MCN 201 SUSTAINABLE ENGINEERING / S3 ME

MODULE 1

Sl No	Questions	Marks
1	Give an example of a technology which has contributed positively to sustainable Development	5
2	Illustrate the three pillars of sustainable development	3
3	Explain the three pillar model of sustainability	8
4	List four strategies for achieving Sustainable development	5
5	Justify, giving one reason, why sustainability is an essential component in any developmental programmes and projects	3
6	Comment on any one challenge experienced in the implementation of sustainable development principles	3
7	Comment on the challenges for sustainable development in our country and suggest a way to overcome the same.	5
8	What is sustainable development?	5
9	Write a short note on need of sustainability.	3
10	Explain Millennium Development Goals (MDGs)	10
11	Explain in detail the different Sustainable Development Goals	10
12	What is the main motto of the Clean Development Mechanism (CDM)? Relate the same to the suggestions of Kyoto protocol.	10
13	Government has recently banned Diesel Auto-rikshaws older than 15 years from the roads. Analyse this action by considering the three pillars of sustainable development.	14
14	There exists an unavoidable nexus between technology and sustainable engineering. Explain with any four examples.	14

MODULE 2

Sl No	Questions	Marks
1	Describe carbon credit.	5
2	Give an account of climate change and its effect on environment.	5
3	Explain the common sources of water pollution and its harmful effects.	5
4	Give an account of solid waste management in cities	10
5	Explain the 3R concept in solid waste management?	10
6	Write a note on any one environmental pollution problem and suggest a sustainable solution.	5
7	In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.	10
8	Write short note on the need of environmental sustainability? Also explain the concept of zero waste?	5
9	Explain Carbon credits, carbon trading and carbon foot print	14
10	What is the reason behind Ozone layer depletion and suggest a remedy	14
11	Briefly discuss on the impacts of global warming on earth	14
12	List any four water pollutants.	4

13	Explain in detail the ill effects of any five major water pollutants.	10
14	How the Zero Waste concept and the 3R concept are interrelated? How are these concepts inevitable in Sustainable Development?	10

MODULE 3

Sl No	Questions	Marks
1	Describe biomimicry. Give two examples.	5
2	Explain the basic concept of life cycle assessment.	10
3	Explain the different steps involved in the conduct of Environmental Impact Assessment.	5
4	Suggest some methods to create public awareness on environmental issues.	5
5	Nature is the most successful designer and the most brilliant engineer that has eve evolved. Discuss	10
6	Match the items in the following sets: SetA: {ISO 14006; ISO 14041; ISO 14048;ISO 14012} Set B: {LCA Data Documentation Format; Environmental Auditing qualifying criteria;Eco design guidelines; LCA inventory analysis}	10
7	Write short notes on ISO 14000 series	5
8	Suppose you are required to do the Life Cycle Assessment of an Electric Vehicle. In the utilisation stage, the assessment must be made for the energy used to drive the vehicle. List any three possible impacts of the Electric Vehicle during the usage stage? Suggest a possible way to reduce the impact during utilisation of the vehicle?	5
9	Differentiate between conventional and non conventional energy sources. Which willyou support? Why?	14
10	Describe Environment Impact Assessment (EIA)	3
11	What is Circular economy?	3
12	Explain ISO 14001:2015 framework and its benefits.	14

MODULE 4

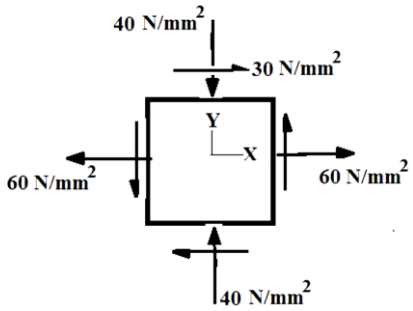
Sl No	Questions	Marks
1	Name three renewable energy sources	5
2	Mention some of the disadvantages of wind energy	5
3	Write a note on advantages of non-conventional energy sources	5
4	Write a note on different hydro power plants available?	14
5	Explain the working of a solar water heating system	14
6	Which will you suggest conventional energy source and non-conventional energy source and why	14
7	Name two energy derived from oceans and explain how	14
8	What is a bio-fuel? Is it a sustainable option	14
9	Write notes on: 1. Land degradation due to water logging. 2. Over exploitation of water	5
10	Geothermal energy is difficult to extract. Comment on	14
11	Write a note on different hydro power plants available	14
12	As far as the present technological advancements are concerned, it is not	14

	practical to rely on non-conventional energy sources alone for an Industry. Do you agree with this? Provide arguments based on this statement with proper examples	

MODULE 5

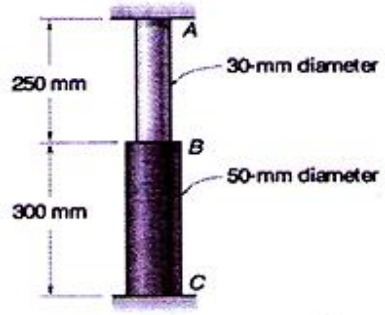
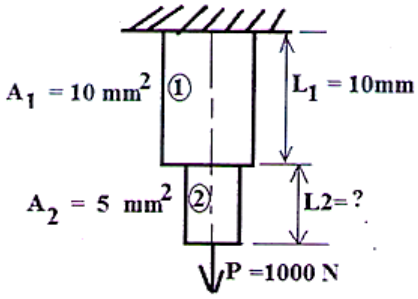
Sl No	Questions	Marks
1	Enlist some of the features of sustainable habitat	5
2	Explain green engineering.	5
3	Discuss the elements related to sustainable urbanisation.	5
4	Discuss any three methods by which you can increase energy efficiency in buildings	5
5	How a green building differs from a conventional building? Compare any five aspects?	5
6	Explain the criteria for the material selection of sustainable builings?	10
7	Write short note on the green building certification in india	5
8	Write short note on sustainable transportation? What are all the characterestics?	10
9	Write a note on basic concepts of sustainable habitat	14
10	Suggest suitabke measures to make the conveyance energy efficient in buildings	10
11	Imagine a city with all the amenities including schools, industries, offices, recreational facilities, beaches etc. What are the different points that you will look into before calling it a sustainable city?	14

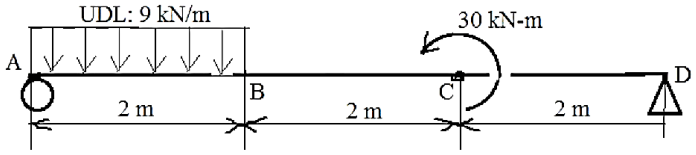
MECHANICS OF SOLIDS (MET 201)

