

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK



VI SEMESTER

ME3662- DESIGN OF TRANSMISSION SYSTEMS

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DEPARTMENT OF MECHANICAL ENGINEERING



QUESTION BANK

UNIT I - DESIGN OF FLEXIBLE ELEMENTS

Motor power capacity for various applications -Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

PART-A (2 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	Define power transmission and list any two flexible power transmission elements.	BT-1	Remembering
2	What is meant by motor power capacity?	BT-1	Remembering
3	State any two applications of flat belt drives.	BT-1	Remembering
4	Define coefficient of friction in belt drives.	BT-1	Remembering
5	What is crowning of pulley? Why is it necessary?	BT-2	Understanding
6	List any two advantages of flat belt drives.	BT-1	Remembering
7	What is meant by slip in belt drives?	BT-1	Remembering
8	Distinguish between open belt drive and crossed belt drive.	BT-2	Understanding
9	Why V-belts transmit more power than flat belts?	BT-4	Analysing
10	Define centrifugal tension in belt drives.	BT-1	Remembering
11	List any two standard cross-sections of V-belts.	BT-1	Remembering
12	State the law of belting.	BT-2	Understanding
13	What factors affect the power capacity of a belt drive?	BT-2	Understanding
14	Define pitch length of a V-belt.	BT-1	Remembering
15	What is meant by wedge action in V-belt drives?	BT-2	Understanding
16	List any two applications of wire ropes.	BT-1	Remembering
17	What is a hoisting wire rope?	BT-1	Remembering
18	Define factor of safety used in wire rope design.	BT-1	Remembering
19	Why pulleys for wire ropes are made large in diameter?	BT-4	Analysing
20	What is meant by bending stress in wire ropes?	BT-2	Understanding
21	List any two advantages of chain drives over belt drives.	BT-2	Understanding
22	Define pitch of a chain.	BT-1	Remembering
23	What is chordal action in chain drives?	BT-2	Understanding
24	State any two applications of chain and sprocket drives.	BT-1	Remembering

25	Why chain drives are preferred for heavy-duty applications?	BT-4	Analysing
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PART-B (16 Marks)			
Q.No	QUESTIONS	BT Level	Competence
1	Calculate the power capacity of the leather belt of 9mm x 250mm is used to drive a CI pulley 900mm in diameter at 336rpm. If the active arc on the smaller pulley is 120° and stress in tight side is 2Mpa. The density of the leather may be taken as 980 kg/m ³ and coefficient of friction of leather on CI is 0.35.	BT-5	Evaluate
2	Design a flat belt drive for a fan running at 360 rpm which is driven by a 10 kW at 1440 rpm motor. The belt drive is open type and the distance between the pulley Centres is 2000 mm .The diameter of a driven pulley is 1 m.	BT-6	Creating
3	Design a flat belt drive to transmit 20 kW at 720rpm. The centre distance is 3m and the speed ratio is 3. Diameter of rolling pulley is 1.2 m.	BT-6	Creating
4	Design a flat belt drive to transmit 15 kW at 480rpm from an engine to line shaft at 1200 rpm. The Centre distance between the pulleys is 2m .The diameter of engine pulley is 600 mm.	BT-6	Creating
5	A flat belt drive is required to transmit 12 kW from a motor running at 720 rpm. The belt is 12 mm thick and has mass density of 0.001 gm/mm ³ . Permissible stress in the belt not exceed 2.5 N/mm ² . Diameter of driving pulley is 250 mm whereas the speed of driven pulley is 240 rpm. The two shafts are 1.25 m apart, coefficient of friction is 0.25. Determine the width of the belt.	BT-6	Creating
6	Design a suitable V-belt for a centrifugal pump running at 340 rpm is to be driven by 100 kW motor at 1440 rpm. The drive is to work at least 20 hours every day. Centre distance is 1.2 m.	BT-6	Creating
7	Design a V-belt drive to transmit 10kW at 400 rpm. The speed ratio is 3. Centre distance between the pulleys is 600 mm and the drive is crusher.	BT-6	Creating
8	Design a V-belt drive and calculate the actual belt tension and average stress for the following data. Driven pulley diameter = 500 mm, driver pulley diameter, d=150 mm, center distance C=925 mm, speed N ₁ = 1000 rpm, N ₂ = 300 rpm and power, P = 7.5kW.	BT-6	Creating

