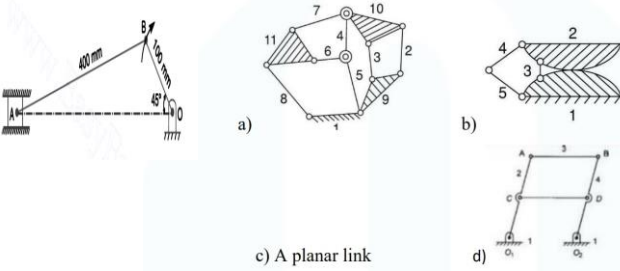
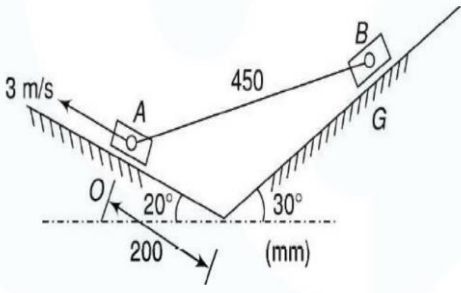
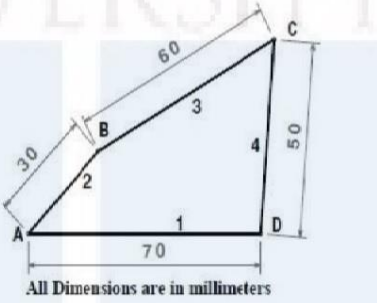
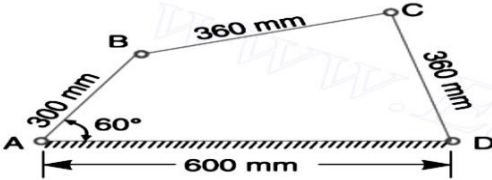


CODE: MET 301	COURSE NAME: MECHANICS OF MACHINERY	Credit: 4
Q.No	Module I	Marks
1	 <p>Find the degrees of freedom of the above cases</p>	14
2	 <p>Find the velocity of the slider B for the given configuration if the velocity of the slider A is 3m/s</p>	14
3	What is kinematic chain? State the conditions required for a kinematic chain to execute constrained motion.	3
4	Differentiate between a machine and structure	3
5	Sketch the Peaucellier straight line motion mechanism and prove that the tracing point describes a straight line path	7
6	What is meant by inversion of a mechanism? Describe with suitable sketches the inversions of a double slider- crank chain	14
7	What is meant by inversion? Explain with neat figures, the different inversions of four bar mechanism.	14
8	Define the following terms: i) Kinematic link ii) Kinematic pair iii) Kinematic chain iv) Mechanism	3
9	Classify kinematic pair with examples.	3
10	State and prove Kennedy's theorem.	3
11	A slider crank mechanism has lengths of the crank and the connecting rod equal to 200 mm and 200 mm respectively. Locate all the instantaneous centres of the mechanism for the position of the crank when it has turned through 30° from the inner dead centre. Also find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/sec	7
12	Differentiate constrained kinematic chain unconstrained kinematics chain.	3
13	Write the equation for Grubler's criterion to a plane mechanism.	3
14	Define: Kinematic pair, Give classification of Kinematic pair with neat sketch.	7
15	State and explain Grashof's criterion	7
16	Explain degree of freedom with neat sketch. Also explain Grubler's criterion	7
17	Sketch and describe the working of Whitworth Quick return motion mechanism.	7
18	Explain various inversion of a single slide-crank mechanism with the help of example.	7

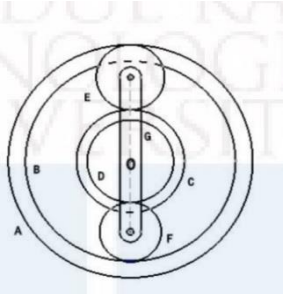
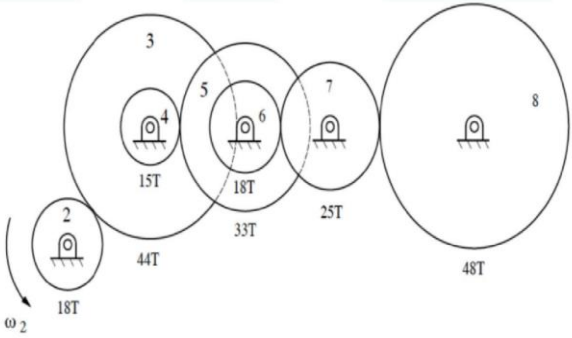
19	Explain the following: 1. Rubbing Velocity 2. Instantaneous center 3. Mechanical Advantage	7
20	Explain instantaneous centre method for finding out the velocity of a point on link.	7
21	What are the applications of single slider crank mechanism	3
22	Give some examples for kinematics pairs	3
23	What is movability?	3
24	What is meant by transmission angle?	3
25	Write down the Grashof's Law for a four bar mechanism?	3
26	Whether a cycle chain is kinematic chain or not	3
27	What is resistant body?	3
28	Differtiate machine and mechanism	3
29	Write the application of Kutzbach criterion and Grubler's criterion to plane mechanism.	14
30	Locate all the instantaneous centres of the slider crank mechanism as shown in Figure. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: (i) Velocity of the slider A, and (ii) Angular velocity of the connecting rod AB.	14
31	Define Actual Mechanical Advantage	3
32	Describe the mechanism obtained by inversions of four bar chain	14
33	In a crank and slotted lever quick return motion mechanism, the distance between the fixed centres is 240mm and the length of the driving crank is 120mm. find the inclination of the slotted bar with the vertical in the extreme position and time ratio of cutting stroke to the return storke. If the length of the slotted bar is 450mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever.	14
34	State Kennedy's theorem	3
35	Describe the motion of the following items as pure rotation, pure translation or complex planar motion. a) The hand of a clock b) The pen in an XY plotter c) connecting rod of an IC engine	7
36	 <p style="text-align: center;">All Dimensions are in millimeters</p> <p style="text-align: center;">Figure-1</p> <p>Draw the inversions of the mechanism shown in figure 1 which leads to double crank, double rocker and crank rocker mechanisms. Describe the nature of motion of each link in each case also</p>	14
37	The crank of a slider crank mechanism rotates clockwise at a constant speed of 300rpm. The crank is 150 mm and the connecting rod is 600 mm long. Determine: 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.	14

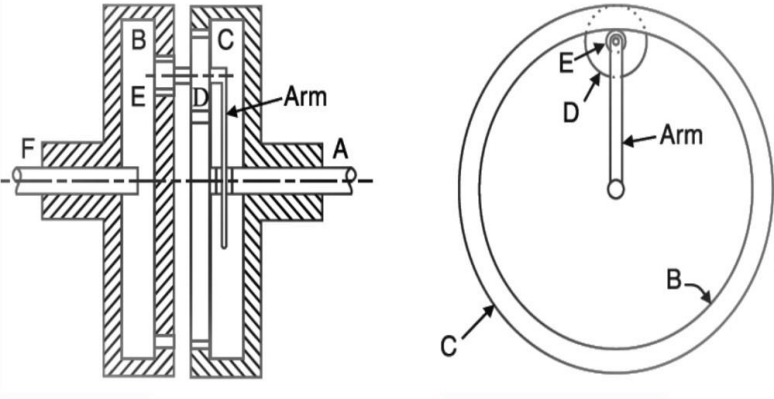
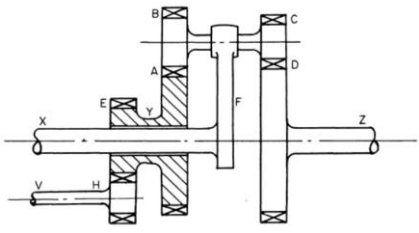
38	 <p>In a pin jointed four bar mechanism, as shown in Figure, $AB = 300$ mm, $BC = CD = 360$ mm, and $AD = 600$ mm. The angle $BAD = 60^\circ$. The crank AB rotates uniformly at 100 rpm in clockwise. Locate all the instantaneous centres and find the angular velocity of the link BC.</p>	14
39	<p>Locate all the instantaneous centres of the slider crank mechanism as shown in Figure. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: (i) Velocity of the slider A, and (ii) Angular velocity of the connecting rod AB.</p>	14
Q.No	Module II	Marks
1	<p>$PQRS$ is a four-bar chain with link PS fixed. The lengths of the links are $PQ = 62.5$ mm; $QR = 175$ mm; $RS = 112.5$ mm; and $PS = 200$ mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle $QPS = 60^\circ$ and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of link QR.</p>	14
2	<p>Draw the displacement, velocity and acceleration diagrams of simple harmonic motion</p>	3
3	<p>Derive equation for velocity, acceleration, max. velocity and max. acceleration for simple harmonic motion.</p>	7
4	<p>A cam is to be designed for a knife edge follower with the following data :</p> <ol style="list-style-type: none"> 1) Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. 2) Dwell for the next 30°. 3) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. 4) Dwell during the remaining 180°. <p>Draw the profile of the cam when the line of stroke is offset 20 mm from the axis of the cam shaft. The radius of the base circle of the cam is 40 mm.</p>	14