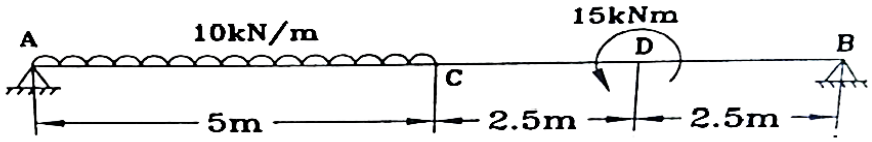
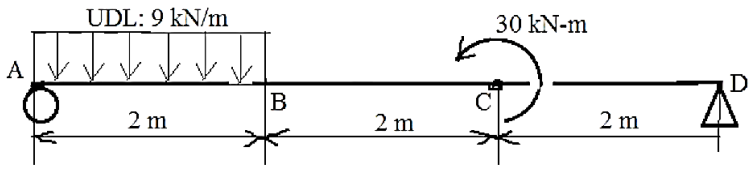
MET 202	MOS	Credit: 4	
SI NO	**Module 1**	**Mark**	**Year**
1.	Write down the Cauchy's equation and explain each term in that equation terms. Mention where it is applied.	3	2020 Dec
2.	What are stress invariants? Why would they remain invariant?	3	2020 Dec
3.	What is a stress tensor? Write the stress tensor for plane stress condition.	3	2021 Dec
4.	Explain principal stresses and principal strains?	3	2021 Dec
5.	Why is the stress tensor symmetric? Express the stress tensor (3 X 3) for simple axial loading of a rod, with x-axis coinciding with the axis of loading	3	2022 Dec
6.	Differentiate between plane–stress and plane-strain by citing suitable example for each case.	3	2022 Dec
7.	Write the stress tensor in Cartesian coordinates and resolved into a hydrostatic state and a state of pure shear.	3	2023 Dec
8.	Define the terms: (i) Principal planes and (ii) principal stresses.	3	2023 Dec
9.	If the stress tensor at a point is given by $\sigma xx=0$, $\sigma yy=0$, $\sigma zz=0$, $\tau xy=10$, $\tau xz=-10$, $\tau yz=20$, find stress invariants, characteristic equation, principal stresses and the principal plane associated with the maximum principal stress.	10	2020 Dec
10.	If the displacement field is $(3x2+y)\,i+(2y2+z)\,j+(4z2+x)\,k$, obtain the Strain tensor at (2,1,1).	4	2020 Dec
11.	The state of stress is shown in the figure. Using Mohr's circle, determine the principal stresses, the Maximum shear stress and the Plane of maximum shear stress. 	10	2021 Dec
12.	If the stress tensor at a point is given by $\tau xx=1$, $\tau yy=5$, $\tau zz=6$, $\tau xy=2$, $\tau xz=3$, $\tau yz=4$, find the resultant stress vector on a plane with direction cosines $\{1/\sqrt{3}, 1/\sqrt{3}, 1/\sqrt{3}\}$	10	2023 June
13.	The state of stress at a point in a body is $\begin{bmatrix}1 & 3 & 2\\ 3 & 2 & 1\\ 2 & 1 & -1\end{bmatrix}$ Determine the normal and shear stress on a plane that is equally inclined to all the three axes.	9	2021 Dec
14.	Write the strain displacement relations in Cartesian coordinates. Write also the strain tensors for plane strain and plane stress condition.	5	2021 Dec
15.	At a point in a bracket the stresses on two mutually perpendicular planes are 14^0 N/mm2 and 90 N/mm2 both tensile. The shear stress across these planes is 50 N/mm2. Find using the Mohr's stress circle the (i) Principal stresses and (ii) Maximum shear stress and location of plane of maximum shear	14	2021 Dec

16.	The state of plane stress at a point is given by σxx = 40 MPa, σyy = 20MPa and τxy = 16 M Pa. Using Mohr's circle determine the i) principal stresses and principal planes and ii) maximum shear stress	14	2022 Dec
17.	The state of stress at a point is characterised by the components σx = 12.31, σy = 8.96, σz = 4.34 τxy = 4.20, τyz = 5.27, τzx = 0.84 Find the values of the principal stresses and their directions and also determine the principal shears and the associated normal stresses.	14	2023 Dec
18.	The tensile stresses at a point across two mutually perpendicular planes are 120 $N/mm^2$and 60 N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30^{o}to the axis of the minor stress. Solve using Mohr's circle	14	2023 Dec

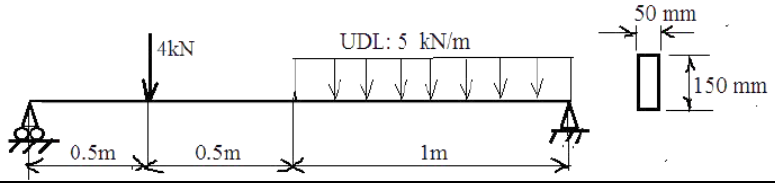
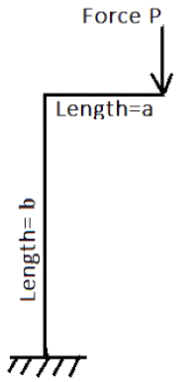
	Module 2		
1.	Write down the general expression for temperature stress and explain the terms in it.	3	2020 Dec
2.	Explain the importance of section modulus	3	2020 Dec
3.	Draw the stress-strain curve of a mild steel bar in tension test and show the salient points?	3	2021 Dec
4.	Explain Hooke's law for linearly elastic isotropic material?	3	2021 Dec
5.	Differentiate between engineering-stress-strain curve and true-stress-strain curve and comment on the applicability of the engineering stress strain curve in the design of mechanical engineering components	3	2021 Dec
6.	Differentiate between plane–stress and plane-strain by citing suitable example for each case.	3	2022 Dec
7.	Write three-dimensional Hooke's law for isotropic material.	3	2023 Dec
8.	Draw Stress-strain diagram for ductile materials and mark significant points.	3	2023 Dec
9.	Draw the stress-strain diagram for a ductile and brittle material and explain the salient points.	3	2023 Dec
10.	A steel bar is placed between two copper bars each having the same area and length as the steel bar at 15^{o}C. At this stage they are rigidly connected together at both the ends. When the temperature is raised to 315^{o}C, the length of the bars increases by 1.50 mm. Determine the original length and the final stresses in the bars. Take Es = $2.1x10^5$ N/mm^2; Ec = $1x10^5$ N/mm^2; αs = $1.2x10^{-5}$per ^{o}C and αc = $1.75x10^{-5}$per ^{o}C	9	2023Dec
11.	The following data refer to a mild steel specimen tested in laboratory. Diameter of the specimen = 25mm, length of the specimen = 300mm, extension under a load of 15 kN = 0.045mm, load at yield point = 127.65 kN, maximum load = 208.60 kN, length of the specimen after failure = 375mm, and neck diameter = 17.75 mm. Determine (i) Young's modulus, (ii) Yield point, (iii) Ultimate stress, (iv) Percentage of elongation (v) Percentage reduction in area, and (vi) Safe stress adopting a factor of safety of 2.	9	2023 Dec
12.	Find an expression for the total elongation of a uniformly tapering rectangular bar when it is subjected to an axial load P.	5	2023 Dec
13.	A rod of length 1.5 m and diameter 30 mm is centrally bored for 500 mm length, the bore diameter being 10 mm. Under a load of 30 kN, if the extension of rod is 0.2 mm, find the modulus of elasticity.	8	2022 Dec
14.	A steel rod 15 mm diameter is enclosed in a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates of	14	2022 Dec

	negligible thickness. The nuts are tightened on the projecting parts of the rod. If the temperature of the assembly is raised by 60C calculate the stresses developed in copper and steel. The modulus of rigidity of steel and copper are 210 kN/mm2 and 105 kN/mm2 respectively. Coefficient of thermal expansion of steel 12 x10 °C. Coefficient of thermal expansion for brass = 18 x 10 /° C.		
15.	A compound bar of length 500 mm consists of a strip of aluminium 50 mm wide x 20 mm thick and a strip of steel 50 mm wide x 15 mm thick rigidly joined at ends. If the bar is subjected to a load of 50 kN, find the stress developed in each material and the extension of the bar. Take the elastic modulus of aluminium and steel as l x l05 N/mm2 and 2 x105 N/mm2.	14	2022 Dec
16.	A rod consisting of two cylindrical portions AB and BC is restrained at both ends. Portion AB is made of steel (E = 205 GPa, α= 11.7 X 10-6 °C) and portion BC is made of brass (E =100 GPa, α=20.9 X 10°C). Knowing that the rod is initially unstressed, determine the compressive force induced in ABC when there is a temperature rise of 60 °C.  	14	2021 Dec
17.	A rod of length 1 m and diameter 20 mm is subjected to a tensile load of 20 KN. The increase in length of the rod be 0.30 mm and decrease in diameter is 0.0018 mm. Calculate the poison's ratio, Young's modulus, Bulk modulus and Modulus of rigidity?	8	2021 Dec
18.	Explain Generalized Hooke's law for linear elastic isotropic solids. Write the stress and strain tensor for plain strain condition.	6	2021 Dec
19.	Derive expression for extension of a tapered- rod (Young's Modulus is E) of length L tapering from diameter D to d, when loaded by an axial force P.	7	2020 Dec
20.	What should be the length of part 2, if both parts in the figure are to have the same elongation? What is the magnitude of deformation in each part? Use E =2 x10 5 N / mm  	7	2020 Dec
21.	A steel rod 20mm in diameter screwed at the ends passes through a copper tube of inner diameter 25 mm and outer diameter 30mm. The temperature of the assembly was at 115 ° C when they were assembled and was relieved of all stresses. Find the stresses in the rod and the tube when the temperature has fallen to 15°C. ESteel =2.1	9	2020 Dec

