CBCS SCHEME

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17MAT41

Fourth Semester B.E. Degree Examination, July/August 2021
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions.*

1 a. Use Taylor's series method to find $y(1.5)$ from $y' = xy^{\frac{1}{3}}$, $y(1) = 1$, consider upto third order derivative term. **(06 Marks)**

b. Find $y(0.2)$ by using modified Euler's method given that $y' = x + |\sqrt{y}|$, $y(0) = 1$. Take $h = 0.2$ and carry out two modifications at each step. **(07 Marks)**

c. If $5xy' + y^2 = 2$, $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0143$ then find $y(4.4)$ by using Milne's method. **(07 Marks)**

2 a. Use Taylor's series method to find $y(1.02)$ from $y' = xy - 1$, $y(1) = 2$ consider upto fourth order derivative term. **(06 Marks)**

b. Use Runge-Kutta method to find $y(0.2)$ from $y' = \frac{y^2 - x^2}{y^2 + x^2}$, $y(0) = 1$ taking $h = 0.2$. **(07 Marks)**

c. Use Adam Bashforth method to find $y(0.4)$ from $y' = x + y^2$, $y(0) = 1$, $y(0.1) = 1.1$, $y(0.2) = 1.231$, $y(0.3) = 1.402$ **(07 Marks)**

3 a. Express $2x^3 - x^2 - 3x + 2$ in terms of Legendre polynomials. **(06 Marks)**

b. Find $y(0.1)$ by using Runge-Kutta method given that $y'' = x^3(y + y')$, $y(0) = 1$, $y'(0) = 0.5$ taking step length $h = 0.1$. **(07 Marks)**

c. If α and β are the roots of $J_n(\alpha) = 0$ then show that $\int_0^1 xJ_n(\alpha x)J_n(\beta x)dx = 0$ if $\alpha \neq \beta$. **(07 Marks)**

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

b. Find $y(0.4)$ by using Milne's method given $y'' + y' = 2e^x$, $y(0) = 2$, $y'(0) = 0$, $y(0.1) = 2.01$, $y'(0.1) = 0.2$, $y(0.2) = 2.04$, $y'(0.2) = 0.4$, $y(0.3) = 2.09$, $y'(0.3) = 0.6$. **(07 Marks)**

c. State and prove Rodrigue's formula. **(07 Marks)**

5 a. Derive Cauchy-Riemann equation in Cartesian form. **(06 Marks)**

b. Find the analytic function $f(z) = u + iv$ in terms of z given that $U = \frac{2\sin 2x}{e^{2y} + e^{-2y} - 2\cos 2x}$. **(07 Marks)**

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

6 a. If $f(z)$ is analytic function then prove that, $\left[\frac{\partial|f(z)|}{\partial x}\right]^2 + \left[\frac{\partial|f(z)|}{\partial y}\right]^2 = |f'(z)|^2$. **(06 Marks)**

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

c. Find the bilinear transformation that maps the points $z = -1, i, 1$ onto the points $W = 1, i, -1$. Also find the invariant points. **(07 Marks)**

7 a. Find the value of K such that the following distribution represents a finite probability distribution. Hence find its mean and standard deviation. Also find

(i) $P(x \le 1)$ (ii) $P(x > 1)$ (iii) $P(-1 < x \le 2)$

x	−3	−2	−1	0	1	2	3
P(x)	K	2K	3K	4K	3K	2K	K

(06 Marks)

b. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students where marks will be
(i) Less than 65 (ii) More than 75 (iii) Between 65 and 75 (A(1) = 0.3413) (07 Marks)

c. The joint probability distribution for two random variables X and Y as follows:

X \ Y	−2	−1	4	6
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Find : (i) E(X)E(Y) (ii) E(XY)
(iii) Covariance of (XY) (iv) Correlation of X and Y. (07 Marks)

8 a. Derive mean and variance of the exponential distribution. (06 Marks)

b. The joint probability distribution for two random variables X and Y as follows: (07 Marks)

Find (i) E(X) and E(Y)
(ii) E(XY)
(iii) Covariance (X, Y)
(iv) Correlation of X and Y.