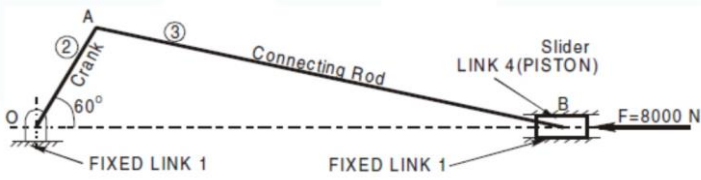
5	Following is the data for a circular arc cam working with a flat faced reciprocating follower: Minimum radius of the cam = 40 mm; angle of lift = 75°; lift= 24 mm; Nose radius = 8 mm; Speed of the cam = 420rpm. Determine the main dimensions of the cam and the acceleration of the follower at the (i) beginning of the lift (ii) end of contact with the circular flank (iii) beginning of contact with the nose (iv) apex of nose.	14
6	What do you mean by Coriolis component of acceleration? How is its direction found out?	3
7	Define the following terms as applied to a cam with a neat sketch i) Prime circle ii) Pressure angle	7
8	Derive the expression for velocity and acceleration when the follower moves with simple harmonic motion	7
9	Sketch the displacement, velocity and acceleration diagrams of a cam follower which moves with cycloidal motion.	7
10	Define polynomial cam. What are its advantages?	3
11	A flat faced follower is operated by a symmetrical circular cam with the straight line path of the follower passing through the cam axis. The least diameter of the cam is 40mm, lift is 12mm, total angle of action is 160° .The cam rotates at 500rpm. If the period of acceleration is 60% of the retardation during lift, determine (i) the main dimensions of the cam. (ii) maximum acceleration and retardation during the lift.	14
12	What is pressure angle of a cam? Discuss its importance in cam design.	3
13	How are cams and followers classified? Describe in detail.	14
14	Obtain the profile of a disc cam operating roller follower having the following motions; Cam lifts the follower for 120° with SHM followed by 30° dwell. During next 150° follower is lowered with uniform acceleration and deceleration and then dwell. Assume minimum radius of cam as 25mm, lift as 30mm and roller diameter 15mm	14
15	Why is a roller follower preferred over knife edge follower	3
16	Design a cam profile to suit the situations for the follower such as SHM, dwell, constant velocity, uniform acceleration cycloidal motion etc	7
17	A cam rotating at 150 rpm operates a reciprocating follower of radius 2.5 cm. The follower axis is offset by 2.5 cm to the right. The least radius of the cam is 5 cm and the stroke of the follower is 5 cm. ascent and descent with take place by uniform acceleration and retardation. Ascent take place during 75° and descent during 90° of cam rotation. Dwell between ascent and descent is 60°. Draw the cam profile. Also sketch velocity and acceleration diagrams and mark salient values.	14
18	Draw profile of a cam operating a knife edge follower for the following data : Maximum lift of the follower = 4.5 cm Angle for rise of follower with SHM = 150° Angle for dwell period after rise = 60° Angle for return of the follower with uniform velocity = 100° Least radius of the cam = 3 cm The cam rotates at a uniform velocity of 120 rpm. Determine the maximum velocity and acceleration of the follower during rise and return	14

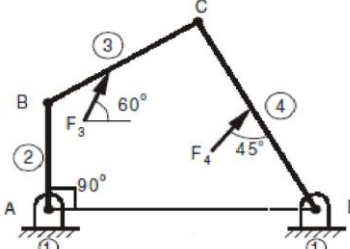
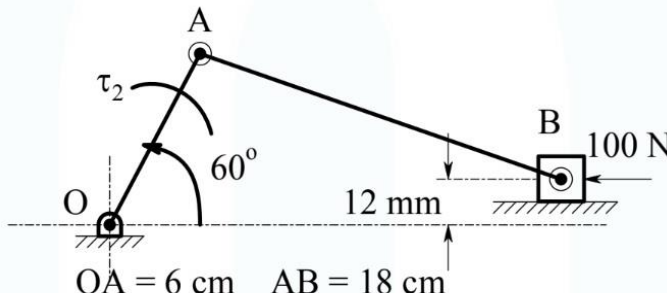
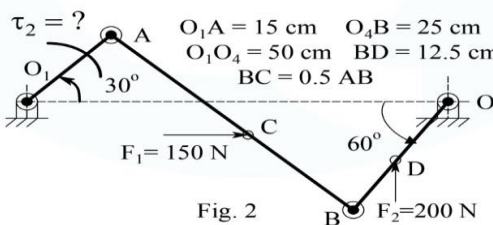
19	<p>A cam is rotating at uniform speed of 1200 rpm in the clockwise sense. It operates a roller following of 20 mm diameter with the data given as follows :</p> <p>Minimum diameter of the cam = 60 mm Maximum lift = 50 mm Angle for rise with equal uniform acceleration and retardation = 120° Angle for dwell after rise = 60° Angle for return with equal uniform acceleration and retardation = 90° Draw the cam profile for : (a) the follower axis passes through the cam centre, and (b) the follower axis is offset to the right by 10 mm. Determine maximum acceleration and maximum velocity of the follower during rise and return.</p>	14
20	<p>A uniformly rotating cam operates a flat faced mushroom follower. Draw cam profile for the following data :</p> <p>Lift of the follower = 30 mm Base circle radius of the cam = 30 mm Angle for ascent (rise) with cycloidal motion = 120° Dwell angle after ascent = 30° Return angle of the follower with uniform acceleration and retardation for retardation being twice the acceleration = 120°</p>	14
21	<p>Differentiate Pitch point and Trace Point</p>	3
22	<p>A cam is to be given the following motion to a knife edge follower:</p> <ol style="list-style-type: none"> 1: outstroke during 60° of the cam rotation; 2: Dwell for next 30° of cam rotation ; 3: Return stroke during next 60° of cam rotation; 4: Dwell for remaining 210° of cam rotation. <p>The stroke of the follower is 6cm. the follower moves with uniform velocity during outstroke and return stroke. Draw the displacement diagram for the follower.</p> <p>Solution: Data given: $\theta_a = 60^\circ$, $\theta_{d1} = 30^\circ$, $\theta_r = 60^\circ$, $\theta_{d2} = 210^\circ$, lift or stroke = 6cm</p>	14
23	<p>A disc with base circle radius of 50 mm is operating a roller follower with SHM. The lift is 25mm angle of ascent 120° , dwell 90°, and dwell during the remaining period. The cam rotates at 300 rpm. Find the maximum velocity and acceleration during ascent. The roller radius is 10mm. Draw the cam profile when the line of reciprocation of follower passes through the cam axis.</p>	14

24	<p>A cam is to give the following motion to a KNIFE-EDGED-FOLLOWER: 1. Out stroke during 60° of cam rotation; 2. Dwell for the next 30° of cam rotation; 3. Return stroke during next 60° of cam rotation, and 4. Dwell for the remaining 210° of cam rotation. The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with UNIFORM VELOCITY during both the out stroke and return stroke. Draw the profile of the cam when</p> <p>(a) The axis of the follower passes through the axis of the cam shaft, and</p> <p>(b) The axis of the follower is offset by 20 mm from the axis of the cam shaft.</p>	14
25	<p>Outstroke during 60° of cam rotation; 2. Dwell for the next 30° of cam rotation; 3. Return stroke during next 60° of cam rotation, and 4. Dwell for the remaining 210° of cam rotation. The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with UNIFORM VELOCITY during both the outstroke and return strokes. Draw the profile of the cam when (a) the axis of the follower passes through the axis of the cam shaft, and (b) the axis of the follower is offset by 20 mm from the axis of the cam shaft.</p>	14
26	<p>Draw the cam profile for following conditions:</p> <p>Follower type = roller follower, in-line; lift = 25mm; base circle radius = 20mm; roller radius = 5mm; out stroke with UARM, for 1200 cam rotation; dwell for 600 cam rotation; return stroke with UARM, for 900 cam rotation; dwell for the remaining period. Determine max. velocity and acceleration during out stroke and return stroke if the cam rotates at 1200 rpm in clockwise direction.</p>	14
27	<p>Draw the cam profile for following conditions:</p> <p>Follower type = roller follower, off set to the right of cam axis by 18mm; lift = 35mm; base circle radius = 50mm; roller radius = 14mm; out stroke with SHM in 0.05sec; dwell for 0.0125sec; return stroke with UARM, during 0.125sec; dwell for the remaining period. During return stroke, acceleration is $\frac{3}{5}$ times retardation. Determine max. velocity and acceleration during out stroke and return stroke if the cam rotates at 240 rpm.</p>	14
28	<p>Draw the cam profile for following conditions:</p> <p>Follower type = oscillating follower with roller as shown in fig.; base circle radius = 20mm; roller radius = 7mm; follower to rise through 400 during 900 of cam rotation with cycloidal motion; dwell for 300; return stroke with cycloidal motion during 1200 of cam rotation; dwell for the remaining period. Also determine the max. velocity and acceleration during outstroke and return stroke, if the cam rotates at 600 rpm.</p>	14
29	<p>A push rod of valve of an IC engine ascends with UARM, along a path inclined to the vertical at 60°. The same descends with SHM. The base circle diameter of the cam is 50mm and the push rod has a roller of 60mm diameter, fitted to its end. The axis of the roller and the cam fall on the same vertical line. The stroke of the follower is 20mm. The angle of action for the outstroke and the return stroke is 60° each, interposed by a dwell period of 60°. Draw the profile of the cam.</p>	14
30	Define tangent cam	3
31	Explain offset follower. ...	3