	X 105 N/mm2 , Ecopper =1.0 X 10^ 5 N/mm2 , αSteel = 0.000012 /ºC and αCopper= 0.0000175/ºC.		
22.	Formulate Generalized Hooke's law equations for a tri-axial state of stress in Cartesian coordinates, starting from consideration of Hooke's law for an elastic solid and Poisson's ratio.	5	2020 Dec
	Module 3		
1.	What do you mean by 'simple bending' or 'pure bending'? What are the assumptions made in the theory of simple bending?	3	2023 Dec
2.	Draw the S.F and B.M. diagrams for a cantilever of length L carrying a uniformly distributed load of 'w' per m length over its entire length.	3	2023 Dec
3.	Define Flexural rigidity. What is its importance?	3	2022 Dec
4.	Explain the importance of section modulus	3	2022 Dec
5.	Derive the relation between intensity of loading, shear force and bending moment at a section of a uniformly loaded beam?	3	2021 Dec
6.	State the assumptions made in the theory of torsion in circular shaft	3	2020 Dec
7.	State the assumptions involved in deriving Elastic Flexure Formula.	3	2020 Dec
8.	Explain point of inflection and point of contraflexure.	3	2020 Dec
9.	A solid circular shaft and a hollow circular shaft whose inside diameter is (3/4) of the outside diameter, are of the same material, of equal lengths and are required to transmit a given torque. Compare the weights of these two shafts if the maximum shear stresses developed in the two shafts are equal.	10	2023 Dec
10.	What do you mean by section modulus? Find an expression for the section modulus for rectangular and circular sections.	4	2023 Dec
11.	Draw Shear Force and Bending Moment Diagram for the beam shown: 	10	2020 Dec
12.	Find the maximum bending stress induced in a horizontal simply supported beam made of steel of length 2m, with square cross section of side 10mm, loaded by a vertically downward force of 200N at mid-span. E steel= 2.1 X 105 N/mm2.	4	2020 Dec
13.	A solid shaft is proposed to be replaced by a hollow shaft (of the same length and the same material) for transmitting a torque of 30 kNm. If the allowable shear stress of the material used is 100 N/mm2, find the ratio of the weight of hollow shaft to the solid one, if the inner diameter for hollow one is to be 0.5 times its outer diameter.	10	2020Dec
14.	A beam is loaded by a load distribution acting in the transverse direction. Derive differential equations connecting the Load, Shear Force and Bending Moment.	4	2020 Dec
15.	A T- shaped crossection bar having top section having dimensions dimension 150 x 25 mm and web section 20 x 200 mm is subjected to a vertical shear force of 50 kN. Moment of inertia of the cross section about the horizontal neutral axis is 1.086 x 108 mm4 Calculate the shear stress acting a) on the top surface b) on the intersection of top and bottom flange c) on the neutral axis (maximum shear stress) and d) draw the stress distribution diagram	14	2022 Dec
16.	What are the assumptions taken while deriving Torsion equation. Derive the "Torsion equation" T/J = Gθ/L = fS/R. Notations having their usual meanings.	14	2022 Dec
17.	Determine the diameter of a solid shaft which will transmit 90 kW at 160 rpm	8	2021 Dec

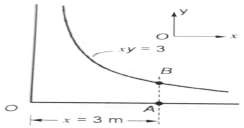
	if the shear stress in the shaft is limited to 60 N/mm2. Find also the length of the shaft, if the twist must not exceed 1 degree over the entire length. Take modulus of rigidity = 8 X 104 N/mm2.		
18.	Compare the weights of equal length of solid and hollow shaft to transmit a given torque for the same maximum stress, if inside diameter of the shaft is ¾ of the outside.	6	2021Dec
19.	Draw the shear force and bending moment diagram for the simply supported beam shown in the figure. 	14	2021 Dec
20.	Draw Shear Force and Bending Moment Diagram for the beam shown: 	10	2020 Dec
21.	Find the maximum bending stress induced in a horizontal simply supported beam made of steel of length 2m, with square cross section of side 10mm, loaded by a vertically downward force of 200N at mid-span. Esteel = 2.1 X 105 N/mm2	4	2020 Dec
22.	A solid shaft is proposed to be replaced by a hollow shaft (of the same length and the same material) for transmitting a torque of 30 kNm. If the allowable shear stress of the material used is 100 N/mm , find the ratio of the weight of hollow shaft to the solid one, if the inner diameter for hollow one is to be 0.5 times its outer diameter.	8	2020 Dec

	Module 4		
1.	Find an expression for the strain energy stored in a body when the load is applied gradually.	3	2023 Dec
2.	Explain the following terms: (i) Resilience, (ii) Proof resilience, and (iii) Modulus of resilience.	3	2023 Dec
3.	Explain Castigliano's second theorem	3	2022 Dec
4.	Write down the expression for the strain energy stored in a body subjected to axial loading condition	3	2022 Dec
5.	Explain elastic strain energy and complementary strain energy?	3	2021 Dec
6.	Make a short note on deflection analysis by Castiglianos' method. What is the limitation regarding the material behaviour, while applying this method?	3	2020 Dec
7.	A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. Moment of inertia for the section of the girder is 16 × 108 mm4 and Es = 210 kN / mm2. Calculate the deflection of the girder at points under the two loads and maximum deflection using Macaulay's method.	14	2022 Dec

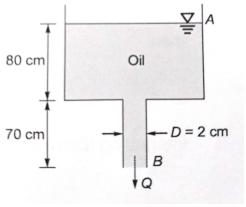
8.	Derive an expression for the strain energy stored in an element having length L , flexural rigidity EI and Torsional rigidity GJ when subjected to under a) Bending, M and b) Torsion, T	14	2022 Dec
9.	A beam section is 10 m long and is simply supported at the ends. It carries concentrated loads of 100 kN and 60 kN at distances of 2 m and 5 m respectively from the left end. Calculate the deflection under each load using Macaulay's method. Find also the maximum deflection. Take moment of inertia as 18 X 108 mm4 and E = 200 kN /mm2	14	2021 Dec
10.	A simply supported beam of 6 m span carries a uniformly distributed load of 2 kN/m from the left end up to the mid span and a concentrated load of 10 kN at a distance of 2 m from the right end. Determine the deflection at the point of application of point load using Castigliano's theorem?	14	2021 Dec
11.	Find deflection at the mid-span, if E=12GPa and cross section as shown 	10	2020 Dec
12.	Sate Reciprocal Relation and demonstrate its applicability in an engineering problem.	4	2020 Dec
13.	A structure as shown is loaded by a vertically downward force 'P at the free end'. Find deflection at the free end, in the direction of the load using Castigliano's method. Consider strain energy due to Bending Moment Alone (Neglect other effects). Use a=2m, b=4m, P=30 X 103N, EI (applicable for both legs) is 30 X 106 Nm2. 	8	2020 Dec
14.	Derive strain energy expressions in terms of the geometry, material property and load during (i) Bending and (ii) Torsion.	6	2020 Dec

	MODULE 5		
1.	Explain how the failure of a short and of a long column takes place?	3	2023 Dec
2.	What do you understand by the term "Theories of failure"? Name the important theories of failure.	3	2023 Dec
3.	Explain the importance of Slenderness ratio in the study of column?	3	2022 Dec
4.	What is Rankine's theory for Normal stress?	3	2022 Dec
5.	What is slenderness ratio? What is the effective length of columns with both ends fixed?	3	2021 Dec
6.	State Hencky-von Mises theory for maximum distortion energy?	3	2021 Dec

