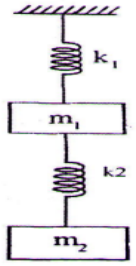
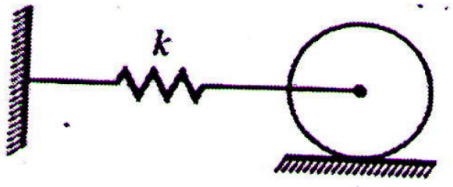
S6 - MECHANICAL QUESTION BANK 2023

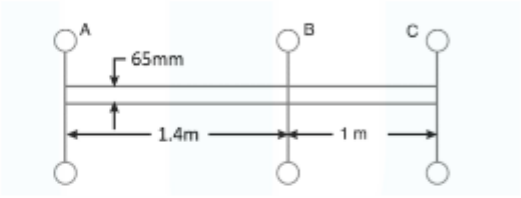
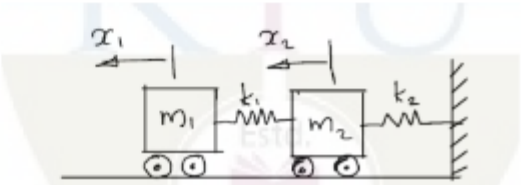
Questions compiled by

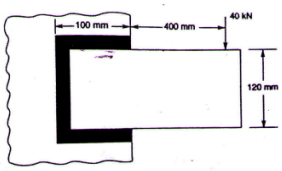
DEPARTMENT OF MECHANICAL ENGINEERING

VIDYA ACADEMY OF SCIENCE AND TECHNOLOGY TECHNICAL CAMPUS, KILIMANOOR, THIRUVANATHAPURAM

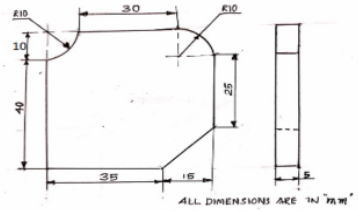
CODE: MET304	COURSE NAME: DYNAMICS AND DESIGN OF MACHINERY		Credit: 4
Q.No	**Module I**	**Month & Year**	**Marks**
1	Differentiate between static and dynamic equilibrium	2018	3
2	Define inertia force.	2019	3
3	Define inertia torque.	2018	3
4	State D'Alembert's principle.	2019	3
5	Define piston effort.	2019	3
6	Define crank effort and crank-pin effort.	2019	3
7	What is meant by turning moment diagram or crank effort diagram?	2019	7
8	A constant torque 2.5 kW motor drives a riveting machine. The mass of the moving parts, including the flywheel is 125 kg at 70 cm radius. One riveting operation absorbs 10,000J of energy and takes 1.2 seconds. Speed of the flywheel is 240 rpm before riveting. Determine (1) No. rivets closed per hour and (2) the reduction in speed after the riveting operation.	2018	14
10	A constant torque 2.5 kW motor drives a riveting machine. The mass of the moving parts, including the flywheel is 125 kg at 70 cm radius. One riveting operation absorbs 10,000J of energy and takes 1.2 seconds. Speed of the flywheel is 240 rpm before riveting. Determine (1) No. rivets closed per hour and (2) the reduction in speed after the riveting operation.	2018	14
11	Describe briefly Newton's method and energy method used for obtaining the natural frequencies.	2022	10
12	A damped spring mass system has mass 3 kg, stiffness 100 N/m and damping coefficient 3 Ns/m. Determine the following: i. Damping ratio ii. Damped natural frequency iii. Logarithmic decrement iv. Ratio of two successive amplitudes	2022	10
13	Describe with a neat sketch the turning moment diagram for a four-stroke internal combustion engine	2022	4
14	The turning moment of an engine is given by the equation: 2500 + 750 sin 3θ Nm where θ is the crank angle in radians. The mean speed of the engine is 300 rpm. The flywheel along with other rotating parts attached to the engine have a mass of 500 kg at a radius of gyration of 0.8 m. Determine i) the power developed by the engine and ii) the percentage of fluctuation of speed of the flywheel	2022	10
Q.No	**Module I**	**Month & Year**	**Marks**
1	Find the natural frequency of a spring mass system using energy method	2020	7
2	A vibrating system consists of a mass of 60Kg, a spring with stiffness of 40kN/m and a damper. The damping provided is only 20% of the critical value. Determine 1. Damping factor 2. Critical damping coefficient 3. The natural frequency of damped vibration 4. Logarithmic decrement 5. The ratio of two consecutive amplitudes	2020	7
3	A machine part having a mass of 4kg vibrates in a viscous medium. A harmonic exciting force of 35N acts on the part and causes a resonant amplitude of 16mm with a period of 0.25 seconds. Find the damping coefficient. If the frequency of the exciting force is changed to 8 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper.	2020	
4	What is the whirling speed of a shaft? Explain	2020	4
5	A machine supported symmetrically on four springs has a mass of 70kg. The mass of the reciprocating part is 3kg which moves through a vertical stroke of 150mm with simple harmonic motion. Determine the combined stiffness of the springs so that the force transmitted to the foundation is 1/20th of the impressed force. Neglect damping. If under actual working conditions, the damping reduces the amplitudes of successive vibrations by 25%. Find (1) the force transmitted to the foundation at 1000rpm 2) The force transmitted to the foundation at resonance	2020	14
6	Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a rotor of mass of 1 kg at its mid-point. The density of the shaft material is 7680 kg/m3 ,and the modulus of elasticity is 200GN/m2. Assume the shaft is supported on short bearings	2020	10
7	Write brief notes on vibration isolation	2020	4
8	Explain torsionally equivalent shaft and derive an expression for it.	2020	10