Q.No	Module III	Marks
32	Define pressure angle with respect to cams	3
1	For the case of gears, What is meant by i) Pressure angle, ii) Circular pitch, iii) Module.	3
2	 <p>In an epicyclic gear train as shown in Figure 4 the internal wheels A and B and the compound wheels C & D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All wheels have the same module and the number of teeth are:</p> <p>$T_c = 28, T_D = 26, T_E = T_F = 18$</p> <p>i) Sketch the arrangement ii) Find the number of teeth on A and B iii) If the arm G makes 100 r.p.m clockwise and A is fixed, find the speed B iv) If the arm G makes 100 r.p.m clockwise and wheel A makes 10 r.p.m counter clockwise, find the speed of wheel B</p>	14
3	Derive equation for path of contact and arc of contact of mating gears.	7
4	Two 20° gears have a module pitch of 5mm. The number of teeth on the pinion 20 and the gear ratio is 2. If the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module	14
	i) The angle turned through by pinion when on ii) The maximum velocity of sliding	
5	What is meant by interference and undercutting in involute gears? What are the methods to avoid interference of gears?	14
6	What is a gear train? Explain the different types of gear trains.	14
7	 <p>Find the angular velocity of gear 8 if the angular velocity of gear 2 is 800 rpm in the direction shown below:</p>	3
8	In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B?	14

9	<p>Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form, module is 6 mm, addendum is one module, and pressure angle is 20°. The pinion rotates at 90 rpm. Determine (i) The number of teeth on the pinion to avoid interference and the corresponding number of teeth on the wheel (ii) The length of path of contact and arc of contact (iii) The number of pairs of teeth in contact, and (iv) The maximum velocity of sliding.</p>	14
10	<div style="text-align: center;">  </div> <p>An internal wheel B with 80 teeth is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel D-E gears with the two internal wheels; D has 28 teeth and gears with C while E gears with B. The compound wheels revolve freely on a pin which projects from a disc keyed to a shaft A, co-axial with F. If the wheels have the same pitch and the shaft A makes 800 r.p.m., what is the speed of the shaft F?</p>	3
11	<p>What are the main gear tooth profiles that satisfy the law of gearing? Compare them.</p>	3
12	<p>Two involute spur gears with pressure angle 20° have a velocity ratio of 3. The module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine the minimum number of teeth on each wheel to avoid interference and the contact ratio.</p>	7
13	<p>State and derive the law of gearing.</p>	7
14	<div style="text-align: center;">  </div> <p>In the epicyclic train shown in the diagram, gear C (100 teeth) are fixed to a sleeve Y which is free to rotate on spindle X. B (24 teeth) and C (22 teeth) are keyed to a shaft which is free to rotate in a bearing on arm F. D (70 teeth) is attached to the output shaft Z. All teeth have the same pitch. The shaft X makes 300 rev/min and the shaft V 100 rev/min in the same direction. The wheel H has 15 teeth. Determine the speed and direction of rotation of Z.</p>	14
15	<p>a) Design a four bar crank rocker to give 45° of rocker motion with a time ratio of 1:1.25 with 45° output rocker motion. (9 marks)</p> <p>b) Design a slider crank mechanism to coordinate two positions of the input link and the slider for the following angular and linear displacement of the input link and slider respectively.</p> <p>$\theta_{12} = 30^\circ$ & $S_{12} = 100$ mm</p>	14
16	<p>Explain the different tasks involved in the kinematic synthesis of mechanisms.</p>	3

17	Explain the different types of synthesis	7
18	Explain what do you mean by structural error?	3
19	Explain the overlay method of synthesis.	7
20	Explain the two-position synthesis of a slider crank mechanism.	3
21	Derive a relation for Freudenstein's equation for the synthesis of mechanisms.	14
22	Design a slider crank mechanism to coordinate three positions of the input crank and the output slider for the following data using graphical method and explain the procedure. $\theta_2 = 30^\circ$, $S_2 = 40\text{mm}$, $\theta_3 = 60^\circ$, $S_3 = 96\text{mm}$	14
23	Synthesize a four-bar linkage using Freudenstein's equation to satisfy in one of its positions. The specification of position θ , velocity ω and acceleration α are as follows: $\theta_2 = 60^\circ$, $\omega_2 = 5 \text{ rad/s}$; $\alpha_2 = 2 \text{ rad/s}^2$; $\theta_4 = 90^\circ$; $\omega_4 = 2 \text{ rad/s}$; $\alpha_4 = 7 \text{ rad/s}^2$	14
24	What are precision points? Explain the Chebyshev spacing of precision points.	7
25	Define kinematic synthesis. Explain the various steps involved in kinematic synthesis?	7
26	Explain 2 position and 3 position synthesis of a four bar mechanism by assuming suitable dimensions.	7
27	What are coupler curves? Explain their role in synthesis.	3
28	Explain the procedure for any one of the methods to design a four link mechanism to coordinate two positions of the input crank and the output rocker.	7
29	How precision points are obtained using Chebyshev spacing?	7
30	Design a four bar mechanism to generate the function $y=2x^2$ where x varies from 2 to 4 with an interval of 1. Assume input angle to vary from 40° to 120° and output angle to vary from 60° to 132° . The length of fixed link is 1m.	14
31	Define the following terms (a) Limit positions (b) Dead centers (c) Function generator (d) Path generator	7
32	Explain the overlay method for synthesis.	7
33	Explain the procedure for any one of the methods to design a four link mechanism to coordinate two positions of the input crank and the output rocker.	14
34	Define law of gearing.	3
35	Define reverted gear train and state its applications.	7
Q.No	Module IV	Marks
1	Explain the effect of gyroscopic couple on aeroplane while it takes a right turn viewing from rear end	7
2	A uniform disc of 150 mm diameter has a mass of 5 N. It is mounted on one end of an arm of length 50cm. The other end of the arm is free to rotate in a universal bearing. If the disc rotates about the arm with a speed of 400rpm anticlockwise looking from the front, with what speed will it precess about the vertical axis?	7
3	 <p>A Slider-crank mechanism as shown in figure is given below. The force acting on slider is 8000 N. Calculate the driving torque. The dimensions of links are: $OA = 200 \text{ mm}$; $AB = 800 \text{ mm}$ and $\angle BOA = 60^\circ$</p>	14
4	The dimensions of a four-link mechanism are: $AB = 400\text{mm}$, $BC = 600\text{mm}$, $CD = 500\text{mm}$, $AD = 900 \text{ mm}$ and $\angle DAB = 60^\circ$. AD is the fixed link. E is a point on the link BC such that $BE = 400\text{mm}$ and $CE = 300\text{mm}$ (BEC clockwise). A force of 150 N acts on DC at a distance of 250mm from D. Find the required input torque on the link AB for static equilibrium of the mechanism.	14

5	<p>In a vertical IC engine, the connecting rod is 4.5 times the crank. The mass of the reciprocating parts is 1.20kg and the stroke of the piston is 140mm. The engine runs at 2000 rpm. If the net load on the piston due to gas pressure is 2kN when the crank has turned through an angle of 60° from the top dead centre, determine the (i) Thrust in the connecting rod, (ii) Thrust on the piston walls, (iii) Tangential force on the crank pin, (iv) Torque on the crankshaft</p>	14
6	 <p>A four bar mechanism as shown in figure, is subjected to two forces, $F_3 = 2000\text{N}$ at 60° from horizontal at midpoint of link 3 and $F_4 = 4000\text{N}$ at 45° from link 4 at midpoint of link 4. The dimensions of links are as under: $AB = 0.3\text{ m}$, $BC = 0.4\text{ m}$, $CD = 0.45\text{ m}$ and $AD = 0.6\text{ m}$. Perform static force analysis and determine resisting torque on link 2 using superposition method.</p>	14
7	<p>A slider crank mechanism of crank radius 60mm and connecting rod length 240mm is acted upon by 2kN gas force at its piston. Calculate the torque to be applied on the crank to make the mechanism in static equilibrium, when the crank makes 60° with the line of stroke.</p>	14
8	<p>The piston diameter of an internal combustion engine is 125 mm and the stroke is 220 mm. The connecting rod is 4.5 times the crank length and has a mass of 50kg. The mass of the reciprocating parts is 30kg. The centre of mass of the connecting rod is 170mm from the crank pin centre and the radius of gyration</p>	14
9	<p>State and explain D'Alembert's principle.</p>	3
10	 <p>The applied force is 100 N, and the coefficient of friction between the slider and the guide is 0.27, using graphical method determine the magnitude and sense of torque τ_2 applied on OA for the static equilibrium of the linkage.</p>	3
11	 <p>Fig. 2 shows a four bar linkage on which various forces acting and their directions are shown. Determine the magnitude and direction of the torque applied on the link O_1A to keep the equilibrium of the linkage. Also determine the magnitude and direction of the forces transmitted to the frame of the linkage. Use Matrix method.</p>	14
12	<p>What do you mean by dynamic equivalent system? Explain</p>	7
13	<p>Define static force analysis.</p>	3
14	<p>Differentiate between static and dynamic equilibrium</p>	3
15	<p>Define applied and constraint forces.</p>	3

