B000311(014)

B.Tech. (Third Semester) Examination

Nov-Dec. 2023

common to all branch

(C~~ivil Engg. Branch~~)

MATHEMATICS-III

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. Part (a) is compulsory of each question and attempt any **two** from (b), (c) and (d) of each questions.*

Unit-I

1. (a) Write formula for Laplace transform of a periodic function.   4

(b) (i) Find out $L\left(t^2 \sin at\right)$ 4

    (ii) Apply Laplace Transform to Evaluate :   4

$$\int_0^\infty te^{-2t} \sin 3t \, dt$$

(c) (i) Evaluate :   4

$$L^{-1}\left\{\frac{1}{\left(s^2+1\right)\left(s^2+9\right)}\right\}$$

    (ii) Evaluate :   4

$$L^{-1}\left\{\frac{s+2}{\left(s^2+4s+5\right)^2}\right\}$$

(d) Apply Laplace Transform to find solution

$$ty'' + 2y' + ty = \cos t,$$

given that $y(0)=1$.   8

Unit-II

2. (a) Form a partial differential equation from the given arbitrary function $f\left(x^2 + y^2, z-xy\right)=0$.   4

(b) Solve the given equation :   8
$$\left(x^2 - y^2 - z^2\right)p + 2xyq - 2xz = 0$$

(c) Solve the following equation   8
$$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 6\frac{\partial^2 z}{\partial y^2} = y\cos x$$

(d) Apply method of separation of variables to solve

$$4\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u, \text{ given } u(0, y)=3e^{-y}-e^{-5y}. \quad 8$$

Unit-III

3. (a) The probability density function of a continuous random variable is given by

$$f(x)=\begin{cases} \dfrac{k}{x^3} & , \quad 5 \le x \le 10 \\ 0 & , \quad \text{otherwise} \end{cases}$$

Find value of k.   4

(b) From a bag containing 3 red and 2 white balls, a man is to draw 2 balls at random without replacement, being promised ₹ 20 for each red ball and ₹ 10 for each white one. Find his expectation.   8

(c) Fit a Poisson distribution to the set of observations :

x	:	0	1	2	3	4
$f(x)$	:	122	60	15	2	1

Do all the computation for two decimal places.   8

(d) A certain number of articles manufactured in one batch were classified into three categories according to a particular characteristics, being less than 50, between 50 and 60 and greater than 60. If this characteristics is known to be normally distributed, determine the mean and standard deviation for this batch if 60%, 35% and 5% were found in these categories.   8

Unit-IV

4. (a) Find the missing terms in the following data :   4

x	:	45	50	55	60	65
$f(x)$	:	3	–	2	–	–2·4

(b) Apply Newton's Backward interpolation formula and obtain the cubic polynomial which takes the following values :   8

x	:	0	1	2	3
$f(x)$	:	1	2	1	10

(c) Apply Stirling's and Bessel's central interpolation formula respectively to find $f(29)$ and $f(32)$ from the following data :

x	:	20	25	30	35	40
$f(x)$	:	11·4699	12·7834	1·7648	14·4982	15·0463

Do all the calculations for four decimal places.   8

(d) Apply Newton's Divide Difference formula to obtain $f(x)$ as a cubic polynomial which represents the following data :   8

x	:	1	2	7	8
$f(x)$	:	1	5	5	4

Unit-V

5. (a) Write Adams-Bashforth predictor - corrector formula.   4

(b) Apply Taylor's series and find out series solution up to four non-zero terms for the given equation

$$\frac{dy}{dx} = xy^{\frac{1}{3}} \text{ and } y(1) = 1$$

Do all the calculation for four decimal places and find numerical solution at $y(1\cdot2)$. 8

(c) Apply Runge Kutta method of fourth order to find out numerical solution of the given differential equation

$$\frac{dy}{dx} + y + xy^2 = 0, \text{ at } y(0\cdot2), \text{ by taking } h = 0\cdot1. \text{ Do}$$

all the calculation for four decimal places. 8

(d) Apply Milne's predictor corrector method to find numerical solution $y(0\cdot4)$ for the given equation

$$2\frac{dy}{dx} = \left(1 + x^2\right)y^2, \text{ where } y(0) = 1, \text{ also given}$$

$y(0\cdot1) = 1\cdot06$, $y(0\cdot2) = 1\cdot12$ and $y(0\cdot3) = 1\cdot21$. Do all the calculation for four decimal places. 8

B037312(037)

B.Tech. (Third Semester) Examination
Nov.-Dec. 2023

(New Scheme)

(Mechanical Engg. Branch)

MECHANICAL MEASUREMENT and METROLOGY

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. Part (a) is compulsory & carry equal 4 marks. Attempt any **two** parts from (b), (c) and (d) of each questions carry equal 8 marks.*

Unit-I

1. (a) Differentiate precaution and accuracy. Define the term standard.