7.	Explain the fundamental difference between the deformation behaviour in (i) bending of beams and (ii) buckling of columns.	3	2020 Dec
8.	State yield criterion as per Max. Normal Strain Theory. Why didn't it get acceptability?	3	2020 Dec
9.	A compression member of 500 mm effective length consists of a solid aluminium rod of 25 mm diameter. In order to reduce the weight of the member by 25%, the solid rod is replaced by a hollow aluminium rod of 25 mm external diameter. Determine the critical loads for the two members. Find also the percentage reduction in the critical load when the hollow member is provided. Take E = 7.28 x 10^4 N/mm^2.	10	2023 Dec
10.	Define slenderness ratio. State the limitations of Euler's formula.	4	2023 Dec
11.	A steel shaft is subjected to an end thrust producing a stress of 90 MPa and the maximum shearing stress on the surface arising from torsion is 60 MPa. The yield point of the material in simple tension was found to be 300 MPa. Calculate the factor of safety of the shaft according to the following theories: (i) Maximum shear stress theory (ii) Maximum distortion energy theory.	10	2023 Dec
12.	Explain with reasons one theory of failure each which is best suited for: (i) Ductile materials (ii) Brittle materials.	4	2023 Dec
13.	Derive Euler's Buckling load for the long column subjected to the end conditions as both ends are hinged.	10	2022 Dec
14.	A machine element is subjected to the following stresses σ_{xx} = 60 MPa, σ_{yy} = 45 MPa and τ_{xy} = 30 MPa. Determine the failure stress value using the following theories of failure a) Rankine's theory for maximum normal stress & Guest's theory for maximum shear stress	14	2022 Dec
15.	Find Euler's critical load for a hollow cylindrical cast iron column 200 mm external diameter and 25 mm thick. The column is 6 m long and hinged at both ends. Take E= 8 X 104 N/mm2. Find Euler's critical load and Rankine's critical load taking σ_c= 550 N/mm2, $\alpha = \frac{1}{1600}$. For what length of the column would the critical loads by Euler's and Rankine's formula be equal?	14	2021 Dec
16.	A mild steel shaft of 100 mm diameter is to sustain a maximum torque of 20 kNm and maximum bending moment of 10 kNm at a point in the material. Determine the factor of safety based on any three theories of failure. Assume Poisson's ratio as 0.3 and elastic limit in tension as 220MPa.	14	2021 Dec
17.	Using the expression for Euler's critical buckling load, formulate an expression for Rankine's Crippling load in terms of Rankine's constant	6	2020 Dec
18.	A column has a square cross-section of 40 mm side. If it has to carry a load of 89,600 N, what should be its limiting length if both ends are assumed to be pinned. Rankine constant α = 1/1600, and compressive strength is 560 N/mm2.	8	2020 Dec
19.	If the principal stresses at a point are: {σ1, σ2, σ3} = {10, 0, -4} MPa and if the yield strength of the material under consideration is 40 MPa, find the factor of safety in design as per (a) Max. Normal Stress Theory (b) Max. Shear Stress Theory and (c) Max. Distortion Energy Theory.	9	2020 Dec

CODE: MET203	COURSE NAME: MECHANICS OF FLUIDS		Credit: 4
Q.No	**Module I**	**Month & Year**	**Marks**
1	The specific gravity of a liquid is 3.0. What are its specific weight, specific mass and specific volume.	KTU Model	3
2	State Pascal's law and give some examples where this principle is used.	KTU Model	3
3	(a) Through a very narrow gap of height h, a thin plate of large extend is pulled at a velocity V . On one side of the plate is oil of viscosity μ1 and on the other side oil of viscosity μ2. Calculate the position of the plate so that i. the shear force on the two sides of the plate is equal. ii. the pull required to drag the plate is minimum. Assume linear velocity distribution in transverse direction.	KTU Model	7
4	A metallic cube of 30 cm side and weight 500 N is lowered into a tank containing two fluid layers of water and mercury. Top edge of the cube is at water surface. Determine the position of the block at water mercury interface when it has reached equilibrium.	KTU Model	7
5	A rectangular tank 1.5 m wide, 3 m long and 1.8 m deep contains water to a depth of 1.2 m. Find the horizontal acceleration which may be imparted to the tank in the direction of length so that i. there is just no spilling from the tank ii. front bottom corner of the tank is just exposed.	KTU Model	7
6	A spherical water drop of 1 mm diameter splits up in air into 64 smaller drops of equal size. Find the work required in splitting up the drop. The surface tension coefficient of water in air = 0.073 N/m	KTU Model	7
7	The pressure at a point in a fluid is 15 cm of mercury column. Express it in N/m2 of absolute pressure and gauge pressure.	December 2022	3
8	Distinguish between the following: (i) Density and relative density (ii) Ideal and real fluids (ii) Dynamic and kinematic viscosity	December 2022	3
9	Derive an expression for the depth of centre of pressure from free surface of liquid of a vertical plane surface submerged in the liquid.	December 2022	7
10	A stone weighs 392.4 N in air and 196.2 N in water. Compute the volume of stone and its specific gravity.	December 2022	7
11	With a neat sketch, explain the conditions of equilibrium for floating and submerged bodies.	December 2022	7
12	U-tube manometer is used to measure the pressure of water in a pipe linewhich is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases.,	December 2022	7
Q.No	**Module II**	**Month & Year**	**Marks**
1	Explain Streamlines, Streaklines and Pathlines.	KTU Model	3
2	What do you understand by the terms: (i) Total acceleration, (ii) Convective acceleration, and (iii) Local acceleration.	KTU Model	3
3	Name the different forces present in a fluid flow. For the Euler's equation of motion, which forces are taken into consideration.	KTU Model	3
4	In a fluid flow field, velocity vector is given by v = (0.5 + 8x)i + (0.5 − 0.8 y)j. Find the equation of streamline for the given velocity field.	KTU Model	7
5	The stream function = 4xy in which is in cm2=s and x and y are in meters describe the incompressible flow between the boundary shown : Calculate i. Velocity at B ii. Convective acceleration at B iii. Flow per unit width across AB 	KTU Model	7
6	Consider the velocity field given by u = x2 and v = −2xy. Find the circulation around the area bounded by A(1; 1); B(2; 1); C(2; 2); D(1; 2).	KTU Model	7

7	Verify whether the following are valid potential functions. i. φ = 2x + 5y ii. φ = 4x2 − 5y2	KTU Model	7
8	Differentiate between the rotational and irrotational flows.	December 2022	3
9	Show that the stream lines and equipotential lines form a net of mutually perpendicular lines.	December 2022	3
10	Show that the product of the slope of the equipotential line and the slope of the constant steam function line at the point of intersection is -1	December 2022	6
11	A fluid flow field is given by V= x2y i+y2z j - (2xyz+yz2)k. Prove that the flow field represents a possible case steady incompressible fluid flow. Also calculate the velocity and acceleration at the point (2, 1, 3)	December 2022	8
12	A two-dimensional velocity field is given by u = 2xy, v =– x2y. Compute (a) velocity at (1,1) (b) convective acceleration at (1,1) (c) local acceleration	December 2022	8
13	If the velocity field is given by u = x2– y2 + x and v = – (2xy + y), determine the velocity potential and the stream function.	December 2022	6
Q.No	**Module III**	**Month & Year**	**Marks**
1	Differentiate between pitot tube and pitot static tube.	KTU Model	3
2	A submarine moves horizontally in sea and has its axis 15 m below the surface ofthe water. A pitot tube properly placed just in front of the submarine and along its axis is connected to two limbs of a U tube containing mercury. The differenceof level is found to be 170 mm. Find the speed of the submarine knowing that thespecific gravityof mercury is 13.6 and that of sea water is 1.026 with respect to water	KTU Model	7
3	A pitot tube is inserted in a pipe of 30 cm diameter. The static pressure of the tube is 10 cm of mercury vacuum. The stagnation pressure at the centre of the pipe recorded by the pitot tube is 1.0 N=cm2. Calculate the rate of flow of water through the pipe, if the mean velocity of flow is 0.85 times central velocity. Assume coefficient of tube as 0.98.	KTU Model	7
4	A smooth pipe of uniform diameter 25 cm, a pressure of 50 KPa was observed at section 1 which has an elevation of 10 m. At another section 2, at an elevation of 12 m, the pressure was 20 KPa and the velocity was 1.25 m/s. Determine the direction of flow and the head loss between the two sections. The fluid in the pipe is water.	KTU Model	8
5	Petrol of specific gravity 0.8 is following through a pipe of 30 cm diameter. The pipe is inclined at 30◦ to horizontal. The venturi has a throat diameter of 10 cm. U tube manometer reads 6.25 cm Hg. Calculate the discharge through the pipe. Assume Cd = 0:98.	KTU Model	6
6	Discuss the limitations of Bernoulli's equation.	December 2022	3
7	Explain the working of Pitot-static tube	December 2022	3
8	Explain the concept of vena-contracta.	December 2022	3
9	Derive an expression for the continuity equation in Cartesian coordinates.	December 2022	7
10	Water is flowing at the rate of 20 litres/s through a tapering pipe. The diameters at the bottom and upper ends are 250 mm and 150 mm respectively. If the intensities of pressure at the bottom and upper ends are 250 kN/m2 and 150 kN/m2 respectively, find the difference in datum head.	December 2022	7
11	Derive an expression for the Bernoullis’s equation	December 2022	7
12	Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm2 and the pressure at the upper end is 9.81 N/cm2. Determine the difference in datum head if the rate of flow through pipe is 40 lit/s.	December 2022	7
Q.No	**Module IV**	**Month & Year**	**Marks**
1	Define and explain the terms (i) Hydraulic gradiant line and (ii) Total energy line.	KTU Model	3
2	Show that the coefficient of friction for viscous flow through a circular pipe is given by f = 16/Re	KTU Model	3
3	Assuming viscous flow through a circular pipe derive the expression for, i. Velocity distribution ii. Shear stress distribution Also plot the velocity and shear stress distribution.	KTU Model	7