16	Differentiate between static force analysis and dynamic force analysis.	3
17	State the principle of superposition.	3
18	What is gyroscopic torque?	3
19	What is meant by expression friction circle?	3
20	What is meant by turning moment diagram or crank effort diagram?	7
21	What are the causes and effect of vibration?	7
22	What is the effect of gyroscopic couple on rolling of ship? Why?	7
23	The rotor of a turbine yacht rotates at 1200rpm clockwise when viewed from stern. The rotor has a mass of 750 kg and radius of gyration of 250mm. Find the maximum gyroscopic couple transmitted to the hull when yacht pitches with a maximum angular velocity of 1 rad/s. What is the effect of this couple?	14
Q.No	Module V	Marks
1	A Single cylinder vertical engine has a bore of 40 cm and a stroke of 50 cm. The connecting rod is 120cm long. The mass of reciprocating parts is 150kg. On the expansion stroke with the crank at 30° from the top dead centre the gas pressure is 1 Mpa. If the engine runs at 300rpm, determine a. Net force acting on the piston b. Resultant load on the gudgeon pin c. Thrust on the cylinder walls	14
2	Four masses A, B, C and D revolves at equal radii and equally spaced along a shaft. The mass B is 7kg and the radii of C and D make angles of 90° and 240° respectively with the radius of B. Find the Magnitude of masses A, C and D and angular position of A, so that the system may be completely balanced.	14
3	Derive an expression for the natural frequency of the free longitudinal vibration by (i) Equilibrium method, (ii) Energy method, (iii) Rayleigh's method.	14
4	A steel shaft 100mm in diameter is supported in shaft bearing 0.4m apart. The shaft carries three loads: first mass 12kg at the centre, second mass 10kg at a distance 0.12m from the left bearing and third mass of 7kg at a distance 0.09m from the right bearing. Find the value of the critical speed by using Dunkerley's method if $E = 2 \times 10^{11} \text{ N/m}^2$	14
5	The data for three rotating masses are given below: $M_1 = 4 \text{ kg}$ $r_1 = 75 \text{ mm}$ $\omega_1 = 45$ $M_2 = 3 \text{ kg}$ $r_2 = 85 \text{ mm}$ $\omega_2 = 135$ $M_3 = 2.5 \text{ kg}$ $r_3 = 50 \text{ mm}$ $\omega_3 = 240$ Determine the amount of counter mass at a radial distance of 65mm required for their static balance.	14
6	A steel shaft 100mm in diameter is supported in shaft bearing 0.4m apart. The shaft carries three loads: first mass 12kg at the centre, second mass 10kg at a distance 0.12m from the left bearing and third mass of 7kg at a distance 0.09m from the right bearing. Find the value of the critical speed by using Dunkerley's method if $E = 2 \times 10^{11} \text{ N/m}^2$	14
7	A rotating shaft carries four unbalanced masses 20 kg, 11kg, 18kg and 12 kg at radii 8cm, 5cm, 6cm and 7cm respectively. The 2nd, 3rd and 4th masses revolve in planes 10cm, 15cm and 18 cm respectively measured from the plane of the first mass and are angularly located at 70°, 120° and 270° respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 6cm radii and revolving in planes midway between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine graphically the magnitudes of the masses and their respective angular positions.	14

8	A three cylinder single acting engine has its cranks set equally at 120° and it runs at 600 r.p.m. The torque-crank angle diagram for each cycle is a triangle for the power stroke with a maximum torque of 90 N-m at 60° from dead centre of corresponding crank. The torque on the return stroke is sensibly zero. Determine 1. Power developed. 2. Coefficient of fluctuation of speed, if the mass of the flywheel is 12 kg and has a radius of gyration of 80 mm 3. Coefficient of fluctuation of energy 4. Maximum angular acceleration of the flywheel.	14
9	A shaft carries four masses A, B, C and D of magnitude 250kg, 350kg, 480kg and 250kg respectively and revolving at radii 64mm, 60mm, 50mm, and 64mm in planes measured from A at 300mm, 400mm, and 700mm. The angles between the cranks measured anticlockwise are A to B 45° , B to C 70° , C to D 120° . The balancing masses are placed in planes P and Q. The distance between the planes A and P is 100mm, between P and Q is 400mm and between Q and D is 200mm. If the balancing mass Q revolve at a radius of 100 mm, and balance mass P revolve at a radius of 150mm, find their magnitudes and angular positions.	14
10	What is the whirling speed of a shaft? Explain	7
11	Explain the method of balancing of several masses in different planes.	7
12	Explain the balancing of several masses rotating in same plane by Graphical Method.	7
13	Why is balancing of rotating parts necessary for high speed engines? Explain clearly the terms	7
14	static balancing and dynamic balancing. State the necessary conditions to achieve them.	7
15	What are the reasons for unbalance in rotating machine elements? Give two practical examples of v	7
16	What is meant by field balancing? Explain the procedure in detail.	7
17	A statically balanced system need not to be dynamically balanced always. Justify the statement.	7
18	Explain the balancing of several masses rotating in same plane by Graphical Method.	7
19	What is static and dynamic balancing	7
20	Four masses A, B, C & D are completely balanced. Masses C & D makes an angle of 90° and 195° respectively with that of mass B in the counterclockwise direction. The rotating masses have the following properties: masses at B, C & D are 25 Kg, 40 Kg and 35 Kg respectively with their radii of rotations are 200 mm, 100 mm & 180 mm respectively. The radius of rotation of mass A is 150 mm. Planes B & C are 250 mm apart. Determine the (i) mass A and its angular position with that of mass B, (ii) position of all the planes relative to plane of mass A.	14
21	A rotating shaft carries four unbalanced masses A=20 kg, B=15kg, C=18kg and D=12kg. The mass centers are 50, 60, 70 and 60 mm respectively from the axis of the shaft. The second, third and fourth masses rotates in planes 100, 150 and 300 mm respectively measured from the plane of first mass and at angular locations of 60° , 120° , and 280° respectively, measured clockwise from the first mass. The shaft is dynamically balanced by two masses, both located at 50mm radii and revolving in planes midway between those of first and second masses and midway between those of third and fourth masses. Determine the balancing masses and their angular positions	14

22	The four masses m_1 , m_2 , m_3 and m_4 having their radii of rotation as 200 mm, 150 mm, 250 mm and 300 mm are 200 kg, 300 kg, 240 kg and 260 kg in magnitude respectively. The angles between the successive masses are 45° , 75° and 135° respectively. Find the position and magnitude of the balance mass required, if its radius of rotation is 200 mm. Use analytical method.	14
23	Explain why the reciprocating masses are partially balanced.	3
24	Explain Primary and Secondary Unbalanced Force Due to Reciprocating Masses	3
25	Partial balancing of Primary Unbalanced Force in Reciprocating Engine	3
26	How and why are reciprocating masses balanced in a piston-cylinder assembly? Why reciprocating masses are partially balanced?	3
27	What is Hammer blow? Derive an expression for limiting speed required for hammer blow.	3
28	Write down short note on 'Variation of Tractive Force'.	3
29	Derive the expressions for variation of tractive force, for an uncoupled two cylinder locomotive engine	7
30	What are inline engines? How these engines are balanced	7
31	What is a secondary balancing of inline multi cylinder engines?	7
32	Derive the expressions for primary and secondary unbalanced forces in a V -Engine.	7
33	Explain concept of Balancing of V engines.	7
34	Explain the direct and reverse crank method for determining unbalanced forces in radial engines.	7
35	Explain concept of Direct and Reverse Crank	7

CODE MET303	COURSE NAME: THERMAL ENGINEERING	Credit: 4
Q.No	Module I	Marks
1	Explain Rankine cycle with help of a T-S diagram.	3
2	Differentiate between fire tube boiler and water tube boiler	3
3	List the difference between throttle governing and nozzle governing	3
4	Steam at a pressure of 15 bar and 250 °C is expanded through a turbine to a pressure of 4 bar. It is then reheated at constant pressure to initial temperature of 250 °C and finally expanded to condenser pressure of 0.1 bar. Calculate efficiency of the cycle. What will be the efficiency if reheating is not employed? Pump work can be neglected.	8
5	Derive the expression for mass flow rate of steam through a nozzle and obtain the critical pressure ratio	6
6	With the help of a neat figure explain the working of a Benson boiler. What are its merits over other boilers?	8
7	With the help of T-s and p-h diagram explain the significance of binary vapour cycle	6
8	Explain the methods of increasing the thermal efficiency of a Rankine cycle	10
9	Compare the characteristic features of a fire tube boiler and water tube boiler	10
10	A simple rankine cycle works between pressure 28 bar and 0.06 bar, the initial condition of the steam being dry saturated. Calculate the cycle efficiency.	10
11	List one advantage and one disadvantage of the reheat cycle and of the regenerative cycle	2
12	In a reheat Rankine cycle, steam at a pressure of 40 bar and 300°C is expanded through a turbine to a pressure of 4 bar. It is then reheated at a constant pressure to 300°C and then expanded to 0.1 bar. Estimate the work done per kg of steam flowing through the turbine, the amount of heat supplied during the reheat process and the cycle efficiency. Neglect pump work	8
13	Dry saturated steam enters a frictionless adiabatic nozzle with negligible velocity at a temperature of 300°C. It is then expanded to a pressure of 40 bar. For a mass flow rate of 2kg/s, calculate the exit velocity of the steam. Use mollier chart	3
14	With the aid of a neat sketch, explain the working of a Cochran Boiler	7
15	Explain the metastable flow in a nozzle with h-s diagram	3
Q.No	Module II	Marks
1	Explain degree of reaction of a steam turbine.	3
2	Derive the condition for maximum efficiency of a reaction turbine	6
3	With the help of figures enumerate the difference between pressure compounding and velocity compounding of steam turbines	8
4	What do you mean by reheat factor? List the parameters influencing the value of reheat factor	4
5	In an impulse steam turbine, steam issues from the nozzle with a velocity of 1200 m/s. The nozzle angle is 20° and the mean blade velocity is 400 m/s. The inlet and outlet blade angles are equal. The blade velocity coefficient is 0.8. The mass of steam flowing through the turbine per hour is 950 kg. Calculate: (i) Blade angles. (ii) Relative velocity of steam entering the blades. (iii) Tangential force on the blades. (iv) Power developed. (v) Blade efficiency	10
6	Discuss the methods of energy transfer in impulse and reaction turbines	10
7	What is meant by reheat factor? List the parameters influencing the value of reheat factor	3
8	Derive the condition for maximum efficiency of a reaction turbine	7
9	In an equiangular, simple impulse turbine, steam issues from the nozzle with a velocity of 900 m/s. Nozzle angle is 20° and mean blade velocity is 360 m/s. Assuming frictionless blades, for a mass flow rate of 1000kg/min, calculate the blade angles, the power developed in kW and the blade efficiency	7
10	Draw the combined velocity diagram for a moving blade of a single stage impulse steam turbine. Clearly denote all the components	4