9	A centrifugal pump running at 340rpm is to be driven by a 100kW motor running at 1440rpm. The drive is to work for at least 20 hours every day. The centre distance between the motor shaft and the pump shaft is 2000mm. Suggest a suitable multiple V-belt drive for this application. Also calculate the actual belt tensions and stress induced.	BT-5	Evaluate
10	A compressor is to run by a motor pulley running at 1440 rpm, speed ratio is 2.5. Choose a flat belt crossed drive. Centre distances between pulley is 3.6m take belt speed as 16m/s. Load factor is 1.3 and take 5 ply of flat belt. Power to be transmitted to be 12 kW. High speed load rating is 0.0118kW/Ply/mm width at V=5 m/s .Determine the width and length of the belt.	BT-5	Evaluate
11	A truck equipped with 9.5 kW engine uses a roller chain of the final drive to the rear axle. The driving sprocket runs at 900 rpm and driven sprocket at 400 rpm with a center distance of approximately 600 mm. select a suitable the roller chain.	BT-6	Creating
12	A roller chain drive is used between a driver shaft running at 1440 rpm and a driven shaft running approximately at 720rpm. The power transmitted is 15kW. The drive is to be used for 2 shift /day with 8 hours /shift. The center distance is approximately 1000 mm and the chain tension can be adjusted by moving the motor in the rails. Design the drive.	BT-6	Creating
13	A work shop crank carries a load of 30 kN using wire ropes and a hook. The hook weighs 15 kN. Diameter of the rope drum is 30 times the diameter of the rope. The load is lifted with an acceleration of 1m/s^2 . Find the diameter of the rope. $FS = 6$, $E_r = 80\text{ kN/mm}^2$, $\sigma_u = 180\text{ kN/mm}^2$, cross section of the rope = $0.4 \times (\text{Diameter of the rope})^2$. Design wire rope with suitable assumption.	BT-6	Creating
14	At the construction site, 1 ton of steel is to be lifted up to a height of 20 m with the help of 2 wire ropes of 6x 19 size, nominal diameter 12 mm and breaking load 78 kN. Determine the factor of safety if the sheave diameter is 56d and if wire rope is suddenly stopped in one second when travelling at a speed of 1.2 m/s. What is the factor of safety if bending load is neglected?	BT-5	Evaluate

15	Design a rubber belt to drive a dynamo generating 20 kW at 2250 r.p.m. and fitted with a pulley 200 mm diameter. Assume dynamo efficiency to be 85%. Allowable stress for belt = 2.1 MPa; Density of rubber = 1000 kg / m ³ ; Angle of contact for dynamo pulley = 165°; Coefficient of friction between belt and pulley = 0.3	BT-5	Evaluate
16	In a horizontal belt drive for a centrifugal blower, the blower is belt driven at 600 r.p.m. by a 15 kW, 1750 r.p.m. electric motor. The centre distance is twice the diameter of the larger pulley. The density of the belt material = 1500 kg/m ³ ; maximum allowable stress = 4 MPa; $\mu_1 = 0.5$ (motor pulley); $\mu_2 = 0.4$ (blower pulley); peripheral velocity of the belt = 20 m/s. Determine the following: 1. Pulley diameters; 2. belt length; 3. cross-sectional area of the belt; 4. minimum initial tension for operation without slip; and 5. resultant force in the plane of the blower when operating with an initial tension 50 per cent greater than the minimum value.	BT-6	Creating
17	A V-belt is driven on a flat pulley and a V-pulley. The drive transmits 20 kW from a 250 mm diameter V-pulley operating at 1800 r.p.m. to a 900 mm diameter flat pulley. The centre distance is 1 m, the angle of groove 40° and $\mu = 0.2$. If density of belting is 1110 kg /m ³ and allowable stress is 2.1 MPa for belt material, what will be the number of belts required if C-size V-belts having 230 mm ² cross-sectional area are used.	BT-5	Evaluate
18	Design a chain drive to actuate a compressor from a 10 kW electric motor at 960 r.p.m. The compressor speed is to be 350 r.p.m. Minimum centre distance should be 0.5m. Motor is mounted on an auxiliary bed compressor is to work for 8 hours/ day.	BT-5	Evaluate

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

Gear materials - Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength, and wear considerations. Force analysis – Tooth stresses – Dynamic effects - Helical gears – Module - normal and transverse, Equivalent number of teeth – forces.