X \ Y	−4	2	7
1	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
5	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$

c. In a certain factory turning out razor blades there is a small chance of 0.002 for any blade to the defective. The blades are supplied in packets of 10. Using Poisson distribution find the approximate number of packets containing (i) No defective blade (ii) One defecting blade (iii) Two defective blades in a consignment of 10000 packets. (07 Marks)

9 a. A coin was tossed 400 times and the head turned up 216 times. Test the hypothesis that the coin is unbiased at 5% level of significance. (06 Marks)

b. A certain stimulus administered to each of 12 patients resulted in the following increases of blood pressure 5, 2, 8, -1, 3, 0, -2, 1, 5, 0, 4, 6. Can it be concluded that the stimulus will in general be accompanied by an increase in blood pressure. $(t(11)_{00.05} = 2.2)$ (07 Marks)

c. Find the unique fixed probability for the regular stochastic matrix :

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1/2 & 1/2 & 0 \end{bmatrix}.$$

(07 Marks)

10 a. Define the terms : (i) Null hypothesis (ii) Type – I and Type II error.
(iii) Tests of significance. (06 Marks)

b. In experiments on pea breeding the following frequencies of seeds were obtained:

Round and Yellow	Wrinkled and Yellow	Round and Green	Wrinkled and Green	Total
315	101	108	32	556

Theory Predicts that the frequencies should be in proportions 9:3:3:1. Examine the correspondence between theory and experiment $\left(\psi^2_{0.05} = 7.815\right)$. (07 Marks)

c. A students study habits are as follows. If he studies one night, he is 30% sure to study the next night, on the other hand, if he does not study one night he is 60% sure not to study the next night as well. Find the transition matrix for the chain of his study. In the long run how often does he study? (07 Marks)

CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions.
2. Use of Thermodynamics data hand book is permitted.

1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle. **(10 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°C. If maximum pressure is 25 bar find: i) Air standard efficiency of the cycle ii) Mean effective pressure. **(10 Marks)**

2 a. Derive an expression for the optimum pressure ratio for the maximum network output in an Brayton cycle. **(08 Marks)**

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

c. The following data refers to an open cycle gas turbine. Pressure ratio = 5, Maximum temperature = 1075K, Minimum temperature = 290K, C_p for gas = 1.15kJ/kg.K, γ for air = 1.4 and γ for gas = 1.33, calorific value of the fuel = 45000kJ/kg, Efficiency of the compressor = 0.85, Efficiency of the turbine = 0.9, Efficiency of combustion = 0.95, Mass flow rate = 5kg/sec, Find: i) Thermal efficiency of the plant ii) Power output of the plant iii) Air to fuel ratio. **(10 Marks)**

3 a. Discuss the effect of i) Boiler pressure ii) Condenser pressure iii) Superheat on the performance of Rankine cycle. with the help of T-S diagram. **(09 Marks)**

b. With a schematic diagram and its P-V and T-S diagrams explain the Rankine cycle and also derive its thermal efficiency. **(11 Marks)**

4 a. With a schematic diagram and its T-S diagram, explain the working of reheat vapour cycle of deduce an expression for cycle efficiency. **(10 Marks)**

b. A steam turbine working of a Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10 kg/s, determine,
i) Quality of steam at the end of expansion
ii) Turbine shaft work
iii) Power required to operate the pump
iv) Work ratio. **(10 Marks)**

5 a. Explain the following terms with reference to a combustion process:
i) Stoichiometric air ii) Enthalpy of formation iii) Enthalpy of combustion
iv) Adiabatic flame temperature v) Enthalpy of reaction. **(10 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an Orsat apparatus. CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine: i) The composition of fuel ii) The air-fuel ratio iii) The percentage of excess air used. **(10 Marks)**

6 a. Define indicated power. Explain briefly how the frictional power of a multicylinder engine is determined using Morse test. State the assumptions made. **(10 Marks)**

b. A two stroke diesel engine was motored when meter reading was 1.5kW. Test on the engine was carried out for one hour and data observed were, brake torque = 120N-m, rpm = 600, fuel used = 2.5kg, cooling water = 818kg, CV of fuel = 40.3MJ/kg, Rise in temperature of cooling water = 10°C, room temperature = 27°C, A:F used = 32:1, exhaust gas temperature = 347°C, C_p for exhaust gases = 1.05kJ/kg.K. Determine, brake power, indicated power, mechanical efficiency and thermal efficiency. Draw heat balance sheet on minute and percentage basis. **(10 Marks)**