Q.No	Module III	Marks
1	With the help of a diagram explain turbocharging.	3
2	Explain the procedure of Morse test	3
3	With the help of a neat figure explain the working of Wankel engine. Mention its merits and demerits over conventional IC engines	9
4	Discuss the effect of variable specific heat in actual cycle of IC engines	5
5	The following observations were recorded during a trial of a four stroke single cylinder diesel engine for a trial duration of 30 min. Fuel consumption is 4 liters, Calorific value of fuel 43 MJ/kg, specific gravity of the fuel = 0.8, average area of indicator diagram = 8.5 cm ² , length of indicator diagram = 8.5 cm, spring constant = 5.5 bar/cm, brake load = 150 kg, spring balance reading = 20 kg, effective brake wheel diameter = 1.5 m, speed = 200 rpm, cylinder diameter = 30 cm, stroke = 45 cm. Calculate i) indicated power ii) brake power iii) mechanical efficiency iv) specific fuel consumption in kg/kWh and v) indicated thermal efficiency	10
6	Explain the concept of charge stratification in IC engines	4
7	Compare a 2 stroke and 4 stroke engines. Which engine do you prefer for two wheelers? Why?	10
8	Explain the working of a Rotary Engine and Stratified Charge Engine	10
9	Explain turbo charging and super charging. How does it affect the engine performance and pollution levels?	10
10	A four cylinder petrol engine has an output of 4.8 kW at 180 rpm. A Morse test is carried out and the brake torque readings with each cylinder cut-off in turn are 177 Nm, 170 Nm, 169 Nm and 173 Nm respectively. For normal running at this speed, the specific fuel is 42 MJ/kg. Calculate the mechanical efficiency and brake thermal efficiency of the engine.	6
11	Explain the supercharging of engines	6
12	Sketch the heat balance curves for CI engine at constant speed and discuss the nature of curve	4
Q.No	Module IV	Marks
1	Discuss about pollutants coming from a CI engine	3
2	What do you mean by Octane number?	3
3	With the help of pressure-crank angle diagram explain different stages of CI engine combustion	8
4	Explain the phenomenon of detonation in SI engine based on autoignition theory	6
5	With the help of figures compare different types of SI engine combustion chambers	8
6	Discuss any two emission control methods employed in reducing the emission of CI engine	6
7	Define Flash point, Fire point, Calorific value, volatility and carbon residue of a fuel	10
8	Compare the various stages of combustion in SI and CI engine with p-θ diagram	10
9	Write four desirable properties of an SI engine fuel	4
10	What is meant by pre-ignition? Does pre-ignition occur in CI engine? Justify your answer	3
11	Name the stages of combustion in a CI engine and explain with the aid of a pressure-crank angle diagram	7
12	List any 2 methods for reducing NO _x emission and discuss their basic principle	5
13	Name the factors affecting detonation in SI engine and discuss their effect	5
14	Explain octane rating and cetane rating?	4
Q.No	Module V	Marks
1	Why reversed Carnot cycle is practically impossible to execute?	3
2	Define bypass factor and mention its significance	3
3	A freezer of 20 TR capacity has evaporator and condenser temperature of -30 °C and 25 °C respectively. The refrigerant R-12 is sub-cooled by 4 °C before entering the expansion valve and is superheated by 5 °C before entering the evaporator. If a six cylinder single acting compressor with stroke equal to bore running at 1000 rpm. is used. Determine i) COP ii) Theoretical piston displacement per minute iii) Theoretical bore and stroke	9

4	Derive an expression for COP of a Reversed Brayton cycle for air refrigeration system	5
5	2.5 kg of air is cooled and dehumidified from 30 o C DBT, 40% RH to 15 o C DBT & 80% RH in a cooling and dehumidifying coil. Find (i) ADP, (ii) Bypass Factor and (iii) Heat Transfer. If bypass factor is halved keeping the ADP same find (iv) exit air condition and (v) Heat Transfer	10
6	Define i) DPT ii) RH ii) SHF and iv) ADP	4
7	Define the terms: (i) Refrigeration (ii) Coefficient of Performance and (i) Ton of Refrigeration. State the major applications of refrigeration	5
8	Describe any one refrigeration technique for the production of very low temperature using a neat diagram.	5
9	Draw the T-s and p-h plots of actual vapour compression refrigeration cycle and highlight its differences from a simple vapour compression refrigeration cycle.	5
10	What is an air washer; show in a representative psychrometric chart the various psychrometric processes that can be performed using an air washer.	5
11	With the help of schematic and T-s diagrams describe the working of a Bell Coleman Refrigeration cycle	5
12	State merits and demerits of a vapour compression system over air refrigeration system. Also illustrate the effects of wet and dry compression on the COP	5
13	What are the different factors that affect the human comfort? Sketch a typical comfort chart?	5
14	Differentiate between comfort and industrial air conditioning process.	5
15	Give the classification of air conditioning systems. With a schematic diagram describe a winter air conditioning system	5

Course Code MET 307	Course Name MACHINE TOOLS AND METROLOGY	Credit 4	
Q.No.	Module I	Marks	
1	Differentiate horizontal and vertical spindle screw machines.	5	2021 Dec
2	Explain any three work holding devices used in Slotter machine	9	2021 Dec
3	Explain any four processes that can be done on a drilling machine with sketches.	8	2021 Dec
4	Draw a block diagram of boring machine and label all parts.	6	2021 Dec
5	With a neat sketch explain the various parts of an engine lathe.	7	2022 Dec
6	With neat sketches explain various types of boring tools and reamers.	7	2022 Dec
7	With the help of neat sketches explain the various operations that can be performed in a lathe and the tools used for these operations.	7	2022 Dec
8	With a neat sketch explain the hydraulic shaper mechanism. What are the advantages of this mechanism over crank and slotted lever mechanism?	7	2022 Dec
9	With a neat sketch, explain various operations performed in drilling machine	10	2023 Dec
10	List the operations performed on shaper	4	2023 Dec
11	Which are the major parts of carriage of a lathe? Explain functions of each	7	2023 Dec
12	Explain the differences between turret and capstan Lathe	7	2023 Dec
13	Define counter boring and explain briefly counterboring process in the lathe.	3	2021 Dec
14	Define the terms speed, feed and depth of cut in a straight turning operation.	3	2022 Dec
15	List any six operations that can be performed in a drilling machine.	3	2022 Dec
16	Write any three differences between turret and capstan Lathe.	3	2023 Dec
17	Why Cast Iron is preferred for Lathe bed?	3	2023 Dec
18	Differentiate between twist drill and straight flute drill.	3	2023 Dec
19	Sketch and explain the applications of any four work holding devices used in a lathe.	9	2024 June
20	What are the constructional features of carriage of a lathe?	5	2024 June
21	What is the need for a quick return mechanism in a shaper? Explain the working of a hydraulic type quick return mechanism used in shaper.	9	2024 June
22	Compare the features of a planer and a shaper.	5	2024 June

Q.No.	Module II	Marks	
1.	Differentiate Up milling and down milling.	3	2021 Dec
2.	Explain any one synthetic abrasive used in making grinding wheel and its significant application.	3	2021 Dec
3.	How will you calculate the machining time in a milling operation?	3	2022 Dec
4.	Compare honing and lapping operations.	3	2022 Dec
5.	What is honing?	3	2023 Dec
6.	Differentiate between conventional milling and climb milling.		
7.	What is the purpose of performing a lapping process? How is it performed?		
8.	Mark all elements of plain milling cutter with neat figure.	7	2021 Dec
9.	Explain the principle of indexing head with a good sketch.	7	2021 Dec
10.	Explain the method of specifying a grinding wheel with suitable examples.	6	2021 Dec
11.	Differentiate between hand lapping and machine lapping	8	2021 Dec
12.	With the help of neat sketches explain any five operations that can be performed in a milling machine and the tools used for these operations.	7	2022 Dec
13.	With neat sketches explain the cylindrical grinding and the surface grinding operations.	7	2022 Dec
14.	With neat sketches explain the differential indexing method used in milling process	7	2022 Dec
15.	With the help of a suitable example explain the marking system of a grinding wheel.	7	2022 Dec
16.	with a neat sketch explain the principal parts of a milling machine.	7	2023 Dec
17.	Illustrate the milling cutter nomenclature with a neat diagram.	7	2023 Dec
18.	What is lapping? What are its advantages?	7	2023 Dec
19.	Compare Glazing & Loading of grinding wheels.	7	2023 Dec
20.	What is indexing? Compare compound indexing and differential indexing.	9	2024 June
21.	Explain the working of a dividing head.	5	2024 June
22.	What are the parameters used in specifying a grinding wheel? Give an example.	9	2024 June
23.	Differentiate between cylindrical grinding and centerless grinding.	5	2024 June
Q.No.	Module III	Marks	
1.	Briefly explain gear generation process	3	2021 Dec
2.	Mention any three gear finishing operations.	3	2021 Dec
3.	What is a form cutter? How is it used in a gear manufacturing process?	3	2022 Dec