4	A large tank shown in the figure has a vertical pipe 70 cm long and 2 cm in diameter.The tank contain oil of density 920 Kg=m3 and viscosity 1.5 poise. Find the discharge through the tube when the height of oil level of the tank is 0.80 m above the pipe inlet. 	KTU Model	7
5	A compound piping system consist of 1800 m of 50 cm, 1200 m of 40 cm and 600 m of 30 com diameter pipes off same material connected in series. i. What is the equivalent length of a 40 cm pipe of same material? ii. What is the equivalent diameter of a pipe 3600 m long? iii. If three pipes are in parallel what is equivalent length of 50 cm pipe?	KTU Model	10
6	A pipe line of 2100 m is used for transmitting 103 KW. The pressure at the inlet of the pipe is 392.4 N=cm2. If the efficiency of transmission is 80%, find the diameter of the pipe. Take f = 0:005.	KTU Model	4
7	What is cavitation? What is its significance in fluid flow?	Dec 22	3
8	Derive Hagen-Poiseuille equation from the fundamentals and state the assumptions made. Sketch the shear stress and velocity distribution across the circular pipe.	Dec 22	14
9	A syphon of diameter 200 mm connects two reservoirs having a difference in elevation of 20m. The length of syphon is 500 m and the summit is 3.0 m above the water level in the upper reservoir. The length of the syphon from upper reservoir to the summit is 100 m. Find out the discharge through syphon. Neglect minor lessees. The coefficient of friction, f = 0.005.	Dec 22	10
10	Explain the difference between major and minor losses in pipes. List any two minor losses.	Dec 22	4
Q.No	**Module V**	**Month & Year**	**Marks**
1	What do you mean by repeating variables? How repeating variables are selected for dimensional analysis.	KTU Model	3
2	How will you determine whether a boundary layer flow is attached flow, detached flow or on the verge of separation.	KTU Model	3
3	The velocity profile u of a boundary layer flow over a flat plate is given . Develop the expression for local drag coefficient Cfx over the distance x = L from the leading edge of the plate. $\frac{u}{U_\infty} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$ If the boundary thickness is given as $\delta = \sqrt{\frac{280\nu x}{13U_\infty}}$	KTU Model	7
4	A model test is to be conducted in a water tunnel using a 1:20 model of a submarine which is used to travel at a speed of 12 km=h deep under the sea. The water temperature in the tunnel is so maintained that its kinematic viscosity is half as that of the sea water. At what speed the model test is to be conducted.	KTU Model	7
5	With a neat sketch explain the different regions of the boundary layer along a long thin flat plate.	KTU Model	7
6	Using Buckingham's pi theorem show that the velocity through a circular orifice is given by $\sqrt{2gH}\phi\left[\frac{D}{H}, \frac{\mu}{\rho V H}\right]$	KTU Model	7
7	Define Reynold's Number. What is its significance?	December 2022	3
8	Derive expressions for the displacement, momentum and energy thickness in connection with the boundary layer theory.	December 2022	14
9	The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's π-theorem, obtain an expression for Δp.	December 2022	14

10	Consider two-dimensional laminar boundary-layer flow along a flat plate. Assume the velocity profile in the boundary layer is sinusoidal,Find expressions for : (a) The rate of growth δ, as a function of x. (b) The displacement thickness δ*, as a function of x. $$\frac{u}{U} = sin\left(\frac{\pi}{2}\frac{y}{\delta}\right)$$	December 2021	14
11	The drag force F, on a smooth sphere depends on the relative speed V, the sphere diameter D, the fluid density ρ, and the fluid viscosity μ. Obtain a set of dimensionless groups that can be used to correlate experimental data.	December 2021	14

MET 205	METALLURGY AND MATERIALS ENGINEERING	CREDITS	Year of Introduction
		4	2019

	MODULE 1		
1	Derive the expression for atomic packing factor for the FCC crystal structure	5	July 2017
2	What is critical shear? Explain.	5	Dec 2020
3	What is the difference between polymorphism and allotropy?	5	Dec 2021
4	Which are the allotropic forms of iron?	5	Dec 2022
5	What are the common features of graphite and diamond?	5	Dec 2023
6	What is the importance of Miller indices? Explain the procedure for determining Miller indices for a plane.	5	Dec 2022
7	Differentiate between slip and twin? Differentiate between their mechanisms	5	Dec 2023
8	What are crystallographic planes?	5	Dec 2022
9	What is plastic deformation?	5	Dec 2020
10	What is a slip system? Describe the slip systems in FCC, BCC and HCP metal	10	Dec 2017
11	Describe the plastic deformation of metals.	5	Dec 2020
12	Explain Schmid's Law.	5	Dec 2020
13	What is plastic deformation? Describe the slip and twining modes of deformation with the simple Sketches	10	Dec 2020
14	What is the APF for SC and BCC?	10	Dec 2020
15	Explain the terms 'atomic packing factor' and 'co-ordination number'.	5	Dec 2020
16	What are the miller indices? Explain the procedure for obtaining miller indices for any crystallographic plane with a suitable example.	5	Dec 2021
17	Derive the expression for atomic packing factor for the FCC crystal structure.	5	Dec 2021
18	Describe the frank read source theory of dislocations.	5	Dec 2020
19	Copper has an atomic radius of 0.128 nm, an FCC crystal structure, and anatomic weight of 63.5 g/mol. Compute its theoretical density. b. State and explain Fick's first law.	10	July 2017
20	Sketch within a cubic unit cell the following planes (1 1 $\bar{1}$), (1 $\bar{1}$ 0), (0 0 1) and directions [1 1 1], [1 0 1]	10	Dec 2017
21	Calculate the radius of iridium atom, having FCC crystal structure, a density of 22.4 gm/cc and atomic weight of 192.2 gm/mol.	10	Dec 2017
	MODULE 2		
1	What is meant by surface defects? List the type of surface defects observed in crystalline materials.	5	Dec 2021
2	Distinguish between homogeneous and heterogeneous nucleation	5	Dec 2020
3	Explain different types of point defects/ Explain the following point imperfections (a)vacancy (b) interstitial (c) Frenkel defect	10	Dec 2021
4	Define dislocation? With the help of simple sketches differentiate between edge dislocation and screw dislocation	10	Dec 2020
5	Describe the steps involved in preparing a sample for metallographic examination	7	Dec 2020