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

b. A food storage chamber requires a refrigeration system of 10 Ton capacity with an evaporator temperature of -10°C and condenser temperature of 30°C. The refrigerant F-12 is sub cooled by 5°C before entering the throttle valve and the vapour is superheated by 6°C before entering the compressor. The specific heats of vapour and liquid are 0.7327 and 1.235 respectively. Determine: i) The refrigerating capacity per kg ii) Mass of refrigerant circulated per minute iii) COP. **(10 Marks)**

8 a. Define the following: i) Dry bulb temperature ii) Wet bulb temperature iii) Specific humidity iv) Saturated air v) Degree of saturation. **(10 Marks)**

b. Represent the following processes on a psychrometric chart i) Sensible heating ii) Dehumidification. **(04 Marks)**

c. Atmospheric air at 101.325kPa has 30°C DBT and 15°C DPT, without using the psychrometric chart using the property values from the tables, calculate:
i) Partial pressure of air ii) Specific humidity iii) Relative humidity. **(06 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance ratio and the index of expansion and compression. **(10 Marks)**

b. A single stage double acting reciprocating compressor delivers $0.25m^3/s$. of air measured at 1.013 bar and 27°C. The delivery pressure is 7bar. At the beginning of compression, air is at 0.98 bar and 40°C. The clearance volume is 4% of swept volume. The stroke to bore ratio is 1:3. Compressor runs at 300rpm. Calculate, the volumetric efficiency cylinder dimensions and indicated power if the index of compression and expansion is 1.3. **(10 Marks)**

10 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the geometric mean of the suction and discharge pressures. **(10 Marks)**

b. Mention the types of nozzles. Explain any one. **(04 Marks)**

c. A two stage reciprocating air compressor works between pressure limits of 1 bar and 8 bar and draw in air at 15°C at the rate of 467 litres per minute. The compression in both stages is isentropic and inter cooling is perfect. Estimate minimum power supplied. **(06 Marks)**

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

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

b. The right limb of a simple U tube manometer containing Hg is open to the atmosphere. While the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12cms below the level of Hg in the right limb. Find the pressure of liquid or fluid in the pipe if the difference of Hg level in two limbs is 20cm. **(10 Marks)**

2 a. A caisson for closing the entrance to a dry done is of trapezoidal form 16 m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure are the caisson, if the water on the outside is just with the tap and dock is empty. **(10 Marks)**

b. The velocity distribution of flow over a plate is parabolic with vertex 30cms from the plane, where the velocity is 180cm/s. If the viscosity of the fluid of 0.9N-s/m^2 find the velocity gradient and shear stresses at distances of 0.15cms and 30cms from the plane. **(10 Marks)**

3 a. Derive continuity equation in Cartesian coordinates for fluid flow in 3-dimensions. **(10 Marks)**

b. Differentiate between:
   i) Study flow and Unsteady flow
   ii) Viscous flow and Turbulent flow. **(05 Marks)**

c. Define and explain stream function and velocity potential function. **(05 Marks)**

4 a. State assumption in Bernoulli's equation and derive the relation. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

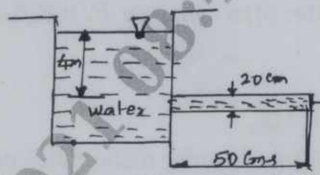
c. A 30cm × 15cm venturimeter is inserted in a vertical pipe line carrying oil of specific gravity 0.85, the flow of oil is upwards. Throat section is 50cm above inlet section of venturimeter. The oil mercury differential manometer gives a reading of 30cm of mercury. Find the rate of oil flow in lts/sec and the pressure difference between inlet and throat section. Assume C_d 0.96. Neglect all losses. **(08 Marks)**

5 a. Derive an expression for loss of head due to sudden enlargement. **(10 Marks)**

b. For laminar flow between the stationary parallel plates. Obtain an expression for velocity distribution. **(10 Marks)**

6 a. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$, refer the Fig.Q.6(a). **(10 Marks)**