4.	With neat sketch explain any one method of straight bevel gear generation	3	2024 June
5.	Explain any two gear finishing operations.	3	2024 June
6.	Describe how a gear is manufactured by broaching.	6	2021 Dec
7.	Write the procedure of bevel gear manufacturing by machine.	8	2021 Dec
8.	What are the gear finishing operations and explain any one of them with sketches.	7	2021 Dec
9.	Write the procedure of cutting spiral gear teeth with suitable example.	7	2021 Dec
10.	With a neat diagram explain the gear hobbing process	7	2022 Dec
11.	With the help of neat sketches explain the various parts of a surface broaching machine and a continuous broaching machine.	7	2022 Dec
12.	With a neat sketch explain any one bevel gear cutting process	7	2022 Dec
13.	Differentiate between the internal and the external broaching processes	7	2022 Dec
14.	with a neat sketch, explain the different type of broaching process.	9	2023 Dec
15.	Explain the basic principle of broaching.	5	2023 Dec
16.	With a neat sketch explain the gear hobbing machine.	10	2023 Dec
17.	List the gear finishing methods.	4	2023 Dec
18.	What is the difference between a gear forming method and a gear generating method?	5	2024 June
19.	With the help of neat sketches, explain the different generating methods used for cutting teeth in spur and helical gears	9	2024 June
20.	What are the unique features of a broaching tool? Give a classification of broaching operations.	9	2024 June
21.	What are the major components of a broaching machine?	5	2024 June
Q.No.	Module IV	Marks	
1.	Describe Taylor's principle of gauges.	3	2021 Dec
2.	What is the standard deviation in the limit system?	3	2021 Dec
3.	Differentiate between precision and accuracy.	3	2022 Dec
4.	What are feeler Gauges? What is its practical use	3	2022 Dec
5.	Define the term flatness? How it is measured and quantified	3	2022 Dec
6.	Differentiate between line standard and end standard.	3	2023 Dec
7.	What is metrology? State its objectives.	3	2023 Dec
8.	Distinguish between precision and accuracy of measurement.	3	2024 June
9.	What is an end standard?	3	2024 June
10.	How straightness is checked using a straight edge?	3	2024 June
11.	Differentiate systematic error and random error.	6	2021 Dec

12.	Explain the classification of tolerances with suitable examples.	8	2021 Dec
13.	Explain the applications of slip gauge, ring gauge and snap gauges.	6	2021 Dec
14.	Define precision, accuracy, sensitivity and interchangeability	8	2021 Dec
15.	Explain the terms interchangeability and selective assembly	7	2022 Dec
16.	Explain the principle of gauge tolerance. How do we give wear allowance to a snap gauge?	7	2022 Dec
17.	The tolerances for a hole and shaft assembly having a nominal size of 50 mm are 6 as follows: Hole: $+0.021$ $= 40^{+0.000} \text{ mm}$ and shaft = $40^{-0.040}$ mm Determine (a) Maximum and minimum clearances (b) Tolerances on shaft and hole (c) Allowance (d) Maximum and minimum metal limit of hole and shaft (e) Type of fit	6	2022 Dec
18.	With the help-of neat sketches explain plug, ring, slip and snap gauge	8	2022 Dec
19.	With a neat sketch explain the classification of gauges.	9	2023 Dec
20.	State and explain Taylor's principle for gauge design.	5	2023 Dec
21.	Explain the classification of fit with suitable diagram.	9	2023 Dec
22.	Differentiate between tolerance and allowance.	5	2023 Dec
23.	With the help of a neat sketch, explain the terms (i) basic size (ii) limits of size (iii) tolerance (iv) allowance (v) tolerance zone	9	2024 June
24.	What is fit? What are the different types of fit?	5	2024 June
25.	What is the use of a gauge? Explain the uses of a plug gauge and a ring gauge.	9	2024 June
26.	Distinguish between a shaft basis system and a hole basis system.	5	2024 June
Q.No.	Module V	Marks	
1.	Compare electrical and electronic comparators.	3	2021 Dec
2.	What are the different applications of CMM.	3	2021 Dec
3.	What is a Coordinate Measuring Machine (CMMX What is its use?	3	2022 Dec
4.	What is the advantage of using the wavelength standard?	3	2023 Dec
5.	Explain Principle of microscopy	3	2024 June
6.	What is interferometry? Explain optical flat and it uses.	8	2021 Dec
7.	Explain elements of surface roughness with a figure.	6	2021 Dec
8.	Explain the terminology of gear with a neat figure.	7	2021 Dec
9.	Explain the measurement of screw thread elements by three wire method.	7	2021 Dec
10.	Explain the principle, working and parts of an autocollimator with	7	2022 Dec

	a neat sketch		
11.	With the help of neat diagrams explain the mechanical, the optical and the pneumatic comparators.	7	2022 Dec
12.	What are the various elements of a gear to be measured and how are they measured practically?	7	2022 Dec
13.	With the help of a neat diagram explain the principle and working of any one instrument used for the surface roughness measurement.	7	2022 Dec
14.	Describe the method of evaluating roughness using i. Peak to valley high method ii. CLA method	8	2023 Dec
15.	List the advantage and application of CMM.	6	2023 Dec
16.	sketch and describe the optical arrangement of Laser Interferometer.	9	2023 Dec
17.	Compare mechanical and pneumatic comparator.	5	2023 Dec
18.	Explain the principle of optical measurement. How is measurement done using an optical flat?	9	2024 June
19.	What is the working principle of a comparator? Give a classification of comparators.	5	2024 June
20.	Why surface roughness needs to be controlled? How does surface roughness differ from surface finish?	5	2024 June
21.	Explain the features of (i) an instrument used for direct measurement of surface texture. (ii) Coordinate Measuring Machine	9	2024 June

MET305 INDUSTRIAL & SYSTEMS ENGINEERING

S5 ME

Module 1

Sl no	Question	Year	Marks
1	What are the functions of Industrial Engineering?	Dec 2023	6
2	What are the human factors to be considered while designing a new product?	May 2023	4
3	Describe the procedure followed while designing a product.	Dec 2021	8
4	How inventories are classified and costs associated by inventories?	May 2023	8
5	A manufacturer has to supply 10,000 units of product annually. The unit cost is Rs. 2 and it costs Rs.36 to place an order. The inventory carrying cost is estimated at 9% of average inventory investment. Determine 1. EOQ 2.Optimum number of orders to be placed per annum. 3. Minimum total cost of inventory	Dec 2022	8
6	What are the principles of good product design	May 2023	4
7	The fixed cost of producing a product in a company is Rs. 8,00,000. Variable cost per unit of the product is Rs. 30. Each unit of the product is going to be sold at a price of Rs. 180. Determine the breakeven point of this product.	Dec 2021	8
8	What do you understand by the terms prototype and model?	May 2023	4
9	What are the opposing costs in inventory control? Represent them in a neat sketch, showing the total cost curve also.	May 2023	3
10	Define ergonomics. What are its objectives? Elaborate on how ergonomics finds application in work system design.	May 2023	3
11	Explain 'Break-even analysis' with a neat sketch, clearly explaining the terms involved in it. Derive a mathematical expression for break-even quantity.	Dec 2022	8
12	Explain the following: 1) Standardization 2) Simplification and 3) Diversification.	May 2023	14
13	Derive the expression for EOQ and total inventory cost for purchasing model without shortage.	Dec 2022	8
14	Explain with an example how a successful product connect with user on the three levels 'useful' 'usable' and 'desirable'.	May 2023	3
15	Describe functional design and design for production.	May 2023	4

16	Explain function analysis in the context of value engineering with the help of an example.	Dec 2021	3
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Module 2