9	Write brief notes on vibration isolation	2020	4
10	A single cylinder IC Engine directly drives an electric generator. The rotating mass of the engine, flywheel and rotor of generator with the shaft is equivalent to a three-rotor system as shown in figure. The mass moment of inertia of rotors A, B and C are 0.15, 0.3 and 0.1kgm2.The modulus of rigidity of the shaft material is 86kN/mm2 .	2020	10
11	A machine part having a mass of 4kg vibrates in a viscous medium. A harmonic exciting force of 35N acts on the part and causes a resonant amplitude of 16mm with a period of 0.25 seconds. Find the damping coefficient. If the frequency of the exciting force is changed to 8 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper.	2020	14
12	 A two degree of freedom vibrating system is shown in figure 2. Determine the natural frrequencies of vibrations and ratio ofamplitudes of motion of ml and m2 for the two modes of vibration.'m1:3kg, m2=2kg, k1=30N/m and k2=15 N/m	2022	14
13	 A circular cylinder of mass 5kg and radius 20 cm is connected by a spring of stiffiress 3000 N/m as shown in figure l. It is free to roll on horizontal surface without friction, determine the natural frequency of vibration.	2022	5
	Explain the term '*hirling speed' of a shaft. prove that the whirling speed for a (5) rotating shaft is the same aB the natural frequehcy of transverse vibratio	2022	5
Q.No	**Module I**	**Month & Year**	**Marks**
1	A machine supported symmetrically on four springs has a mass of 70kg. The mass of the reciprocating part is 3kg which moves through a vertical stroke of 150mm with simple harmonic motion. Determine the combined stiffness of the springs so that the force transmitted to the foundation is 1/20th of the impressed force. Neglect damping. If under actual working conditions, the damping reduces the amplitudes of successive vibrations by 25%. Find (1) the force transmitted to the foundation at 1000rpm 2) The force transmitted to the foundation at resonance	2020	14
2	What is the whirling speed of a shaft? Explain	2020	4
3	Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a rotor of mass of 1 kg at its mid-point. The density of the shaft material is 7680 kg/m3 and the modulus of elasticity is 200GN/m2. Assume the shaft is supported on short bearings	2020	10

4	A single cylinder IC Engine directly drives an electric generator. The rotating mass of the engine, flywheel and rotor of generator with the shaft is equivalent to a three rotor system as shown in figure. The mass moment of inertia of rotors A, B and C are 0.15, 0.3 and 0.1kgm2. The modulus of rigidity of the shaft material is 86kN/mm2 .Calculate the natural frequency of torsional vibrations. 	2020	14
5	Explain torsionally equivalent shaft and derive an expression for it	2020	7
	A machine of mass 75kg is mounted on springs and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine : 1. The resistance of the dashpot at unit velocity. 2. The ratio of the frequency of the damped vibration to the frequency of the undamped vibration. 3. The periodic time of the damped vibration	2020	14
6	Derive the formula for natural frequency of free undamped longitudinal vibration using any 2 methods. Also derive formula for natural frequency of free transverse vibration.	2020	14
7	From fundamentals derive the expression for logarithmic decrement for a free damped longitudinal vibration system	2020	7
8	Define terms i) Magnification factor ii) Transmissibility	2020	3
	 Find the natural frequencies and mode shapes of a two degree freedom system shown in figure. The masses are m1 = m2 = 10 kg and the stiffness values are k1=k2=2 kN/mm.	2020	7
9	Write brief notes on vibration isolation	2020	7
Q.No	**Module I**	**Month & Year**	**Marks**
1	Define the following properties of material i) Toughness ii) Hardness and iii) Malleability	2022	3
2	Define endurance limit? List the factors affecting endurance limit	2022	3
3	What is meant by caulking and fullering? Explain.	2022	3
4	Differntiate ductile and brittle behaviour of materials	2022	4
5	Find the maximum shear stress induced in the following cases taking stress concentration into account i) A rectangular plate 50mm x l0 mm with a hole 10mm diameter is subjected to an axial load of l0 kN.ii) A stepped shaft has maximum diameter 45mm and minimum .30mm.The fillet radius is 6mm.The shaft is subjected to an axial load of l0 KN	2022	10
6	A round bar is subjected to the following variable loads. Torque varying from 2kNm to 5 kNm, bending moment varying from 10 kNm to 12 kNm. Calculate the size of the bar if it is made of C40 steel with yield stress of 324 MPa. Yield stress in shear is 50% of that in uniaxial loading. Adopt a factor of safety of 2.5 on yield stress for shear.	2022	14
7	Distinguish between Soderberg and Goodman criteria.	2022	4
8	What are the advantages of riveted joint over welded joint?	2022	4
9	Design a double riveted butt joint with equal widths of cover plates to join two plates of thickness 10 mm. The allowable stress for the material of the rivets and for the plates are as follows: For plate material in tension, σt = 80 MPa, for rivet material in compression, σc = 120 MPa, for rivet material in shear, τ = 60 MPa	2022	10
Q.No	**Module I**	**Month & Year**	**Marks**
1	Describe with neat sketches the different types of butt welded joints.	2022	3
2	What is surge in spring? How it can be minimised?	2022	3