(b) What are Transducers and how are they classified? Explain their importance in an instrumentation process.

(c) What are the different sources of errors in measurements and measuring instruments? Explain.

(d) Explian any two types of sensors with neat diagram.

Unit-II

2. (a) What is meant by Thermocouple?

(b) Explain with a neat sketch the constructional features and basic principal working of Mcleod gauge used for the measurement of low pressure.

(c) What are different types of thermistor and pyrometer? Explain optical pyrometer with diagram.

(d) Classify strain gauges. Describe different types of temperature compensatoin done in strain gauges.

Unit-III

3. (a) What are the uses of Seismic Instrument?

(b) Explain working of ultrasonic flow meter with neat sketch

(c) What is Data Acquision System? What are the objectives of DAS?

(d) Explain any two devices to measure vibrations.

Unit-IV

4. (a) What do you mean by end standard?

(b) Describe the working principle of optical projector.

(c) What do you mean by Roundness? Explain any one method of measurement of roundness.

(d) What is Sine bar? How is it used for angle measurement?

Unit-V

5. (a) What is the principle of Interferometry?

(b) How to measure the specifications of gear tooth? Explain with sketches.

(c) What is the need of coordinate measuring machine? Explain its construction and application.

(d) What is the working principle of a comparator? Explain different types of comparators with diagram.

B037313(037)

B. Tech. (Third Semester) Examination, Nov.-Dec. 2023

(AICTE Scheme)

(Mechanical Engineering Branch)

ENGINEERING MECHANICS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Marks : 35

Note : *Attempt all units are compulsory. Part (a) is compulsory and carries 4 marks and solve any **two** from (b), (c) & (d) and carries 8 marks.*

Unit-I

1. (a) Write a short note on Free Body diagram.   4

(b) State the following law of forces :　8

   (i) Parallelogram law of forces

   (ii) Triangle law of forces

   (iii) Polygon law of forces

(c) Two equal loads of 2500 N are supported by a flexible string ABCD at point B and C. Find the tensions in the portions AB, BC and CD of the string.　8
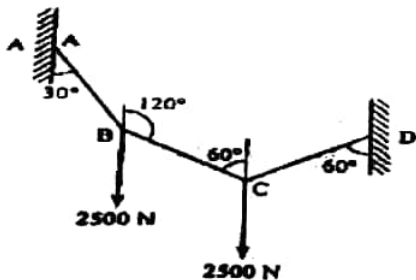

Fig.1

(d) Two rollers of weight P (50 N) and Q (100 N) are connected by a flexible string AB. The rollers rest on two mutually perpendicular planes DE and EF

as shown in fig. find the tension in the sring and angle θ that it maks with the horizontal when the system is in equilibrium. Take $\alpha = 30°$.　8
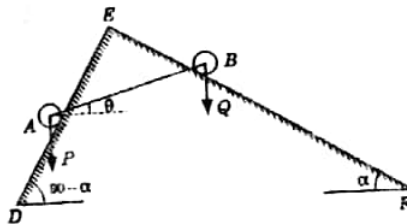

Fig. 2

Unit-II

2. (a) Define the following :　4

   (i) Angle of friction

   (ii) Co-efficient of friction

   (iii) Angle of respose

   (iv) Cone of friction

(b) Derive an expression of maximum power transmitted by the belt.　8

| 4 |

(c) A horizontal bar 1 m long and of negligible weight rests on rough inclined plane as shown in fig. If the angle of friction is 15°, determine the minimum value of x at which the load $Q = 200$ N may be applied before slipping impends. 8
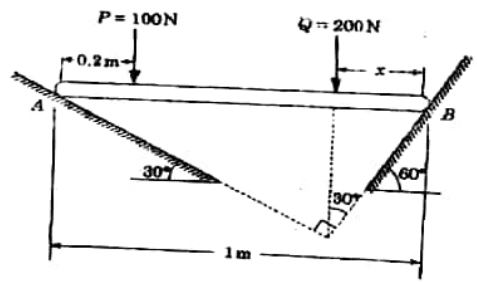

Fig. 3

(d) Two beams AC and CD are hinged at C as shown in fig. using the principle of virtual work find the reaction at B for the position x of the load. 8

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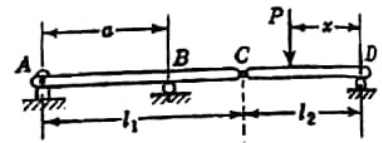| 5 |

Fig. 4

Unit-III

3. (a) Define the terms Centre of gravity and Centroid. 4

(b) State and explain parallel axis theorem. 8
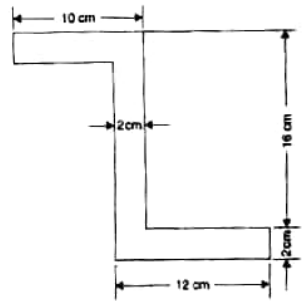
(c) Determine the centroid of the lamina shown in fig. 8