6	Derive an expression for diffusion coefficient.	5	July 2022
7	Describe the frank read source theory of dislocations.	7	July 2017
8	What is self-diffusion?	5	Dec 2023
9	Explain the diffusion process briefly.	5	Dec 2020
10	Discuss vacancy diffusion and interstitial diffusion with neat sketches.	7	Dec 2021
11	What is the difference between edge and screw dislocation.	5	Dec 2021
12	Give an account of equiaxial and dendritic grains	7	Dec 2020
13	Explain Burgers circuit for screw dislocations.	5	Dec 2023
14	Give an account of Fick's laws of diffusion	5	Dec 2021
15	What is a line defect? What are the two types of line defects? Explain.	5	Dec 2023
16	Explain mechanisms of plastic deformation of metals by slip and twinning.	10	July 2017
17	Explain point defects.	5	Dec 2021
18	Compare edge dislocation and screw dislocation b. State and explain Fick's second law	10	July 2017
19	Describe the working of SEM with a neat sketch	10	Dec 2017
20	Explain the steps involved in the preparation of specimen for metallographic examination. Mention at least four differences between SEM & TEM	10	Dec 2018
MODULE 3			
1	Differentiate between peritectic and peritectoid reactions.	5	Dec 2018
2	Differentiate between a pure metal and an alloy	5	Dec 2022
3	State Hume Rothery rules. Explain various Hume Rothery rules for solid solution formation.	5	July 2017
4	Differentiate between eutectic and eutectoid reactions.	5	Dec 2023
5	How are solid solutions classified? What are the two types of solid solutions? Give examples. What are the possible kinds of solid solutions?	10	Dec 2022
6	Discuss significance of Gibb's phase rule. What are its applications?	5	Dec 2018
7	Distinguish between hardening and case hardening.	5	July 2017
8	Distinguish between annealing and isothermal annealing?	5	July 2017
9	Define hardenability. Distinguish between hardness and hardenability	5	Dec 2018
10	What do you mean by spheroidizing?	5	July 2017
11	What is autempering? What are its advantages and limitations?	7	July 2017
12	What is martempering? What are its advantages and limitations?	7	Dec 2018
13	Differentiate between austenite, cementite and martensite.	5	July 2017
14	What is Fe3 C? How does it affect the properties of steel	2	Dec 2022
15	Explain the features of ferrite, pearlite, austenite, ledeburite, cementite, bainite and martensite	10	July 2017
16	Draw the Iron-Carbon equilibrium diagram and explain the invariant reactions associated with steel.	10	Dec 2018
17	Explain the lever rule with reference to equilibrium diagrams	5	Dec 2018

	MODULE 4		
1	What are chromium steels?	5	July 2017
2	What are the applications of gray cast iron? What are the applications of high	5	Dec 2018
3	Distinguish between the terms, recovery and recrystallization involved in the process of heating (annealing) cold worked metals.	5	Dec 2022
4	What are nodular cast irons? What are their uses in engineering field?	5	Dec 2023
5	Describe the properties and applications of any two magnesium alloys.	5	Dec 2018
6	Discuss on various strengthening mechanisms.	5	Dec 2018
7	Explain the microstructure of cast irons.	5	July 2017
8	Explain strengthening by grain refinement.	5	Dec 2022
9	What is meant by work hardening or strain hardening? Explain.	5	Dec 2018
10	Explain annealing after work hardening./ Discuss recovery, recrystallization and grain growth	10	July 2017
11	Write a note on classification of cast irons?/What are cast irons? Name different types of cast irons.	10	Dec 2022
12	What benefits are achieved through the process of recrystallization?	5	Dec 2018
13	What is gunmetal? Enumerate its properties and applications.	5	Dec 2022
14	Give the microstructure, composition, properties and applications of the following: a) Nodular Cast Iron b) Grey cast iron.	10	Sep 2020
	MODULE 5		
1	Define fracture toughness.	5	Dec 2018
2	What is an S-N curve? Draw the S-N curves for ferrous and non-ferrous alloys.	7	July 2017
3	Draw S-N curves for Ti and Al. Indicate its importance.	5	Sep 2020
4	Explain the mechanism of fatigue.	5	July 2017
5	What are the factors leading to crack formation and crack propagation?	5	Dec 2018
6	What is meant by stress raiser or stress concentration?	5	Sep 2020
7	What are the salient features of brittle fracture?	5	Dec 2022
8	Explain Griffith theory of brittle fracture./Explain Griffith's crack theory.	7	July 2017
9	What are the factors that affect fatigue strength?	5	Dec 2022
10	What is transgranular fracture?	5	Dec 2022
11	Define fatigue. What is endurance limit?/Define fatigue limit.	5	Dec 2023
12	What is the significance of ductile to brittle transition temperature?	5	Dec 2022
13	Write a short note on metal matrix materials./What are the properties of metal matrix materials?/List the advantages of metal matrix composites	10	Dec 2018
14	Explain the features of smart materials./ What are smart materials? Explain.	10	Dec 2023
15	Define creep. Write a short note on creep. Write a note on mechanism of creep.	5	Dec 2022
16	Draw a typical creep curve and mark different zones./ What is a creep curve	7	Dec 2018
17	Explain the fatigue failure of metals. Discuss the factors that affect fatigue	5	Dec 2023
18	Write a note on creep resistant materials.	5	Dec 2022
19	Explain the different types of fatigue loading. Explain the effects of stress concentration, size effect and surface texture on fatigue.	10	Dec 2022

20	. Discuss the mechanism of fatigue What is superplasticity? Explain with	5	Dec 2023
21	What are the factors favoring brittle fracture? Explain their roles.	5	Dec 2018
22	How are composite materials classified?	5	Dec 2023
23	What are the different types of composites? Give applications for each type.	5	July 2017
24	List out the features of super alloys.	5	Dec 2018
25	Write a note on materials for bio (medical) applications.	5	July 2017
26	What is meant by shape memory alloys? How does it achieve the effect?	5	Dec 2023
27	What is meant by maraging steel?	5	July 2017
28	What is a composite? Give examples.	5	Dec 2018
29	Explain Ductile to Brittle Transition Temperature. List the factors affecting this phenomenon. (b) Define Fracture toughness.	10	July 2017
30	Discuss the process of ductile to brittle transition and explain the significance of Ductile-Brittle Transition Temperature. b) Illustrate the transgranular and intergranular modes of fracture.	10	Dec 2018
31	Differentiate between particle reinforced and fiber reinforced composites.	5	July 2017
32	Explain smart materials and materials with memory.	5	July 2017
33	Define creep? Sketch a typical creep curve and explain different stages of creep	7	Dec 2018
34	Define super plasticity. Give one application of super plasticity.	3	Dec 2018
35	List the classification of composites. Explain about any two types of composites.	10	Dec 2018
36	Define ceramics? Enumerate the types of ceramics? Mention any two advantages of ceramics. b) Describe about nuclear materials.	10	Dec 2018
37	Write short note on (i) Biomaterials (ii) Smart materials. b) Explain about super alloys. Mention any two important applications of super alloys.	10	Dec 2018

QUESTION BANK

THIRD SEMESTER (2020)

MAT201: PARTIAL DIFFERENTIAL EQUATIONS & COMPLEX ANALYSIS

(FOR EEE, ECE, CE & ME)

MODULE I			
1	Solve $(y-z)p + (x-y)q = (z-x)$	3	KTU JULY 2017
2	Form the partial differential equation from $z = xg(x) + yf(x)$	3	KTU JULY 2017, MODEL 2020
3	Solve $(mz-ny)p + (nx-lz)q = ly - mx$	5	KTU JULY 2017,MODEL 2020
4	Find the partial differential equation representing the family of spheres whose Centre lies on z- axis	3	KTU JULY 2018
5	Find the general solution of $(y^2 + z^2)p - xyz\ q = -xz$	6	KTU JULY 2018
6	Use Charpit's methods to solve $q + xp = p^2$	7	Model qp 2020
7	Find the differential equation of all spheres of fixed radius having their centers in the xy plane.	7	Model qp 2020
8	Find the PDE by eliminating arbitrary function f and g from $z = f(x) + g(y)$	3	KTU Dec 2021
9	Find the complete integral of $px + qy = pq$ using Charpit's method	7	KTU Dec 2021
10	Form the PDE corresponding to family of sphere with center on z-axis and radius a	7	KTU Dec 2021
11	Solve $\frac{\partial^2 z}{\partial x^2} = xy$	3	KTU Dec 2021
12	Find the differential equation of all planes which are at a constant distance 'c' from the origin	7	KTU DEC 2022
13	Solve $y^2p - xyq = x(z-2y)$	7	KTU DEC 2021 KTU DEC 2022
14	Solve $pq + 2x(y+1)p + y(y+2)q - 2(y+1)z = 0$	7	KTU DEC 2022
15	Solve $\frac{\partial u}{\partial x} = \frac{2\partial u}{\partial t}$+u where $u(x,0) = 3e^{5x}$ by method of separation of variables.	7	KTU DEC 2021 KTU DEC 2022
MODULE 2			
1	Write any three assumptions involved in the derivation of the one dimensional wave equation.	3	KTU July 2018
2	A string of the length *l* fastened at both ends. The midpoint of the	3	KTU July 2018