3	What is meant by fluctuat{ng stress? What are the types of fluctuating stress Explain.	2022	3
4	Enumerate the importance of throat thickness in the design of welded joint	2022	4
5	 A bracket is welded to a column as shown. Calculate the size of the weld' if the permissibleshear stress in the weld is limited to 70MPa'	2022	10
6	What is Wahl's factor,state its importance in the design of helical springs	2022	4
7	Design a ctose coiled helical compresoion spring for a service load ranging from (10) 2250N to 2750N. Ttre axial deflection of the spring for the load rarge is 6 mm Assume a spring index of 5. The permissible shear stress intensity is 420 MPa modulus of rigidity G=84N/rn2. Neglet the effect of stress concentration	2022	10
8	What are the different types of welded joint?	2020	4
9	Describe AWS welding symbols with neat sketches.	2020	7
10	Determine the weld size of a joint subjected to axial, bending and twisting loads.	2020	7
11	Derive an expression for the shear stress in the spring wire.	2020	7
12	Derive an expression for the deflection of a helical compression spring.	2020	10
13	Why concentric springs are required in certain applications?	2020	4
14	10.Explain i) surge ii) resilience and iii) curvature effect of a spring.	2022	4
15	A bumper consisting of two helical springs of circular section, brings to rest a railway wagon of mass 1500 kg moving at 1.2 m/s. While doing so, the springs are compressed by 150 mm. The mean diameter of the coil is 6 times the wire diameter. The permissible shear stress is 400 MPa. Determine i) the maximum force on each spring ii) wire diameter of the spring, iii) mean diameter of the coils and iv) the number of active coils. Take G=0.84 x 106 MPa.	2022	14

CODE: HUT 310	COURSE NAME: MANAGEMENT FOR ENGINEERS		Credit:
Q.No	**Module I**	**Month & Year**	**Marks**
1	Explain Management as an 'Art' and 'Profession'	June 2022	3
2	Explain the different types of roles of a manager		3
3	What are the different levels of management	June 2022	7
4	Explain the different theories of management		7
5	Explain the different functions and objectives of management	June 2022	7
6	What are the qualities and responsibilities of a manager		7
7	Explain system approach and Contingency approach of modern organization theory	June 2022	7
Q.No	**Module II**	**Month & Year**	**Marks**
1	Explain the features, steps and types of a planning process	June 2022	**7**
2	Explain the terms mission, objective, goal, policies, and organizing with respect to management		**3**
3	Explain in detail about Principles of Organization		**3**
4	Explain the different types of organization structures	June 2022	**7**
5	Explain the term leadership. What are its different types and functions?		**7**
6	What is Maslow's Need hierarchy theory?		**3**
7	What are managerial grid styles?		**3**
Q.No	**Module III**	**Month & Year**	**Marks**
1	What is productivity? What are the factors affecting productivity?		**3**
2	Problems on types of productivity	June 2022	**7**
3	Explain in detail about decision making process		**3**
4	What are the different decision making models?		**7**
5	Problems on decision making under different conditions	June 2022	**7**
6	Decision trees and analysis of decision tree	June 2022	**7**
Q.No	**Module IV**	**Month & Year**	**Marks**
1	What is Project management? What is its necessary?		**3**
2	Network diagram drawing and network analysis	June 2022	**7**
3	Critical Path method and problems using it	June 2022	**7**
4	Program Evaluation and Review Technique and problems using it	June 2022	**7**
5	Problems on probability of completion of project	June 2022	**7**
6	Time Cost Trade Off Analysis		**7**
Q.No	**Module V**	**Month & Year**	**Marks**
1	What are the functions of Operations Management?		**3**
2	What is Human Resource Management? What are its functions?	June 2022	**3**
3	What is marketing? What are the major concepts and objectives of marketing?		**7**
4	Explain in detail about Financial Management		**7**
5	What is Budget? What are the types of Budgets?		**7**
6	Explain in detail about entrepreneurship and its classifications	June 2022	**7**
7	What is a business plan? What are the steps in writing a business plan?	June 2022	**7**
8	What is Forecasting? Explain in detail about types and methods of forecasting	June 2022	**7**

CODE: MET306	COURSE NAME: ADVANCED MANUFACTURING ENGINEERING		Credit:
Q.No	**Module I**	**Month & Year**	**Marks**
1	Explain Powder metallurgy method in production and the steps involved in it with figures.	Apr 2018	4
2	What are the advantages of HVF methods over conventional method of forming?	Dec 2019	5
3	What are the different methods of atomization for making metal powders in Powder metallurgy?	May 2019	6
4	Differentiate the impregnation and infiltration process in Powder metallurgy	May 2019	4
5	With neat sketches explain the principal methods used to produce metallic powders in powder metallurgy	Apr 2018	6
6	Explain the properties of cutting fluids	May 2017	4
7	Differentiate betwween orthogonal and oblique cutting	May 2017	4
8	Differentiate between Cold isostatic pressing and Hot Isoststic pressing	Dec 2019	4
9	What is the use of chip breakers in metal cutting process	May 2017	4
10	Explain Sintering	Dec 2017	4
11	Explain atomization process and classify it	May 2017	4
Q.No	**Module II**	**Month & Year**	**Marks**
1	What are the different word address formats used in part programming?	Apr 2018	5
2	What is meant by interpolation in NC systems? Explain different types of interpolations.	Apr 2018	10
3	Write any Five preparatory function code in manual part programming and its explanation	May 2019	5
4	Write any two methods of specifying a line in an APT language.	May 2019	5
5	What is DDA? Explain its functions and importance in manufacturing.	Dec 2019	6
6	 Write the part programming for the given specimen	May 2019	6
7	Write a PLC ladder logic diagram to get continuous reciprocating movement of a punch, after designing the system using two limit switches, two motors and other necessary devices. Draw input and output diagrams also.	Dec 2019	10
8	Mention the purpose of miscellaneous functions in part programming. Write any 2 M – codes with their applications.	Apr 2018	5
Q.No	**Module III**	**Month & Year**	**Marks**
1	What are the functions of dielectric fluid and electrode in EDM? Write the desirable properties of dielectric material and electrode materials used in EDM	Apr 2018	10
2	Explain the working of Electro Chemical Machining with a neat sketch and example.	Dec 2019	10
3	Explain the working of AWJM with a neat sketch	Apr 2018	10
4	Compare the advantages and limitations of LBM and EBM	Apr 2018	4
5	What are the process parameters in Abrasive Water Jet Machining?	May 2017	4
6	Write the applications of Wire Cut Electro Discharge Machining.	May 2019	5
7	What are the process parameters in Abrasive Water Jet Machining?	May 2019	5
8	What are the characteristics of Electro Discharge Machining (EDM)	Apr 2018	4
9	Explain Ultra Sonic Machining with a neat figure	May 2017	4
10	How the amplitude and frequency of vibration effects on material removal rate in Ultra Sonic Machining.	May 2019	5
11	Explain the mechanism of material removal in Plasma arc machining	May 2019	5
12	Explain solid state Laser Beam Machining Process with neat figure	Apr 2018	4