Fig. 5

B037313(037) PTO

(d) Calculate the moment of inertia about horizontal and vertical gravity axes (I_{xx} and I_{yy}) of the section shown in fig. 8
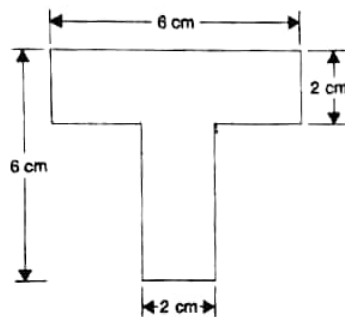

Fig. 6

Unit-IV

4. (a) Define the terms : 4

   (i) Displacement

   (ii) Velocity angular Displacement

   (iii) Angular velocity

   (b) A car accelerates from a velocity of 36 km/hour to

a velocity of 108 km/hour in a distance of 240 m. Calculate the average acceleration and time required. 8

(c) The velocity time diagram for the rectilinear motion of a particle is represented by a parabola as shown in fig. find the distance travelled by the particle in time T/2. 8
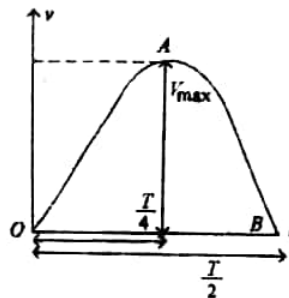

Fig. 7

(d) A grinding wheel is attached to the shaft of an electric motor of rated speed of 1800 r.p.m. When power is switched on the unit attains the rated speed in 5 s and when the power is switched off the unit coasts to rest in 90 s. Assuming uniformly accelerated

motion, determine the number of revolution the unit turns (a) to attain the rated speed (b) to come to rest.   8

Unit-V

5. (a) State D'Alembert's priciple. Also write the equations of dymanic equilibrium.   4

   (b) Two blocks A and B are held oin an inclined plane 5 m apart as shown in fig. The coefficients of friction between the block A and B and the inclined plane are 0.2 and 0.1 respectively. If the block begin to slide down the plane simultaneusly calculate the time and distance travelled by the each block before collision.   8
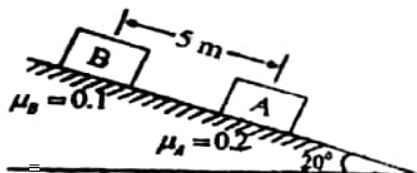

Fig. 8

(c) A gun of mass 3000 kg fires horizontally a shell of mass 50 with a velocity of 300 m/s. What is the velocity with which the gun recoil? Also determine the uniform force required to stop the gun in 0·6 m. In how much time will it stop?   8

(d) Ball A of mass 1 kg moving with a velocity of 2 m/s, impinges forces directly on a ball B of mass 2 kg at rest. Find the velocities of the two balls after the impact. Assume the coefficient of restitution $e = 1/2$.   8

B037314(037)

B. Tech. (Third Semester) Examination, Nov.-Dec. 2023

(Mechanical Engg. Branch)

ENGINEERING THERMODYNAMICS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. Each question carries equal makrs. Part (a) is compulsory and answer any two from (b), (c) and (d). Use standard notations. Steam table and Mollier chart is permitted.*

1. (a) Define an Adiabatic process. Write down the expression of work done for Adiabatic process. 4

   (b) A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand

reversibly behind a piston according to a law $pV^2 =$ constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid, for an initial volume of 0·05 m³. 8

(c) Show that the relation for a heat transfer during process 1-2 in polytrophic process is : 8

$$Q_{12} = \frac{\gamma - n}{\gamma - 1} \times \text{Polytropic work done}$$

(d) A nozzle is a device for increasing the velocity of a steadily flowing stream. At inlet to a certain nozzle, the fluid parameters are :

Enthalpy = 2850 kJ/kg; velocity = 50 m/s, area = 0·1 m² and specific volume = 0·18 m³/kg. At the discharge end the enthalpy is 2650 kJ/kg and the specific volume is 0·49 m³/kg.

Make calculations for the velocity of fluid at exit from the nozzle, mass flow rate of fluid, and the exit area of the nozzle.

The nozzle is horizontal and there is negligible heat loss from it. 8

2. (a) What do you mean by Perpetual Motion Machine of second kind (PMM-II)? Why is it considered as a hypothetical machine? 4

(b) Two reversible heat engine A and B are arranged in series. A rejecting heat directly to B. A receives 200 kilo Joule at a temperature of 421°C from a hot source while engine B is in communication with the cold sink at a temperature of 4·4°C. If the work output of A is twice that of B.