1	Describe the role played by the materials management function in enabling an organisation to achieve profitability	Dec 2021	14								
2	List various types of material handling equipments	Dec 2022	4								
3	Classify various material handling equipments used in a manufacturing company and explain in detail about any four category	May 2023	5								
4	Differentiate between P system and Q system with neat sketches.	Dec 2022	7								
5	What is meant by quantity discount?	May 2023	4								
6	<p>A retailer procures batteries for quartz watches and sells them to watch repair shops. The price paid by the retailer varies on the basis of the quantities of batteries procured by him. The quantity and the price/unit pattern offered to him are given below:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Quantity (Q)</th> <th>Price per one unit of battery</th> </tr> </thead> <tbody> <tr> <td>$0 \leq Q < 100$</td> <td>Rs.20</td> </tr> <tr> <td>$100 \leq Q < 200$</td> <td>Rs.18</td> </tr> <tr> <td>$200 \leq Q$</td> <td>Rs.15</td> </tr> </tbody> </table> <p>The monthly demand for the batteries is 600 units. The storage cost is 15% of unit cost of the battery and the cost of ordering is Rs.30 per order. Determine the optimum quantity to be ordered by the retailer so that the total cost of procurement is minimum.</p>	Quantity (Q)	Price per one unit of battery	$0 \leq Q < 100$	Rs.20	$100 \leq Q < 200$	Rs.18	$200 \leq Q$	Rs.15	Dec 2022	10
Quantity (Q)	Price per one unit of battery										
$0 \leq Q < 100$	Rs.20										
$100 \leq Q < 200$	Rs.18										
$200 \leq Q$	Rs.15										
7	How aggregate planning is done in a manufacturing enterprise?	May 2023	5								
8	What are the principles of material handling systems	May 2023	5								
9	What are the criteria for the choice of a type of material handling equipment?	Dec 2022	3								
10	Describe the factors responsible for replacing a equipment in working condition.	May 2023	3								
11	What is unit load in material handling? How unit load can be accomplished?	Dec 2021	3								

Module 3

1	Define 'Job Satisfaction'.	Dec 2021	3
2	Describe the causes of poor industrial relations.	May 2023	3

3	What is meant by 'collective bargaining'?	Dec 2022	3
4	Describe the causes and effects of industrial disputes and how it can be eliminated	May 2023	4
5	What are the methods of elimination of fatigue?	May 2023	3
6	List any five objectives of Trade union.	May 2023	5
7	Trace the history of Trade unionism.	Dec 2022	5
8	Explain conditions to be met for maintaining good industrial relations.	Dec 2021	5
9	Describe the causes of poor industrial relations.	May 2023	7
10	Define industrial psychology. What are its aims and objectives?	Dec 2022	7
11	Why communication in industry is considered as an important function?	Dec 2021	7
12	What is meant by industrial fatigue? What is the nature and effect of fatigue? What are the methods of eliminating fatigue?	May 2023	14
13	Elaborate on worker's participation in management.	May 2023	14
14	Objectives of labour welfare in an industry	My 2023	6
15	Discuss some labour welfare measures undertaken by organisation in recent days	Dec 2021	6
16	A trade union is an instrument of industrial democracy explain	Dec 2022	5
17	Describe direct and indirect cost associated with accidents	May 2023	4
18	Define industrial accidents and its effect in productivity	May 2023	4
19	Characteristics of collective bargaining and explain safety programme and safety committee	Dec 2021	5

Module 4

1	Compare the inventory levels in conventional and lean manufacturing systems	May 2023	3
2	Expand the Japanese terms of 5S	Dec 2021	5
3	Describe the basic elements of lean manufacturing	May 20223	4
4	Describe the components of agile manufacturing system	Dec 2021	3
5	List the measures that are used to measure innovation in agile production system	Dec 2022	4

6	How do strategic linkages aid the organisation to acquire agility?	Dec 2021	3
7	Describe the characteristics of agile manufacturing	Dec 2022	8
8	Describe the key processes of “Customer Relationship Management”	May 2023	4
9	What is lean manufacturing? Name the seven main wastes being dealt with in lean manufacturing.	Dec 2022	7
10	Define agile manufacturing and list four objectives of agile manufacturing	Dec 2021	8
11	Explain the concept of ‘Agile manufacturing. How agile and six sigma differs? Explain the steps to become agile by an ordinary firm	May 2023	14
12	What are the principles of Lean Manufacturing.	May 2023	8
13	Compare conventional manufacturing with Lean manufacturing	Dec 2022	4

Module 5

1	Enumerate ERP implementation stages.	Dec 2022	3
2	With the aid of a block diagram, explain the construction and working of ERP framework.	May 2023	3
3	Describe ERP related technology	Dec 2021	3
4	State the evolution of ERP.	Dec 2022	3
5	What is Online Analytical Processing?	Dec 2021	3
6	With the aid of a block diagram, explain the construction and working of ERP framework.	May 2023	7
7	Explain the differences between ‘Business Engineering’ and ‘Business Process Reengineering	Dec 2022	7
8	List any six benefits of ERP implementation.	May 2023	3
9	What do you understand by Customer Relationship Management (CRM)?	Dec 2022	3
10	What is ERP? List any seven benefits of ERP implementation?	May 2023	7
11	Explain the concept of ‘Business Intelligence’.	My 2023	3
12	Explain OLAP. Explain any one practical application of OLAP by choosing and illustrating any one suitable business	Dec 2021	7
13	Describe the concept of supply chain management, with the help of a practical example. Draw a neat sketch of the supply chain network of that example.	Dec 2022	7
14	What are the emerging trends in ERP?	May 2022	5

15	What are the myths about ERP?	Dec 2021	4
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MCN301		Grade: 5
Q.No	Module I	Marks
1	What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?	7
2	What are disasters? What are their causes?	7
3	Explain the different types of cyclones and the mechanism of their formation	7
4	Explain with examples, the difference between hazard and risk in the context of disaster management	7
5	Explain the following terms in the context of disaster management (a) exposure (b)resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment	14
6	Explain the differences between hazards and disasters	3
7	Write short note on green house effect	3
8	Define the terms : disaster prevention,disater mitigation,disaster preparedness.	7
9	Explain about various layers of atmosphere based on temperature variation.	7
10	Explain about ozone layer.what are the major constituents that causes ozone layer depletion.	7
11	Define the term monsoon.briefly explain about the classification of Indian monsoon.	7
Q.No	Module II	Marks
1	What is hazard mapping? What are its objectives?	7
2	What is participatory hazard mapping? How is it conducted? What are its advantages?	7
3	Explain the applications of hazard maps	7
4	Explain the types of vulnerabilities and the approaches to assess them	7
5	Define the terms risk,vulnerability and crisis	3
6	Write short note on vulnerabiliy assesment	7
7	Explain about various methods of Representing Vulnerability	7
8	Explain the term disaster risk assesmet.what are the main components in disaster risk assesment.	7
9	Define the term hazard.list out the major types of hazards with brief explanation.	7
10	Explain about hazard Mapping Using Geographic Information System (GIS)	
Q.No	Module III	Marks
1	Explain briefly the concept of ‘disaster risk’	7
2	List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster	7
3	What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy	7
4	Explain about the core elements in disaster management cycle	7
5	Write short note on the term disaster risk reduction (DRR).	7
6	Explain about the types of disaster responses	7
7	What are the steps to effective disaster communication?	7
8	Explain about various types of Disaster Preparedness.	7
9	What are the requirements for an effective response.	3
10	Explain about the objectives of disaster response.	3
Q.No	Module IV	Marks
1	What is disaster prevention? Distinguish it from disaster mitigation giving examples	7
2	What are the steps to effective disaster communication? What are the barriers to communication?	7
3	Explain capacity building in the context of disaster management	7
4	Briefly explain the levels of stakeholder participation in the context of disaster risk reduction	7
5	Explain the importance of communication in disaster management	3
6	How are stakeholders in disaster management identified?	7
7	What are the effective Ways of Promoting Stakeholder Participation in DRR ?	7
8	Benefits and Cost of Stakeholder participation in DRR	7
9	Explain about various disaster communication methods	7
10	Define the term crisis.also explain about the four stages of crisis reaction.	7
Q.No	Module V	Marks
1	Briefly explain the levels of stakeholder participation in the context of disaster risk reduction	7
2	Explain the importance of communication in disaster management	7

4	How are stakeholders in disaster management identified?	5
5	Explain the salient features of the National Policy on Disaster Management in India	7
6	Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction	7
7	What are Tsunamis? How are they caused?	7
8	Explain the earthquake zonation of India	3
9	Suggest suitable methods to prevent landslides in Kerala	3
10	Explain about the major epidemics in India.	7

QUESTION BANK

INDUSTRIAL ECONOMICS AND FOREIGN TRADE

(HUT 300)

MODULE 1			
1	What are the factors affecting demand and state the law of demand	3	,KTU Dec 2021, KTU-2024
2	Explain Production possibility curve? With the help of a production possibility curve, explain (i) Trade Off (ii) Why PPC is concave to the origin?	3, 10	KTU 2024, KtuDec2021 KTU June 2023
3	Explain consumer equilibrium? Explain consumer surplus? Explain producer surplus?	3	KTU
4	Define deadweight loss?	3	KTU KTU DEC 2022
5	What are the central problems of an economy?	3	KTU, KTU Dec 2022
6	a. Explain Dead weight loss.?	7	KTU, KTU Dec 2022 KTU June 2023
7	What are the merits and demerits of Joint stock companies? What are the merits and demerits of Proprietorship.	7, 3	KTU 2024, KTU June 2023
8	a. Prepare a utility schedule showing units of consumption, total utility and marginal utility. Point out any three limitations of the law. b. Draw total utility and marginal utility curves and derive the three relations between marginal utility and total utility.	10	KTU 2024, KTU Dec 2022