13	Describe advantages and limitations of Ion beam machining.	Apr 2018	4
14	Describe the mechanism of material removal in Ion beam machining	Apr 2018	6
Q.No	**Module IV**	**Month & Year**	**Marks**
1	Explain the two Techniques in Explosive forming process.	May 2019	5
2	Explain the Electro hydraulic forming process.	May 2019	5
3	What are the advantages of HVF methods over conventional method of forming?	May 2017	4
4	Explain the types of elastic body waves	May 2017	4
5	Explain in detail about electro magnetic forming	Dec 2019	6
6	Explain the effect of high speed on stress strain relationship of mild steel and aluminium with graphs	Apr 2018	4
7	Explain different types of explosive forming techniques with sketch	Dec 2019	10
8	Differentiate P Wave and S wave in High Velocity Forming	May 2017	4
Q.No	**Module V**	**Month & Year**	**Marks**
1	What is Laminated Object Manufacturing? Explain the process with sketches		
2	What is LIGA process? Explain it with neat sketches	**May 2019**	**5**
3	With a neat sketch explain Diamond turn machining process.	Dec 2019	6
4	With a neat sketch explain Selective Laser Sintering.	Apr 2018	6
5	Explain the working of laser engineered net shaping with sketch.	Dec 2019	6
6	Explain magnetic float polishing with sketch. Write its advantages and applications	Apr 2017	5
7	Name various material addition processes. Explain any One type with sketch	Apr 2018	6
8	Write any six material addition process in Additive Manufacturing	May 2019	5

CODE: MET 372	COURSE NAME: ADVANCED METAL JOINING TECHNIQUES		Credit:
Q.No	**Module I**	**Month & Year**	**Marks**
1	Explain the working principle of Electron Beam Welding with neat diagram	June 2022	10
2	Write four applications of Electron Beam Welding	June 2022	4
3	Explain the process variables and characteristics of Laser Beam Welding	June 2022	10
4	Write a short note on weld joint design of Laser Beam Welding	June 2022	4
5	What are the safety measures associated with Laser Beam Welding?	September 2020	4
6	Explain the different process parameters affecting Laser Beam Welding	September 2020	4
7	What are the different types of lasers used in LBW?	September 2020	2
8	What are the classifications of Electron Beam gun?	September 2020	3
Q.No	**Module II**	**Month & Year**	**Marks**
1	Explain the cold pressure welding process	June 2022	8
2	Explain any two welding parameters in diffusion welding	June 2022	6
3	Explain the working of adhesive welding with neat diagram	June 2022	10
4	Write any four applications of adhesive welding	June 2022	4
5	Explain the different components involved in Explosive welding process?	September 2020	6
6	Explain the Diffusion welding process with neat sketches	September 2020	6
7	What are the different materials that can be joined by Diffusion welding process?	September 2020	2
8	What is the role of dies in Cold Pressure welding?	September 2020	4
9	List the advantages and disadvantages of Cold Pressure welding	September 2020	5
10	Explain the major Adhesive bonding theories.	September 2020	5
Q.No	**Module III**	**Month & Year**	**Marks**
1	Explain the principle of operation of explosive welding with neat sketch	June 2022	10
2	Write two advantages and two limitations of explosive welding	June 2022	4
3	Explain the metal flow phenomena in friction stir welding	June 2022	8
4	What are the different stages in friction welding	June 2022	6
5	Explain the different components involved in Explosive welding process?	September 2020	5
6	Explain the different tests performed to assess the quality of weld in Explosive welding?	September 2020	4
7	List any two applications of Friction welding.	September 2020	2
8	Discuss the process variants of Friction Resistance welding	September 2020	6
9	What are the advantages and disadvantages of Friction welding?	September 2020	6
Q.No	**Module IV**	**Month & Year**	**Marks**
1	Explain the process variables and equipment in ultrasonic welding	June 2022	8
2	Write six applications of ultrasonic welding	June 2022	6
3	Explain the working of brazing operation	June 2022	10
4	Write four applications of brazing operation	June 2022	4
5	With the help of neat diagram, explain Ultrasonic welding process.	September 2020	6
6	Explain Vacuum brazing process with the help of neat sketch	September 2020	6
7	What are the advantages and disadvantages of Vacuum brazing?	September 2020	4
Q.No	**Module V**	**Month & Year**	**Marks**
1	Explain the principle of operation of MIAB	June 2022	10

2	Write two advantages and two limitations of plasma arc welding	June 2022	4
3	Explain the working principle of wet under water welding	June 2022	8
4	Draw neat diagrams of transferred arc and non-transferred plasma arc welding	June 2022	6
5	List the disadvantages and risk of Underwater welding.	September 2020	5
6	Explain the process of dry and wet underwater welding	September 2020	5
7	Explain the principle of operation of Needle Arc Micro Plasma welding with the help of neat diagram.	September 2020	5