Fig.Q.6(a)



b. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1N-s/m^2 is pumped through a 3cm diameter pipe. If the pressure drop per metre length of the pipe is 15kPa. Determine:
i) The mass flow rate of oil kg/min
ii) Shear stress at the pipe wall
iii) Reynolds number of the flow and
iv) The power required per 40m length of the pipe to maintain the flow. **(10 Marks)**

7 a. What is the meaning of Boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **(10 Marks)**

b. Using Rayleigh's method, show that the power 'P' developed by a Hydraulic turbine is given by $P = \rho N^3 D^5 \phi\left[\frac{gH}{N^2 D^2}\right]$, where ρ = density of the liquid, N = rotational speed of the turbine in rpm, D = Diameter of the runner, H = Working Head, g = gravitational acceleration. **(10 Marks)**

8 a. The rate of discharge Q of a centrifugal pump is dependent upon density of the fluid 'ρ', pump speed N in rpm, diameter of the impeller 'D', pressure 'P', viscosity of the fluid 'μ'. Using Bucking Ham's π theorem method, show that

$$Q = ND^3\phi\left[\frac{P}{\rho N^3 D^5}, \frac{\mu}{\rho N D^2}\right]$$ **(10 Marks)**

b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to horizontal. The pull on the string is 24.525N, when the wind is flowing at a speed of 30km/hr. Find the corresponding coefficient of drag and lift. Take density of air = 1.25kg/m^3. **(10 Marks)**

9 a. Explain stagnation properties. Obtain an expression for velocity of sound for adiabatic process. **(10 Marks)**

b. A projectile travels in air of pressure 15N/mm^2 at 10°C at a speed of 1500km/hr. Find the Mach number and Mach angle. Assume γ = 1.4 and R = 287J/kg K. **(05 Marks)**

c. What are the normal and oblique shocks? **(05 Marks)**

10 a. Starting from fundamental, show the velocity of propagation of elastic wave in an isothermal medium is given by $C = \sqrt{RT}$. **(06 Marks)**

b. Define the following terms: i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow. **(10 Marks)**

c. Explain the meaning of CFD and its applications. **(04 Marks)**

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17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1	a.	What is metrology? Explain the objectives of metrology.	**(05 Marks)**
	b.	Explain subdivision of standards.	**(07 Marks)**
	c.	With a neat sketch, explain International prototype meter.	**(08 Marks)**
2	a.	Explain the wringing phenomena of slip gauges.	**(05 Marks)**
	b.	With a neat sketch, explain the working of sine centre.	**(07 Marks)**
	c.	With a neat sketch, explain the working of autocollimator.	**(08 Marks)**
3	a.	State and explain Taylor's principle of gauge design.	**(05 Marks)**
	b.	With neat sketches, explain different types of fit.	**(07 Marks)**
	c.	Explain the principle of interchangeability and selective assembly.	**(08 Marks)**
4	a.	Define comparator. What is the need of a comparator?	**(05 Marks)**
	b.	Explain with a neat sketch the working principle of mechanical optical comparator.	**(07 Marks)**
	c.	Explain with a neat sketch the working principle of solex pneumatic gauge.	**(08 Marks)**
5	a.	With a neat sketch, explain screw thread terminology.	**(05 Marks)**
	b.	Derive an expression for measurement of effective diameter by two wire method.	**(07 Marks)**
	c.	With a neat sketch, explain the working of Tools maker's microscope.	**(08 Marks)**
6	a.	With a neat sketch, explain gear teeth terminology.	**(05 Marks)**
	b.	With a neat sketch, explain the working of coordinate measuring machine.	**(07 Marks)**
	c.	With a neat sketch, explain the working of laser interferometer.	**(08 Marks)**
7	a.	Explain generalized measurement system, with a block diagram.	**(05 Marks)**
	b.	Define: (i) Accuracy (ii) Calibration (iii) Error (iv) Threshold (v) Hysteresis (vi) Least count (vii) Range	**(07 Marks)**
	c.	Explain with a neat sketch, electronic transducers.	**(08 Marks)**
8	a.	With a block diagram, explain telemetring system.	**(05 Marks)**
	b.	With a neat block, explain stylus type oscillography.	**(07 Marks)**
	c.	With a circuit diagram, explain Ballast circuit.	**(08 Marks)**
9	a.	With a neat sketch, explain the working of prony brake dynamometer.	**(10 Marks)**
	b.	With a neat sketch, explain McLeod gauge.	**(10 Marks)**
10	a.	Define thermocouple. State the laws of thermocouple and explain.	**(08 Marks)**
	b.	Define strain gauge. With a neat sketch, explain Wheatstone bridge circuit.	**(08 Marks)**
	c.	Write short notes on: (i) Thermo couple material (ii) Seebeck effect	**(04 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, July/August 2021