	string is taken to a height *h* and the released from the rest in that position .Writethe boundary condition and the initial conditions of the string to find the displacement function y(x, t) satisfying the one dimensional wave equation.		
3	Using method of separation of variables, solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} - u$, $u(x,0) = 5e^{-3x}$	2	KTU July 2018
4	Solve the one dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ with boundary conditions $u(0,t) = 0,\ u(l,\ t) = 0$ for all t and the initial conditions $u(x,0) = f(x), \frac{\partial u}{\partial t}$	10	KTU July 2018
5	A string of length 20 cm fixed at both ends is displaced from its position of equilibrium position. Find the displacement $u(x,t)$ of this string if it is set vibrating by giving each of its points a velocity $v_0 \sin(\frac{\pi x}{a})$	10	KTU June 2016
6	A tightly stretched string of length L is fixed at both ends. Find thedisplacement u(x, t) if the string is given an initial displacement f(x) and an initial velocity g(x).	10	KTU Dec 2018
7	A string of length 20 cm fixed at both ends is displaced from its position of equilibrium, by each of its points an initial velocity given by $(x) = \begin{cases} x,\ 0 \le x \le 10 \\ 20 - x, 10\ \le x \le 20 \end{cases}$, x being the distance from one end. Determine the displacement at any subsequent time.	10	KTU May 2017
8	A tightly stretched string with fixed endpoints x=0 and x=l is initially in aposition given by $u = v_0 sin^3\left(\frac{\pi x}{a}\right), 0 \le x \le l$. If it is released from rest from this position, find the displacement function u(x, t).	10	KTU Dec 2018
9	Solve one dimensional heat equation when k > 0	3	KTU May 2017
10	Write down possible solutions of one dimensional heat equation	3	KTU May 2017
11	Derive one dimensional heat equation	10	KTU May 2017, Dec 2021
12	Write down the fundamental postulates used in the derivation of one dimensional heat equation.	3	KTU July 2018
13	Find the temperature distribution in a rod of length 3m whose end pointsare maintained at temperature zero and the initial temperature is $f(x) = 100(2x - x^2), 0 \le x \le 2$	7	KTU March ,MAY 2017
14	Write the 3 possible solution of one dimensional wave equation	3	KTU Dec 2021
15	Write any 2 assumptions used in the derivation of one-dimensional heat equation	3	KTU Dec 2021
16	Solve the boundary value problem described by $u_{tt} - c^2 u_{xx} = 0, 0 \le x \le l, t \ge 0, u(0,t) = u(l,t) = 0, t \ge 0, u(x,0) = 10 \sin\left(\frac{\pi x}{l}\right), \frac{\partial u}{\partial t}(x,0) = 0$	7	KTU Dec 2021
17	Find the temperature $u(x,t)$ in a homogeneous bar heat conducting material of length l whose ends kept at $0°C$ and whose initial	7	KTU Dec 2021

	temperature is given by $u(x,0) = lx - x^2$		
18	Derive the one dimensional wave equation	7	KTU Dec 2021
19	The ends A and B of a rod 10 cm in length are kept at temperature 0℃ and 100℃ until the steady state condition prevails. If B is suddenly reduced to 0℃ and kept so. Find the temperature distribution in the rod at time t.	7	KTU Dec 2021
20	A tightly stretched string of length one cm is fastened at both ends. Find the displacement of a string if it is released from rest from the position $\sin \pi x + 5 \sin 3\pi x$	7	KTU DEC 2022
21	A rod of 30 cm long has its ends A and B kept at $30°c$ *and* $90°c$ respectively until steady state temperature prevails. The temperature at each end is then suddenly reduced to zero temperature and kept so. Find the resulting temperature function $u(x,y)$, taking $x = 0$ at A.	7	KTU DEC 2022
22	A tightly stretched homogeneous string of unit length with its fixed ends at $x = 0$ and $x = 1$ executes transverse vibrations. The initial velocity is zero and the initial deflection is given by $u(x,0) = \begin{cases} 1, & 0 \le x \le 1/2 \\ -1, & 1/2 \le x \le 1 \end{cases}$	7	KTU DEC 2022
23	Derive one dimensional heat equation.	7	KTU DEC 2022
	MODULE 3		
1	Check whether the following functions are analytic or not. Justify your answer i) $f(z) = z + \bar{z}$ ii) $f(z) = \lvert z \rvert^2$	4+4	May 2016 March 2017, Sept 2020 Dec 2021
2	Let $z = u(x,y) + i\,v(x,y)$ be defined and continuous in some neighborhood of a point $z = x + iy$ and differentiable at z itself. Then provethat the first order partial derivatives of u and v exist and satisfy Cauchy- Riemann equations	7	April 2018
3	Prove that $u = sin\ x\ cosh\ y$ is harmonic. Hence find its harmonic conjugate.	8	July 2017 ,April 2018,Sep 2020
4	Find the points, if any in complex plane where the function $f(z) = 2x^2 + y + i(y^2 - x)$ is (i) Differentiable (ii) Analytic	8	July 2017
5	Find the analytic function whose imaginary part is $(x,y) = log(x^2 + y^2) + x - 2y$	7	May 2019
6	Find the image of $\left\lvert z - \frac{1}{2} \right\rvert \le \frac{1}{2}$ under the transformation $w = \frac{1}{z}$, also find the fixed points of the transformations $w = \frac{1}{z}$	7	Dec 2016
7	Find the image of the lines x = c and y = k where c and k are constants under the transformation w = $sin\ z$	7	Dec 2016

8	Find the image of $0 < x < 1, \frac{1}{2} < y < 1$ under the mapping $w = e^z$	7	March 2017, Sept 2020
9	Find the image of the rectangular region $-\pi \leq x \leq \pi, a \leq y \leq b$ under the mapping $w = sin\ z$	8	March 2017
10	Find the image of the region $\left\|z - \frac{1}{3}\right\| \leq \frac{1}{3}$ under the transformation $w = \frac{1}{z}$	8	April 2018
11	Under the transformation $w = z^2$, find the image of the triangular region bounded by $x = 1, y = 1$ and $x + y = 1$	8	May 2019, Sept 2020
12	Find the image of the half plane Re(z) ≥ 2, under the map w = iz	8	July 2017
13	Check whether the function $f(z) = \begin{cases} \frac{Re(z^2)}{1-\|z\|}, if\ z \neq 0 \\ 0,\ if\ z = 0 \end{cases}$ is continuous at $z = 0$	7	Sept 2020 April 2018
14	Test the continuity at $z = 0$ of $f(z) = \begin{cases} \frac{Im(z)}{\|z\|},\ z \neq 0 \\ 0,\ z = 0 \end{cases}$	3	Dec 2021
15	Show that an analytic function $f(z) = u + iv$ is a constant if its modulus is constant.	7	Dec 2021
16	Find the image of $1 \leq \|z\| \leq 2, \frac{\pi}{6} \leq \theta \leq \frac{\pi}{3}$ under the mapping $w = z^2$	7	Dec 2021
17	Find the image of the semicircle $y = \sqrt{4 - x^2}$ under the transformation $w = z^2$.	7	KTU DEC 2021 KTU DEC 2022
18	Show that $u = x^2 - y^2 - y$ is harmonic. Also find the corresponding harmonic conjugate function.	7	KTU DEC 2022
19	Find the image of the circle $\|z - 1\|$=1 under the mapping $W = \frac{1}{z}$.	7	KTU DEC 2022
20	If $f(z) = u(x, y) + iv(x, y)$ is analytic and $uv = 2023$, then show that $f(z)$ is a constant.	7	
	MODULE 4		
1	Integrate $\frac{z^2}{z^2-1}$ counter clockwise around the circle $\|z - 1 - i\| = \frac{\pi}{2}$	7	Dec 2016
2	Evaluate $\int_c \|z\| dz$ (i) Where c is the line segments joining i and $-i$ (ii) Where c is the unit circle in the left of the half plane.	4+3	March 2017
3	Verify Cauchy-Integral theorem for z^2 taken over the boundary of the rectangle with vertices $-1, 1, 1 + i, 1 - i$ in the counter clockwise sense.	8	March 2017
4	Evaluate $\int_c Im(z^2) dz$ where c is the triangle with vertices 0, 1, i counter clockwise	7	April 2018
5	Find the Taylor series and Laurent series of $f(z) = \frac{-2z+3}{z^2-3z+2}$ with center 0 in	8	April 2018