CODE: MET302	COURSE NAME: HEAT &MASS TRANSFER		Credit: 4
Q.No	**Module I**	**Month & Year**	**Marks**
1	Discuss about the application of Heisler chart and Schmidt plot in heat transfer	KTU Model	3
2	How does a numerical solution method differ from analytical one? Explain.	KTU Model	3
3	Derive 3-dimensional unsteady state heat conduction equation with heat generation, in Cartesian co-ordinate system for anisotropic	KTU Model	7
4	A 3 mm diameter and 5m long electric wire is tightly wrapped with a 2 mm thick plastic cover whose thermal conductivity is k = 0.15 W/m-K. Electrical measurements indicate that a current of 10 A passes through the wire and there is a voltage drop of 8 V along the wire. If the insulated wire is exposed to a medium at $T\infty = 30°C$ with a heat transfer coefficient of h = 12 W/m2-K, determine the temperature at the interface of the wire and the plastic cover in steady operation. Also state with reason, whether doubling the thickness of the plastic cover will increase or decrease heat transfer.	KTU Model	7
5	Derive an expression for temperature distribution for 1-dimensional slab with varying thermal conductivity. Assume the variation of thermal conductivity of slab as $k = k0(1+\beta t)$.	KTU Model	7
6	A square plate heater 15 cm x 15 cm is inserted between two slabs. Slab A is 2 cm thick (k = 50W/m-K) and Slab B is 1cm thick (k = 0.2W/m-K). The outside heat transfer coefficients on side A and side B are 200W/m2-K and 50W/m2-K respectively. The temperature of surrounding air is 25 °C. If rating of heater is 1 KW, find (a) Maximum temperature in the system, and (b) outer surface temperature of the two slabs.	KTU Model	7
8	What is critical radius of insulation? Explain its importance.	June 2022	3
9	Explain Lumped system analysis	June 2022	3
10	Derive general conduction equation in Cartesian coordinate with necessary sketch.Reduce the equation for steady state one dimensional heat conduction across a plane wall without internal heat generation	June 2022	7
11	A rectangular aluminum fin of cross section 8 x 3 cm^2 and 1 m long is protrudes out from a wall of thermal conductivity 250 W/mK. The fin base is maintained at a temperature of 400^oC and the ambient temperature is 30^oC with heat transfer coefficient $10W/m^2K$. The tip of the fin is insulated. Calculate the heat transfer from the fin.	June 2022	7
12	An electric cable of 10 mm diameter is to be insulated by a rubber (k=0.14W/mK).Assume cable surface temperature is 70°C. The surrounding air temperature is 30°C and convective heat transfer coefficient is 10 W/m2K in both bare and insulated cases. Find critical thickness of the insulation and compare the heat transfer for with and without insulation	June 2022	7

13	The interior temperature of a refrigerator is maintained at 5°C. The walls are constructed with two mild steel sheets 3 mm thick with 5 cm of glass wool insulation between them. The heat transfer coefficients on inner and outer surface of refrigerator are 10 W/m$_2$°C and 12.5 W/m$_2$ °C respectively. The temperature in kitchen room is 35°C.Take k (mild steel) =40 W/m-°C and k (glass wool) = 0.04 W/m-°C. Sketch the electric analog of the system. Find the rate of heat leaked to the refrigerator in watts per unit area when it is kept in a kitchen room. Also find interface wall temperatures.	June 2022	7
14	Distinguish between (i) steady and unsteady conduction (ii) 1-D and 2-D conduction.	June 2023	3
15	Write the assumptions used for Fourier's law of heat conduction	June 2023	3
16	A 5 mm diameter and 2 m long electric wire is insulated with a 2 mm thick layer of fibrous cotton (k=0.8W/mK) followed by plastic layer(k=0.15 W/mK) of 3mm thickness. Electrical measurements indicate that a current of 20 A passes through the wire and there is a voltage drop of 25 V along the wire. If the insulated wire is exposed to air at T∞ = 30°C with a convection heat transfer coefficient of h = 12 W/m²-K, determine the temperature at the interface of the wire and the fibrous cotton cover in steady operation.	June 2023	7
17	Explain critical thickness of insulation of a cylinder and derive an expression for the same	June 2023	7
18	Calculate the rate of heat loss through the vertical walls of a boiler furnace of size 4 m × 3 m and 3 m high. The walls are constructed from an inner fire brick wall 25 cm thick of thermal conductivity 0.4 W/mK , a layer of ceramic blanket insulation of thermal conductivity 0.2 W/mK and 8 cm thick , and a steel protective layer of thermal conductivity 55 W/mK and 2 mm thick. The inside temperature of the fire brick layer was measured at 600 0C and the temperature of the outside of the insulation 600 C. Also find the interface temperature of layers	June 2023	7
19	A steam pipe of 10 cm inner diameter and 11 cm outer diameter is covered with an insulating substance k = 1 W/mK. The steam temperature is 2000 C and ambient temperature is 200 C. If the convective heat transfer coefficient between insulating surface and air is 8 W/m2K, find the critical radius of insulation and for this value of rc, calculate the heat loss per m of pipe and the outer surface temperature. Neglect the resistance of the pipe material.	June 2023	7
20	Derive the general heat conduction equation in rectangular coordinates	June 2021	6
21	Define critical thickness of insulation. What is its significance?	June 2021	4
22	A plane wall of thickness L is having uniform thermal conductivity k. Heat is being uniformly generated in the wall at a rate of qg per unit volume. Assuming one dimensional heat conduction through the wall with wall surfaces having same temperature tw, derive an expression for maximum temperature in the wall.	June 2021	6

