in microns)
IT8 = 25i
IT9 = 40i
Fundamental deviation of 'e' shaft is given by $-5.5D^{0.41}$ in microns. Also determine the maximum and minimum clearances. **(04 Marks)**

OR

4 a. Distinguish between the following:
i) Hole Basis System and Shaft basis system
ii) Geometric Tolerances and Positional tolerances **(08 Marks)**

b. State Taylor's principle on limit gauges. **(02 Marks)**

c. Sketch and explain Johannson's Mikrokator. **(06 Marks)**

Module-3

5 a. With a neat sketch explain the Three-Wire method for measurement of effective diameter. **(05 Marks)**

b. With a neat sketch, explain Tool Maker's microscope. **(06 Marks)**

c. Explain with a neat sketch the use of Gear Tooth Vernier Calipers for the measurement of Chordal thickness of a spur gear. **(05 Marks)**

OR

6 a. Explain any one type of laser Interferometer. List some of the advantages of lasers. **(08 Marks)**

b. With a neat sketch, explain CMM. List some of the applications of CMM. **(08 Marks)**

Module-4

7 a. Describe the generalized measurement system with a block diagram. **(06 Marks)**

b. Define the following terms:
(i) Accuracy (ii) Precision (iii) Hysteresis
(iv) Sensitivity (v) Loading effects **(05 Marks)**

c. Sketch and explain any one type of electrical transducer. **(05 Marks)**

OR

8 a. Explain the inherent problems present in mechanical modifying system. **(05 Marks)**

b. Describe the Cathode-Ray-Oscilloscope with a neat sketch. **(07 Marks)**

c. With a neat sketch, explain any one type of capacitive transducer. **(04 Marks)**

Module-5

9 a. Explain with a neat sketch, McLeod gauge for measurement of low pressure. **(08 Marks)**

b. With a neat sketch, explain the working principle of Prony Brake Dynamometer. **(08 Marks)**

OR

10 a. State the laws of thermocouples. **(04 Marks)**

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

c. Write a brief note on Gauge factor with respect to the strain gauges. **(04 Marks)**

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CBCS SCHEME

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15MATDIP41

Fourth Semester B.E. Degree Examination, June/July 2019
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$ by elementary row operation. **(06 Marks)**

b. Find the inverse of the matrix $\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}$ using Cayley - Hamilton theorem. **(05 Marks)**

c. Find all eigen values of the matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ **(05 Marks)**

OR

2 a. Solve the system of equation by Gauss - Elimination method.

$x + y + z = 9$
$x - 2y + 3z = 8$
$2x + y - z = 3$ **(06 Marks)**

b. Using Cayley – Hamilton theorem find A^{-1}, given $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ **(05 Marks)**

c. Reduce the matrix $A = \begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ into row echelon form and hence find its rank. **(05 Marks)**

Module-2

3 a. Solve by the method of undetermined co-efficient $y'' - 4y' + 4y = e^x$. **(06 Marks)**

b. Solve $(D^3 + 6D^2 + 11D + 6)y = 0$. **(05 Marks)**

c. Solve $y'' + 2y' + y = 2x$. **(05 Marks)**

OR

4 a. Solve by the method of variation of parameter $y'' + a^2y = \sec ax$. **(06 Marks)**

b. Solve $y'' - 4y' + 13y = \cos 2x$. **(05 Marks)**

c. Solve $(D^2 - 1)y = e^{2x}$. **(05 Marks)**

Module-3

5 a. If $f(t) = t^2$, $0 < t < 2$ and $f(t+2) = f(t)$ for $t > 2$, find $L[f(t)]$. **(06 Marks)**

b. Find $L[\cos t \cdot \cos 2t \cdot \cos 3t]$ **(05 Marks)**

c. Find $L[e^{-2t}(2\cos 5t - \sin 5t)]$ **(05 Marks)**

OR

6 a. Find $L[e^{-t} \cdot \cos^2 3t]$ **(06 Marks)**

b. Express the following function into unit step function and hence find $L[f(t)]$ given

$$f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$$ **(05 Marks)**

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

Module-4

7 a. Using Laplace transforms solve the differential equation $y'' + 4y' + 4y = e^{-t}$ given $y(0) = 0$, $y'(0) = 0$. **(06 Marks)**

b. Find $L^{-1}\left[\frac{2s-5}{4s^2+25}\right] + L^{-1}\left[\frac{8-6s}{16s^2+9}\right]$ **(05 Marks)**

c. Find $L^{-1}\left[\frac{1}{s(s+1)(s+2)(s+3)}\right]$ **(05 Marks)**

OR

8 a. Employ Laplace transform to solve the equation

$y'' + 5y' + 6y = 5e^{2x}$, $y(0) = 2$, $y'(0) = 1$. **(06 Marks)**

b. Find $L^{-1}\left[\frac{s+5}{s^2-6s+13}\right]$ **(05 Marks)**

c. Find $L^{-1}\left[\log\left(\frac{s+a}{s+b}\right)\right]$ **(05 Marks)**

Module-5

9 a. If A and B are any two mutually exclusive events of S, then show that

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ **(06 Marks)**

b. Prove the following :

(i) $P(\phi) = 0$ (ii) $P(\overline{A}) = 1 - P(A)$ **(05 Marks)**

c. Three machines A, B and C produce respectively 60%, 30%, 10% of the total number of items of a factory. The percentages 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. **(05 Marks)**

OR

10 a. State and prove Bay's theorem. **(06 Marks)**

b. If A and B are events with $P(A \cup B) = \frac{7}{8}$, $P(A \cap B) = \frac{1}{4}$ and $P(\overline{A}) = \frac{5}{8}$ find $P(A)$, $P(B)$ and $P(A \cap \overline{B})$. **(05 Marks)**

c. A shooter can hit a target in 3 out of 4 shots and another shooter can hit the target in 2 out of 3 shots. Find the probability that the target is being hit.

(i) when both of them try (ii) by only one shooter. **(05 Marks)**

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