	(i) $\|z\| < 1$ (ii) $1 < \|z\| < 2$		
6	Use Cauchy's Integral formula evaluate $\int_c \frac{z^2}{z^3-z^2-z+1}\, dz$ where c is taken counter clockwise around the circle (i) $\|z+1\| = \frac{3}{2}$ (ii) $\|z-1-i\| = \frac{\pi}{2}$	8	April 2018 Dec 2020
7	Find the Laurent series expansion of $f(z) = \frac{1}{1-z^2}$ which is convergent in (i) $\|z-1\| < 2$ (ii) $\|z-1-i\| > 2$	8	March 2017
8	If $f(z) = \frac{1}{z^2}$, find the Taylor series that converges in $\|z-i\| < R$ and the Laurent series that converges in $\|z-i\| > R$	8	Dec 2016
9	Evaluate $\int_0^{2+i} (\bar{z})^2\, dz$ along (i) The real axis to 2 and then vertically to $2+i$ (ii) The line $2y = x$	8	May 2019
10	Evaluate $\int_0^{1+2i} \bar{z}\ dz$ along $z = t^2 + it$	7	Sept 2020,Dec 2020
11	Find the Maclaurin series of $f(z) = \sin z$	3	Dec 2020
12	Using Cauchy's integral formula, Evaluate the integral $\int_C \frac{2z+3}{z^2} dz$, where C is a circle $\|z-i\| = 2$ counter clockwise.	7	KTU MAY2019 KTU DEC 2022
13	Evaluate $\int (z^2 + 3z) dz$ *along the circle* $\|z\|$=2 from (2,0) to (0,2) in counter- clockwise direction.	7	KTU DEC 2022
14	Using Cauchy's integral formula, Evaluate $\int_C \frac{e^{2z}}{(z+1)^4} dz$, where C is the circle $\|z\| = 1$ counter- clockwise.	7	KTU DEC 2022
15	Expand $f(z) = \frac{z+1}{z-1}$ as a Taylor series about $z = -1$.	7	KTU DEC 2022
	MODULE 5		
1	Determine the nature and type of singularities of (i) $\frac{e^{-z^2}}{z^2}$ (ii) $1/z$	7	KTU March 2017 KTU SEPT 2020
2	Evaluate $\int_C \frac{\tan z}{z^2} dz$ counter clockwise around $\|z\| = \frac{3}{2}$ using Cauchy's Residue theorem	7	KTU April 2018
3	Using contour integration evaluate $\int_{-\infty}^{\infty} \frac{x^2-x+2}{x^4+10x^2+9} dx$	7	KTU July 2017
4	Evaluate $\int \log z\ dz$, where C is the circle $\|z\|$ = 1.	7	KTU May 2019

5	Find all singular points and residues of the functions (a) $f(z) = \frac{z-\sin z}{z^2}$ (b) $f(z) = \tan z$	8	KTU May 2019
6	Find the Laurent series expansion of $f(z) = \frac{1}{z^2+3z+2}$ in the region $1 < \|z\| < 2$	8	KTU Sept 2020 KTU DEC 2021 KTU DEC 2022
7	Evaluate $\int_C \frac{e^z}{\cos n\pi} dz$, where C is the unit circle $\|z\| = 1$ using Residue theorem	8	KTU Sept 2020
8	Evaluate $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta}$	8	KTU Sept 2020
9	Give example of (a) removable singularity (b) pole (c) essential singularity	3	KTU Dec 2021
10	Find the Laurent series expansions of $\frac{1}{z(z-1)}$ about $z = 0$	7	KTU Dec 2021
11	(a) Find the Laurent series expansion of $f(z) = \frac{1}{(z-1)(z-2)}$ valid in (i) $1 < \|z\| < 2$ (ii) $\|z\| > 2$ (b) Evaluate $\int \frac{1}{5-4\sin\theta} d\theta$	7+7	KTU Dec 2021
12	Evaluate $\int_{-\infty}^{\infty} \frac{x^2+2}{(x^2+1)(x^2+4)} dx$	7	KTU Dec 2021
13	Using residue theorem evaluate $\oint_C \frac{z+1}{z^4-2z^3} dz$, where C is $\|z\| = \frac{1}{2}$	7	KTU Dec 2021
14	Evaluate $\int_{-\infty}^{\infty} \frac{1}{(1+x^2)^3} dx$	7	KTU MAR 2017 KTU DEC 2022
15	Using Cauchy's Residue theorem, evaluate $\int \frac{30z^2-23z+5}{(2z-1)^2(3z-1)} dx$, where C is the circle $\|z\| = 1$ counter-clockwise	7	KTU MAR 2017 KTU DEC 2022

	COURSE NAME & CODE PROFESSIONAL ETHICS (HUT 200) / S3 ME		Credit :
Q.No	**Module I**	**Month & Year**	**Marks**
1	Define and briefly explain the term 'commitment'.	Dec-22	3
2	List the types of virtues.	Dec-22	3
3	Explain various actions of an engineer attributed to dishonesty	Dec-22	7
4	What is civic virtue?	Dec 21 & Dec 22	7
5	Write about the importance of the virtues in a work environment: (i) respect for others (ii) living peacefully	Dec-22	7
6	Explain the core human values in detail.	Dec-22	7
7	List the benefits of empathy.	Dec-23	3
8	Is service a part of learning? Explain	Dec-23	7
9	Explain the different aspects of academic integrity	Dec-23	7
Q.No	**Module II**	**Month & Year**	**Marks**
1	Give three probable reasons on why people behave unethically.	Dec-22	3
2	Define a 'professional engineer'.	Dec-22	3
3	Distinguish between Kohlberg's and Gilligan's theories on moral development of an individual	Dec-22	7
4	Discuss the characteristics of the professions as different from non –professional occupation	Dec-22	7
5	Write about major characteristics of accountability.	Dec-22	7
6	What are the uses and criteria of professional ethics theories?	Dec-22	7
7	Compare and contrast tradition and custom. Give an example.	Dec-21	3
8	Discuss the three types of inquiries giving an example each	Dec-23	7
9	List and explain the skills required to handle moral problems/issues in engineering ethics	Dec-23	7
10	What is meant by "informed consent" when bringing an engineering product to market?	Dec-23	3
Q.No	**Module III**	**Month & Year**	**Marks**
1	What are the elements that should make an engineer a responsible experimenter?	Dec-22	3
2	What is the importance of Industrial standards?	Dec-22	3
3	What are the limitations of code of ethics in profession?	Dec-22	7
4	Define and write in detail about Conscientiousness.	Dec-22	7
5	Write a brief report on Bhopal gas tragedy.	Dec 21 & Dec 22	7
6	Compare and contrast engineering experiments with standard experiments	Dec-22	7
7	Write about Balanced outlook on law and proper role of laws.	Dec-23	7
8	Write a brief report on challenger disaster.	Dec-23	7
9	Name the roles of code of ethics.	Dec-23	3

Q.No	Module IV	Month & Year	Marks
1	Define collective bargaining	Dec 21 & Dec 22	3
2	What is meant by occupational crime? Give an example.	Dec 21 & Dec 22	3
3	Write about whistle blowing and types of whistle blowing	Dec-22	7
4	Discuss the need for protection of Intellectual property.	Dec-22	7
5	Explain the situations under which the 'professional rights' may lead to conflicts of interest. Explain.	Dec-22	7
6	Write notes on trademark and trade secret	Dec-23	7
7	What are the two senses of loyalty	De c 23	7
8	Discuss on the ways and means of reducing occupational crimes in Industries	De c 23	7
Q.No	**Module V**	**Month & Year**	**Marks**
1	What are the duties of an engineer as an experimenter, in environmental ethics	Dec-22	3
2	List the ethical responsibilities of consulting engineers	Dec-22	3
3	Explain the role of engineers as managers.	Dec-22	7
4	Explain the meaning and relevance of environmental ethics.	Dec 21 & Dec 22	7
5	Write about technology transfer and appropriate technology.	Dec-22	7
6	Justify the need of moral leadership in today's business environment?	Dec-21	3
7	Discuss about the problems related to the autonomous nature of computer	Dec 21 & Dec 23	7
8	Discuss on Multi National Cooperation's and morality	Dec-23	7