23	A 25 mm thick metal plate (k = 1 W/m°C) has a uniform volumetric heat generation of 100 kW/m3. The surrounding temperature is 30°C and the surface heat transfer coefficient of 20 W/m2K. Determine the	June 2021	4
Q.No	**Module II**	**Month & Year**	**Marks**
1	What are the characteristics of a boundary layer?	KTU Model	3
2	Write the significance of Nusselt number.	KTU Model	3
3	Saturated propane at 300 K with a velocity of 25 cm/s flows over a flat plate of length L=2 m. and width w=1 m. maintained at uniform temperature of 400 K. Calculate the local heat transfer coefficient at 1m. length and the average heat transfer coefficient fromL=0 m. to L=2 m. Also find the heat transfer.	KTU Model	7
4	Hot air at atmospheric pressure and 80°C enters an 8 m. long uninsulated square duct of cross section 0.2 m. x 0.2 m. that passes through the attic of a house at a rate of 0.15m3/s. The duct is observed to be nearly isothermal at 60°C. Determine the exit temperature of the air.	KTU Model	7
5	Air at 15oC, 35 m/s, flows through a hollow cylinder of 4 cm. inner diameter and 6 cm. outer diameter and leaves at 45oC. The tube passes through a room where the room temperature is 65oC and tube wall is maintained at 60oC. Calculate the heat transfer coefficient between the air and the inner tube.	KTU Model	7
6	side of the plate is maintained at a temperature of 90°C, while the other side is insulated. Determine the rate of heat transfer from the plate by natural convection. If the emissivity of the surface is 1.0, calculate the heat loss by radiation. Also calculate the percentage of heat loss by convection.	KTU Model	7
7	Explain the physical significance of Prandtl No. and Nusselt No.in convection.	June 2022	3
8	What is Grashof number? Explain its significance	June 2022	3
9	Air at pressure of 1 atm and temperature 70°C flows over a flat plate which maintains a surface temperature of 90°C. The plate has a length of 0.2m (in the flow direction) and width of 0.1m. The Reynolds number based on the plate length is 40000. What is the rate of heat transfer from plate to air? If the free stream velocity of air is doubled and the pressure is increased to 3 atm, what is the rate of heat transfer?	June 2022	9
10	Explain hydrodynamic and thermal boundary layer for flow through tubes with the help of neat sketches	June 2022	5
11	A hot square plate 40 cm x 40 cm at 90°C is exposed to atmospheric air at 30°C.Make calculations for the heat loss from both surfaces of the plate, if (a) the plateis kept vertical (b) the plate is kept horizontal. The following empirical correlations have been suggested: $Nu = 0.125 (Gr Pr)^{0.33}$ for vertical position of plate, and $Nu = 0.72 (Gr Pr)^{0.25}$ for upper surface (horizontal position) $= 0.35 (Gr P r)^{0.25}$ for lower surface (horizontal position) where the air properties are evaluated at the mean temperature	June 2022	8

12	An incandescent bulb can be considered as a sphere of 0.06 m dia. The bulb surface is at 130°C. Air at 30°C flows over it with a velocity of 0.6 m/s. Determine the heat loss from the bulb surface.	June 2022	6
13	Discuss the differences between natural and forced convection?	June 2023	3
14	Explain the significance of Reynolds number	June 2023	3
15	When 0.6 kg of water per minute is passed through a tube of 2 cm diameter, it is found to be heated from 20oC to 60oC. The heating is achieved by condensing steam on the surface of the tube and subsequently the surface temperature of the tube is maintained at 90o C. Determine the length of the tube required for fully developed flow.	June 2023	9
16	State and explain Newtons law of cooling.	June 2023	5
17	A vertical pipe 80 mm diameter and 2 m height is maintained at a constant temperature of 120oC. The pipe is surrounded by still atmospheric air at 30o C. Find heat loss by natural convection.	June 2023	10
18	Illustrate thermal boundary layer over a flat plate when the plate surface is hotter than fluid.	June 2023	4
19	What are Nusselt number and Prandtl number? Explain their significanc	June 2021	4
20	Using neat sketches, show the hydrodynamic and thermal boundary layer formation over a flat plate (no explanation required). Mention the terms used in the sketches.	June 2021	6
21	Atmospheric air at 20oC flows over a flat plate with a velocity of 3 m/s. The plate has a length of 500 mm (in the flow direction) and a width of 300 mm. If the plate is maintained at 80oC, calculate the following quantities at the trailing edge: i) Hydrodynamic boundary layer thickness ii) Thermal boundary layer thickness iii) Local skin friction coefficient iv) Local convective heat transfer coefficient v) Rate of heat transfer by convection from the plate	June 2021	10
22	What is lumped system analysis? Derive an expression for temperature distribution in a lumped system in terms of initial temperature and ambient temperature.	June 2021	6
23	A metallic sphere of 25 mm diameter (k = 40 W/m°C, ρ = 7900 kg/m3, c = 480 J/kg°C) is cooled by exposing air at 25°C with a convective heat transfer coefficient of 125 W/m2 °C. Find the time required to cool the sphere from 650°C to 150°C.	June 2021	4
Q.No	**Module III**	**Month & Year**	**Marks**
1	What is meant by condensation heat transfer? How it differs from drop wise heat transfer?	KTU Model	3
2	What are the main factors to be considered for a heat exchanger design?	KTU Model	3