Calculate :

(i) Intermediate temperature between A and B

(ii) Efficiency of each engine and

(iii) Heat rejected to cold sink . 8

(c) State the Kelvin-Planck and Clausius statements of the second law of thermodynamics and establish the equivalence between them. 8

(d) Three identical finite body of constant heat capacity are at temperature 300 K, 300 K and 100 K. If no work or heat is supplied from outside. What will be

the highest temperature to which any one of the body can be raised by the operation of heat engine and refrigerator? 8

3. (a) What do you mean by Dead state and Availability. 4

(b) Write short notes on : (any **two**) 8

   (i) Helmholtz and Gibb's function

   (ii) Gouy's Stodola theorem

   (iii) Second law efficiency

(c) A system at 450 K receives 225 kJ/s of heat energy from a source at 1500 K, and the temperature of both the system and source remain constant during the heat transfer process.

   Determine :

   (i) Net change in entropy

   (ii) Available energy of heat source and system

   (iii) Decrease in available energy 8

(d) One kg of air is contained in a piston cylinder assembly at 10 bar pressure and 500 K temperature. The piston moves outwards and the air expands to 2 bar pressure and 350 K temperature. Make calculations for : 8

(i) The availability in the initial and final states

(ii) The maximum useful work

Assume that the system is insulated and the environmental conditions are 1 bar and 290 K further for air :

$R = 0.287$ kJ/kg K, $C_v = 0.718$ kJ/kg K, $C_p = 1.005$ kJ/kg K.

4. (a) What do you mean by "Law of corresponding states"? 4

(b) A spherical vessel of 1.5 m diameter containing air at 315 K is evacuated until the vacuum inside the vessel is 730 mm of mercury; the evacuation process is carried out at constant temperature. Determine the mass of air pumped out. Proceed to calculate the pressure in the tank if subsequently the air is cooled to 275 K. For air $R = 287$ J/kg K and take atmospheric pressure equal to 760 mm of mercury. 8

(c) At critical point for all gases obeying Vander Waal's equation of state, show that :

$$\frac{P_c V_c}{R T_c} = 0.375$$

Where P_c = Critical pressure, T_c = Critical temperature and V_c = Critical volume.   8

(d) A vessel contains 10 kg of oxygen, 8 kg of nitrogen and 25 kg of carbondioxide at 375 K temperature and 250 kPa pressure. make calculations for the capacity of the vessel, the partial pressure of each gas present in the vessel, and the total pressure in the vessel when the temperature is raised to 450 K.   8

5. (a) Explain dryness fraction and wetness fraction. When dryness fraction is expressed in terms of percentage, what do you call it?   4

(b) A sample of steam at 5 bar is stated to have an enthalpy of 2350 kJ/kg. Make calculations for the specific volume. internal energy and entropy of this sample of steam.   8

(c) 2 kg of steam occupying 0.3 m³ at 15 bar is expanded according to the law $pv^{1.3} = C$, to a pressure of 1.5 bar.   8

Calculate :

(i) Work done

(ii) Condition of steam at the end of expansion

(d) Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine ideal work output of the turbine per kg of steam.   8

B037315(037)

B. Tech. (Third Semester) Examination, Nov.-Dec. 2023

(New Scheme)

(Mechanical Engg. Branch)

MATERIAL SCIENCE

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 40

Note : *Attempt all questions. Part (a) is compulsory carries 4 marks. Attempt any* **two** *from (b), (c) and (d) carries 8 marks each.*

Unit-I

1. (a) Define grain and grain boundary with diagram.   4

   (b) What is crystalline and non crystalline solid? Concept of unit cell and space lattice with diagram.   8

(c) Difference between twin and tilt boundary with diagram. 8

(d) What is a crystal imperfection? Its types with example. 8

Unit-II

2. (a) What are the mechanical properties of materials? 4

(b) Write any 6 mechanical properties and explain it with proper diagram. 8

(c) Difference between cold working and hot working procsses. 8

(d) Explain elastic deformation and plastic deformation with proper diagram. 8

Unit-III

3. (a) Define solidification of metal 4

(b) Difference between homogeneous and heterogeneous. 8

(c) Explain ingot, dendrite and columnar with proper diagram. 8

(d) Draw and explain iron-carbon phase diagram and show its important point 8

Unit-IV

4. (a) What are the purposes of heat treatment 4

(b) Discuss the formation of austenite during heating of steel 8

(c) Explain Surface Hardening and its types with proper diagram 8

(d) What is tempering? When is it necessary? Explain the stages tempering 8

Unit-V

5. (a) Difference between metal and non metals in the term of their characteristics properties and uses 4

(b) Write the composition, properties and uses : 8

(a) High Carbon steels

(b) Duralumin

(c) What is the purposes of Alloy steel? Explain the effects of various alloying element steels.   8

(d) Write the classification, properties and uses of brasses.   8