9	How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government. Explain Types of Elasticity of Demand.	7, 4	KTU 2024																
10	Calculate the marginal utility from the following data <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>X</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> <tr> <td>TU</td> <td>11</td> <td>19</td> <td>26</td> <td>31</td> <td>34</td> <td>36</td> <td>36</td> </tr> </table>	X	1	2	3	4	5	6	7	TU	11	19	26	31	34	36	36	4	KTU June 2023
X	1	2	3	4	5	6	7												
TU	11	19	26	31	34	36	36												
MODULE 2																			
1	a. In the production function $\theta = 2L^{1/2} K^{1/2}$ If $L = 36$ how many units of capital one needed to produce 60 units of output. b. A firm's total cost function is given by the equation, $TC = 4500 + 10Q + 25Q^2$. Write the expression for the following cost concepts. (a) AFC (b) AVC (c) AC (d) MC	4 4	KTU 2024 KTU June 2023																
2	a. In the short run $AVC < P < AC$. Will the firm produce or shut down? Give reason? b. Explain shut down point in the short run with the help of diagram	3 4	KTU KTU June 2023																
3	Define Isoquants and properties, Explain Isocost line, Explain Expansion path, Explain Cobb-Douglas production function	7,4	KTU 2024																
4	Differentiate explicit cost and implicit cost, Explain Sunk cost	3	KTU																
5	Suppose monthly fixed cost of a firm is Rs.40000 and its monthly total variable cost is Rs.60000. If the monthly sales is Rs.120000 estimate contribution and break even sales. ii. If the firm wants to get a monthly profit of Rs.40000 what should be the sales? iii. The total cost function of a firm is given as $TC = 100 + 50Q - 0.2Q^2 + 0.3Q^3$. Find marginal cost when output equals 5 units. b. The total sales of a manufacturing firm are Rs.20000 in this year. Its variable costs one Rs.8000 where its fixed costs are Rs.6000 for that year. Find out the break-even point of this firm.	7 10	KTU2024, KTU Dec 2022 KTU June 2023																

	<p>c. Suppose a firm pays Rs.10000 as monthly rent and Rs.10000 as interest payment. Its monthly expenditure on raw materials is Rs.40000 and it get monthly sales revenue of Rs.80000. The price of one unit of output is Rs.40. Estimate i) PV Ratio ii) Break even sales iii) Break-even output iv) Profit earned v) Margin of safety</p> <p>d. Consider the following data of a company for the year 2022. Sales Rs.80000, Fixed Cost is Rs. 15000, Variable cost is Rs. 35000. Find the following (a) Breakeven Sales (b) Contribution (c) Margin of safety (d) Profit.</p>		
6	Explain Law of variable Proportions with a diagram.	7 10	KTU 2024 KTU June 2023
7	What are the advantages of large-scale production? Explain producer equilibrium with the help of a diagram.	7,4	KTU 2024,2023
8	Explain producer equilibrium with the help of isoquants and is cost line. What is expansion path.	7	KTU, KTU Dec 2022
9	Explain Returns to scale OR Long run production function, Represent it using a figure.	7	KTU, KTU Dec 2022
10	The total cost function of firm is given as $TC=500+5Q+4Q^2+Q^3$. Estimate TVC, TFC and MC when output equals 10 units.	7	KTU, KTU Dec 2022
MODULE 3			
1	What is collusive oligopoly? What is non-price competition under Oligopoly? Give examples of non-price competition under oligopoly? Explain linked demand curve model.	7,4	KTU 2024,KTU Dec 2021
2	What is Predatory pricing? Describe on product pricing and explain the different methods used for pricing.	7 10	KTU 2024,Dec 2022 KTU June 2023
3	Explain the equilibrium of a firm earning supernormal profit under monopolistic competition. Draw figures showing the determination of equilibrium under both.	3	KTU KTU Dec 2022
4	Make comparison between monopoly and perfect competition and Oligopoly	7,10	KTU2024, KTU June 2023
5	What is inelastic demand?	3	KTU Dec 2022

6	Suppose $AC > Price > AVC$. Will a producer produce or shutdown in the short run? Give reason. Answer: Refer Module 2, Qstion 2 answer	3	KTU Dec 2022
7	Why a firm under perfect competition is called a price taker? What are the features of Perfect Competition.	3, 10	KTU 2024, Dec 2022
8	Explain Price rigidity under oligopoly with the help of kinked demand curve. Why price is rigid under oligopoly?	7	KTU, KTU Dec 2022
9	a. With the help of a diagram explain equilibrium under monopolistic competition. b. What are the features of Monopolistic competition, Suppose a firm under monopolistic competition is getting supernormal profit. Draw a diagram and explain this situation	7,10	KTU 2024, KTU Dec 2022
10	Explain Kinked Demand Curve	7 4	KTU KTU June 2023
MODULE 4			
1	Explain in detail the circular flow of income in a four sector model with a neat diagram.	3,4, 10	KTU 2024 KTU June 2023
2	Explain the GNP Deflator, GDP and GNP	3	KTU KTU June 2023
3	Explain demand pull inflation , Explain cost push inflation. Are the monetary or fiscal measures more effective in controlling inflation?	7 10	KTU 2024 KTU June 2023
4	Distinguish between a bond and a share?	3 4	KTU 2024 KTU June 2023
5	Distinguish between NSE and BSE , Distinguish between NIFTY and SENSEX	7	KTU
6	Distinguish between Demat Account and Trading Account.	3	KTU
7	Distinguish between final goods and intermediate goods.	3	KTU Dec 2022
8	a. GDP of a country = 1500 crores, Depreciation =150 Crores NFIA= 50 crores. Estimate GNP,NDP and NNP	7,10	KTU 2024, KTU Dec2021,

	<p>b. Estimate GDPmp. GNPmp and National income. Private consumption expenditure - 2000 (in 1000 crores) Govt. Consumption - 500 ,NFIA - (300) ,Investment - 800 Net Export – 700, Depreciation - 400 Net internal tax – 300</p> <p>c. From the given below estimate Gross National Product, Net National Product and National Income. GDP - 5000 (in 100 billion) NFIA - 50 Indnet - 70 Subsidies- 20 Depreciation- 30</p> <p>d. From the data given below estimate the NDP using</p> <table border="0" data-bbox="371 831 1134 1234"> <thead> <tr> <th>Item</th> <th>Rs</th> </tr> </thead> <tbody> <tr> <td>Consumption Expenditure</td> <td>3000</td> </tr> <tr> <td>Investment Expenditure</td> <td>2000</td> </tr> <tr> <td>Govt. Expenditure</td> <td>700</td> </tr> <tr> <td>Exports</td> <td>600</td> </tr> <tr> <td>Imports</td> <td>300</td> </tr> <tr> <td>Intermediate consumption</td> <td>2000</td> </tr> <tr> <td>Wages and Salaries</td> <td>2000</td> </tr> <tr> <td>Rent</td> <td>500</td> </tr> <tr> <td>Interest</td> <td>500</td> </tr> <tr> <td>Profit</td> <td>1000</td> </tr> </tbody> </table> <p>e. How is national income estimated according to the income method? Estimate NDP and NNP from the given data (all figures in Rs. Crores). Wages and salaries = 800, Rent = 300, Depreciation = 200, Interest = 400, Net Indirect tax = 400, NFIA = 100, Profit = 400.</p> <p>f. Suppose the national income of a country is Rs1000 and depreciation equals Rs300. If NFIA equals Rs (-400) and Indirect Taxes equals Rs300, estimate NNP, NDP, GDP and GNP (all figures in Rs. Crores).</p> <p>g. Estimate GDPMP , GNPMP and National Income. Private consumption expenditure = 2000 (in 000 crores), Government consumption = 500, NFIA= -300, Investment=800, Net exports=700, Depreciation=400 and Net-indirect tax=300.</p>	Item	Rs	Consumption Expenditure	3000	Investment Expenditure	2000	Govt. Expenditure	700	Exports	600	Imports	300	Intermediate consumption	2000	Wages and Salaries	2000	Rent	500	Interest	500	Profit	1000		<p>KTU Dec 2022, KTU June 2023</p>
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Profit	1000																								
9	Distinguish between money market and capital market ?	7,	KTU Dec 2021																						

10	What is monetary policy? What are the monetary policy measures?	7,10	KTU 2024,KTU Dec 2022
MODULE 5			
1	What is free trade? What is Devaluation? Explain the J-curve effect? Suppose the sum of elasticity of export and import is less than one. What will be the effect of devaluation? What are the merits of quota restrictions? What are the arguments in favour of free trade? What are the tariff barriers? Explain its impact on the economy.	7, 4	KTU 2024,Dec 2021
2	Effects of International Trade	4,3	KTU 2024,June 2023
3	How is National income estimated under Product method and expenditure method, income method	7,10	KTU 2024
4	What are the monetary and fiscal policy measures to control inflation?	3,10	KTU 2024,Dec 2021
5	What is international trade? List out the advantages of foreign trade ? What are the disadvantages of foreign trade? Examine the effects of quotas on international trade.	7,3	KTU, 2024 KTU Dec 2022
6	What do you mean by labour augmenting technical progress?	3	KTU Dec 2022
7	What is a Trading account? Point out any three items coming under unilateral transfers account. What is balance of payments?	3,10	KTU 2024,Dec 2022 KTU June 2023
8	Examine the comparative cost theory. Point out any two criticisms against this theory. Explain absolute advantages theory with the help of an example	7,10	KTU 2024,Dec 2022 KTU June 2023
9	What is protection? State any five arguments in favour of protection.	7,4	KTU2024, Dec 2022 KTU June 2023
10	Evaluate the success or failure of devaluation when the	7	KTU Dec 2022

	demand for import is more elastic or less elastic.		KTU June 2023
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