3	A counter flow double pipe heat exchanger is to heat water from 20°C to 80°C at a rate of 1.2kg/s. The heating is to be accomplished by geothermal water available at 170°C at a mass flow rate of 2 kg/s. The inner tube is thin walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient of the heat exchanger is 640 W/m²-K,	KTU Model	8
4	Derive an expression for LMTD of double pipe, parallel flow heat excha	KTU Model	6
5	Steam in the condenser of a power plant is to be condensed at a temperature of 30°C with cooling water from a nearby lake, which enters the tubes of the condenser at 14°C and leaves at 22°C. The surface area of the tubes is 45 m2and the overall heat transfer coefficient is 2100 W/m^2°C. Determine the mass flow rate of the cooling water needed and the rate of condensation of the steam in the condenser.	KTU Model	7
6	In a double pipe heat exchanger, hot fluid with a specific heat of 2300 J/kg enters at 380^{o}C and leaves at 300^{o}C. Cold fluid enters at 25^{o}C and leaves at 210^{o}C. Calculate the heat exchanger area required for (i) Counter flow and (ii) Parallel flow. Take overall heat transfer coefficient as 750 W/m^2 K and mass flow rate of hot fluid is 1 kg/s.	KTU Model	7
7	Why drop-wise condensation is better than film wise condensation? What are the methods to achieve drop wise condensation?	June 2022	3
8	What is fouling factor? How fouling factor is accounted in heat exchanger analysis?	June 2022	3
9	Explain boiling (pool boiling) curve for water with the help of a neat sketch.	June 2022	7
10	In an open-heart surgery under hypothermic conditions, the patient's blood is cooled before the surgery and re-warmed afterwards. It is proposed that a concentric tube counter flow heat exchanger of length 0.5 m is to be used for this purpose, with a thin-walled inner tube having a diameter of 55 mm. If water at 60$_o$ C and 0.1 kg/s is used to heat blood entering the exchanger at 18°C and 0.05 kg/s, what is the temperature of the blood leaving the exchanger and the heat flow rate.	June 2022	7
11	Derive an expression for effectiveness of parallel flow heat exchanger using NTU method.	June 2022	10
12	What are compact heat exchangers? Explain with suitable examples.	June 2022	4
13	Discuss "correction factor" in heat exchanger analysis?	June 2023	3
14	Illustrate cross flow heat exchanger	June 2023	3
15	Explain the classification of heat exchanger by the 'nature of heat exchange' with the help of diagrams.	June 2023	7
16	Derive the expression for log mean temperature difference in parallel flow heat	June 2023	7
17	A chemical having specific heat of 3.3 kJ/kgK enters a parallel flow heat exchanger at 120 $_0$C with a mass flow rate of 20000 kg/h. The flow rate of cooling water is 50000 kg/h with an inlet temperature of 20 $_0$C. The heat transfer area is 10 m$_2$ and overall heat transfer coefficient is 1050 W/m$_2$K. Find the outlet temperature of water and chemical.C$_P$ of water =4.18kJ/kgK	June 2023	10

18	State the causes of fouling in heat exchanger. How fouling is accounted in heat exchanger analysis?	June 2023	7
19	Derive the governing differential equation for a rectangular fin of constant area of cross-section. Find the expression for temperature distribution for an infinitely long case.	June 2021	10
20	Mention the important classifications in heat exchangers with examples for each one.	June 2021	4
21	With the aid of a temperature distribution curve, derive the expression for the logarithmic mean temperature difference of a parallel flow heat exchanger.	June 2021	6
22	In a shell and tube type counter flow heat exchanger, water flows through a copper tube 20 mm I.D. and 22 mm O.D., while oil flows through the shell. Water enters at 20°C and comes out at 30°C, while oil enters at 80°C and comes out at 60°C. The water and oil side film coefficients are 4400 and 1250 W/m2°C respectively. The thermal conductivity of the tube wall is 350W/m°C. If the length of the tube is 2.5 m, calculate the overall heat transfer coefficient and the heat transfer rate.	June 2021	10
Q.No	**Module IV**	**Month & Year**	**Marks**
1	Explain about radiation shape factor.	KTU Model	3
2	What are the properties of blackbody?	KTU Model	3
3	A 70 mm. thick metal plate with a circular hole of 35 mm. diameter along the thickness is maintained at a uniform temperature 250 oC. Find the loss of energy to the surroundings at 27 oC, assuming the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have blackbody characteristics.	KTU Model	6
4	Two large parallel planes with emissivities of 0.3 and 0.5 are maintained at temperatures of 527 0C and 127 0C respectively. A radiation shield having emissivities of 0.05 on both sides is placed between them. Calculate, (i) Heat transfer rate between them without shield. (ii) Heat transfer rate between them with shield.	KTU Model	8
5	Two parallel plates of size 1.0 m. by 1.0 m. spaced 0.5 m apart are located in a very large room, the walls of which are maintained at a temperature of 27^0C. One plate is maintained at a temperature of 900 ^{0}C and other at 400 ^{0}C.theiremissivity'sare0.2and 0.5 respectively. If the plates exchange heat between themselves and the surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surface facing each other.	KTU Model	6
6	Two rectangular surfaces are perpendicular to each other with a common edge of 2 m. The horizontal plane is 2 m. long and vertical plane is 3 m long. Vertical plane is at 1200 K and has an emissivity of 0.4. the horizontal plane is 18 0C and has an emissivity of 0.3. Determine the net heat exchange between the planes.	KTU Model	8
7	What is view factor? State summation rule of view factor.	June 2022	3
8	Explain perfect black body concept.	June 2022	3