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. Find the equation of the plane which passes through the points (0, 1, 1), (1, 1, 2) and (−1, 2 −2). **(07 Marks)**

c. Show that the lines $\frac{x-5}{4}=\frac{y-7}{4}=\frac{z+3}{-5}$ and $\frac{x-8}{7}=\frac{y-4}{1}=\frac{z-5}{3}$ are coplanar and find their common point. **(07 Marks)**

2 a. Find the angle between the planes $x+y+2z-3=0$ and $2x+3y+3z-4=0$. **(06 Marks)**

b. Find the shortest distance between the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $\frac{x-2}{3}=\frac{y-4}{4}=\frac{z-5}{5}$ **(07 Marks)**

c. Find the image of the point (1, 6, 3) in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$. **(07 Marks)**

3 a. If $\vec{A}=2\hat{i}-3\hat{j}-\hat{k}$ and $\vec{B}=\hat{i}+4\hat{j}-2\hat{k}$, find the angle between the vectors $\vec{A}$ and $\vec{B}$. **(06 Marks)**

b. If $\vec{a}=\hat{i}+\hat{j}-\hat{k}$, $\vec{b}=\hat{i}-\hat{j}+\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$, evaluate (i) $[\vec{a}\ \vec{b}\ \vec{c}]$ (ii) $\vec{a}\times(\vec{b}\times\vec{c})$ **(07 Marks)**

c. Find the constant λ such that the vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}+2\hat{j}-3\hat{k}$ and $3\hat{i}+\lambda\hat{j}+5\hat{k}$ are coplanar. **(07 Marks)**

4 a. A particle moves on the curve $x=2t^2$, $y=t^2-4t$, $z=3t-5$, where t is the time. Find the components of velocity and acceleration at t = 1 in the direction of $\hat{i}-3\hat{j}+2\hat{k}$. **(06 Marks)**

b. If $\vec{r}=x\hat{i}+y\hat{j}+z\hat{k}$ and $r=|\vec{r}|$, show that $\nabla r^n=nr^{n-2}\,\vec{r}$. **(07 Marks)**

c. Find a unit vector normal to the surface $x^3+y^3+3xyz=3$ at (1, 2, −1). **(07 Marks)**

5 a. If $\vec{A}=\text{grad}(x^3+y^3+z^3-3xyz)$, find $\text{div}\,\vec{A}$ and $\text{curl}\,\vec{A}$. **(06 Marks)**

b. Find the constant a, b, c so that $\vec{F}=(x+2y+az)\hat{i}+(bx-3y-z)\hat{j}+(4x+cy+2z)\hat{k}$ is irrotational. **(07 Marks)**

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

6 Find the Laplace transform of:

a. $e^{-3t}(2\cos 5t-3\sin 5t)$ **(05 Marks)**

b. $\sin 3t\sin 2t+t\cos t$ **(05 Marks)**

c. $\frac{\cos at-\cos bt}{t}$ **(05 Marks)**

d. $e^{2t}+4t^3-2\sin 3t+3\cos 3t+2^{-t}$ **(05 Marks)**

7 Find the inverse Laplace transform of

a. $\dfrac{s^2 - 3s + 4}{s^3}$ **(05 Marks)**

b. $\dfrac{2}{(s-1)(s-2)(s-3)}$ **(05 Marks)**

c. $\log\left[\dfrac{s^2 + 1}{s(s+1)}\right]$ **(05 Marks)**

d. $\dfrac{2s - 3}{s^2 + 4s + 13}$ **(05 Marks)**

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

b. By Laplace transform method solve the equation $\dfrac{d^2y}{dt^2} + 4\dfrac{dy}{dt} + 3y = e^{-t}$ with $y(0) = 1$, $y'(0) = 1$. **(10 Marks)**

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