9	Derive an expression for the net radiation exchange between two black bodies.	June 2022	7
10	What is Wien's Displacement Law? Explain with the help of Planks distribution.	June 2022	7
11	Calculate the radiation exchange per unit area between two parallel plates of temperature 500°C and 50°C. Emissivity of hot and cold plates are 0.9 and 0.7 respectively. Find the percentage reduction in heat transfer, if a radiation shield of emissivity 0.25 on both surface is placed in between the plates.	June 2022	7
12	State and explain Kirchhoff's law of thermal radiation	June 2023	3
14	List and explain the factors affecting the rate of emission of radiation by a body	June 2023	3
15	Compare white body with grey body	June 2023	5
16	A boiler furnace, whose surfaces closely approximate black surface, is made in the shape of a cylinder of height 2.4 m and diameter 6 m. The base, top and curved surfaces are maintained at 800K, 1500K and 600K respectively. Determine net radiation heat transfer between top and curved surfaces.	June 2023	9
17	Two large plates are maintained at a temperature of 900 K and 500 K respectively. Each plate has area of $6m^2$. Compare the net heat exchange between the plates for the following cases. i) Both plates are black and ii) Plates have an emissivity of 0.5	June 2023	8
18	The filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at 70^0 C. Considering the radiation, determine the filament temperature, if the filament diameter is 0.10 mm and length is 5 cm	June 2023	6
19	What is a black body? What are its properties?	June 2021	4
20	Explain Planck's Law and Wein's displacement law of radiation.	June 2021	6
21	Define shape factor. What is reciprocity theorem?	June 2021	4
22	The radiation shape factor of one circular surface of a thin hollow cylinder, 10 cm diameter and 10 cm long, to the other circular surface is 0.2. What is the shape factor of the curved surface of the cylinder with respect to itself?	June 2021	6
23	Two large parallel plates are kept at 500°C and 30°C. Calculate the net radiation exchange per unit area between the plates. The emissivities of the plates are 0.8 and 0.5 respectively. If a radiation shield of emissivity 0.3 is placed in between them, calculate the percentage	June 2021	10
Q.No	**Module V**	**Month & Year**	**Marks**
1	Give two examples of mass transfer in day-to-day life.	KTU Model	3
2	Explain Ficks law of diffusion with suitable assumptions.	KTU Model	3
3	Explain the analogy between heat and mass transfer.	KTU Model	6
4	Dry air at 300C and 1 atm flows over a wet flat plate 600 mm. long at a velocity of 50 m/s. Calculate the mass transfer co-efficient of water vapour in air at the end of the plate. Take the diffusion co-efficient of water vapour in air, D = 0.26 x 10 -4 m2/s.	KTU Model	8

5	Gaseous hydrogen is stored at elevated pressure in a rectangular steel container of 10 mm. wall thickness. The molar concentration of hydrogen in steel at the inner surface is 2 kg mol/m3, while the concentration of hydrogen in steel at the outer surface is 0.5 kg mol/m3. The binary diffusion coefficient for hydrogen in steel is 0.26 x 10-12 m2/s. What is the mass flux of hydrogen through the steel?	KTU Model	8
6	Explain the phenomenon of equimolar counter diffusion. Derive an expression for equimolar counter diffusion between two gases or	KTU Model	6
7	What are the three modes of mass transfer?	June 2022	3
8	What is the difference between mass concentration and molar concentration?	June 2022	3
9	State and explain Fick's law of molecular diffusion. Write its analogy with Fourier law.	June 2022	7
10	Dry air at 30_0C and 1 atm flows over a wet flat plate 700 mm long at a velocity of 60 m/s. Calculate the mass transfer co-efficient of water vapour in air at the end of the plate. Take the diffusion co-efficient of water vapour in air, D = 0.26 x 10^{-4} m^2/s	June 2022	7
11	Air at 20° C, 40% RH, flows over a water surface at a velocity of 1.2 m/s, the length parallel to flow is 200 mm and width is 300mm. If average surface temperature is 16°C, calculate the amount of water evaporated in kg/sec from the surface? Assume the following properties: Partial pressure of water vapor at 20° and 40% RH, P_{wa} = 0.011 bar, The saturated vapor pressure at 16°C, P_{ws} = 0.017 bar,Kinematic Viscosity of air, υ = 16.38 x 10 m^2/s,Density of air ρ =1.22kg/m^3,Diffusion coefficient; D = 0.256 x 10^{-4} m^2/s,Gas constant	June 2022	7
12	What is equimolar counter diffusion? Obtain an expression for molar diffusion rate in terms of partial pressures	June 2022	7
13	Discuss the three modes of mass transfer	June 2023	3
14	What is convective mass transfer coefficient? What is its dimension?	June 2023	3
15	State and explain governing law of diffusion mass transfer.	June 2023	6
16	Explain steady state diffusion through a plane membrane	June 2023	8
17	Air at 50 $_0$C and 1 atm. flow over the surface of a water reservoir at an average velocity of 2.3 m/s. The water surface is 0.65 m long and 0.65 m wide. The water surface temperature is estimated to be 30_0C. The relative humidity of air is 40%. The density of air is 1.105kg/m^3 and its kinematic viscosity is 17.58 × 10^{-6} m^2/s. Calculate the amount of water vapour evaporates per hour per square meter of water surface in kg/m^2h. Diffusion coefficient= 0.256 × 10^{-4} m^2/ s.	June 2023	14
18	State the law governing mass diffusion and name it. Explain all the terms	June 2021	4
19	Gaseous hydrogen is stored at elevated pressure in a steel container of 16 mm wall thickness. The molar concentration of hydrogen in steel at the inner surface is 1.2 kg mol/m3, while the concentration of hydrogen in steel at the outer surface is zero. The binary diffusion coefficient for hydrogen in steel is 0.25 x 10-12 m2/s. What is the mass flux of hydrogen through the steel?	June 2021	6

20	Define equimolar counter diffusion. In a binary diffusion process of components A and B, show that DAB = DBA for an equimolar counter diffusion.	June 2021	6
21	Discuss Reynolds analogy for heat transfer and mass transfer.	June 2021	4
22	Explain Lewis number and Schmidt number. How are they related to Prandtl number?	June 2021	3
23	Air at 20oC flows through a pipe of 25 mm diameter with a velocity of 5 m/s. The inner surface of the tube is constantly wetted with water so as to maintain a thin water film on the surface. The mass diffusivity of water vapour in air is 0.25 x 10-4 m 2/s. Calculate the mass transfer coefficient of water vapour in air. Use properties of dry air at 20°C.	June 2021	7