PART-A (2 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	Define gear and state its primary function in power transmission.	BT-1	Remembering
2	List any two materials commonly used for spur gears.	BT-1	Remembering
3	What is meant by pitch circle in gears?	BT-1	Remembering
4	Define module of a gear.	BT-1	Remembering
5	State the law of gearing.	BT-2	Understanding
6	What is meant by pressure angle?	BT-1	Remembering
7	Define addendum and dedendum.	BT-1	Remembering
8	What is backlash in gears?	BT-1	Remembering
9	List any two causes of gear tooth failure.	BT-1	Remembering
10	What is meant by wear failure in gears?	BT-2	Understanding
11	Define velocity ratio of a gear drive.	BT-1	Remembering
12	What is Lewis equation used for in gear design?	BT-2	Understanding
13	What is meant by dynamic load in gears?	BT-2	Understanding
14	List the forces acting on a spur gear tooth.	BT-1	Remembering
15	What is meant by fatigue strength of gear tooth?	BT-2	Understanding
16	Define factor of safety in gear design.	BT-1	Remembering
17	What is helix angle in helical gears?	BT-1	Remembering
18	State any two advantages of helical gears over spur gears.	BT-2	Understanding
19	What is normal module in helical gears?	BT-1	Remembering
20	Define transverse module in helical gears.	BT-1	Remembering
21	What is meant by equivalent (virtual) number of teeth in helical gears?	BT-2	Understanding
22	Why helical gears generate axial thrust?	BT-4	Analysing
23	List the forces acting on a helical gear tooth.	BT-2	Understanding
24	What is the effect of increasing helix angle on gear performance?	BT-4	Analysing
25	Why helical gears are preferred for high-speed applications?	BT-4	Analysing

PART-B (16 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	Design a pair of straight spur gear drive for a stone crusher, the gears are made of C40 steel. The pinion is to transmit 30 kW at 1200 rpm. The gear ratio is 3. The gear is to work 8 hours/day 6days in a week for 3 years.	BT-6	Creating
2	Design a spur gear pair to transmit 22.5 kW at 900 rpm. Speed reduction ratio is 2.5. Material for pinion and wheel are C15 steel and cast iron grade 30 respectively. Take pressure angle 20 degree and working life of gear is 10,000 hours.	BT-6	Creating
3	Design a spur gear drive required to transmit 45 kW at pinion speed of 800 rpm. The velocity ratio is 3.5:1. The teeth are 20° full depths involute with 18 teeth on the pinion. Both the pinion and gear are made of steel with a safe static stress of 180 N/mm ² . Assume medium shock condition.	BT-6	Creating
4	Design a straight spur gear drive to transmit 8 kW. The pinion speed is 720 rpm and the speed ratio is 2. Both the gears are made of the same surface hardened carbon steel with 55RC and core hardness less than 350BHN. Ultimate strength is 720 N/mm ² and yield strength is 360 N/mm ² .	BT-6	Creating
5	Design a spur gear to transmit 2 kW at 1440 rpm. Desired speed ratio is 3. Use C45 steel for gears.	BT-6	Creating
6	A 37.5 kW power is transmitted at 450 rpm to a shaft running at approximately 112 rpm through a spur gear drive. The load is steady and continuous. Design the gear drive and check the design. Assume the following materials: Pinion-heat treated cast steel; Gear-High grade cast iron.	BT-6	Creating
7	Design a spur gear drive for a heavy machine tool with moderate shocks. The pinion is transmitting 18 kW at 1200 rpm with a gear ratio of 3.5. Design the drive and check for elastic stress and plastic deformation. Make a sketch and label important dimensions arrived.	BT-6	Creating

8	A motor shaft rotating at 1500 rpm has to transmit 15kW to the shaft with a speed reduction of 3:1. The teeth are 20° involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 N/mm ² . A safe stress of 40 N/mm ² may be taken for the shaft on which the gear is mounted and also for the key. Design a spur gear drive and assume starting torque to be 25% higher than the running torque.	BT-6	Creating
9	Design a helical gear to transmit 15 kW at 1440 rpm to the following specification. Speed reduction is 3, Pressure angle is 20 degree and helix angle is 15 degrees. The material for both the gears is C45 steel. Allowable static stress is 180 N/mm ² , Surface endurance limit is 800 N/mm ² and Young's Modulus of material is 2 x 10 ⁵ N/mm ² .	BT-6	Creating
10	Design a helical gear for the following specification: Power 12.5kW, Pinion speed-1200 rpm, Gear Ratio - 3.5, Pressure angle is 20 degrees, helix angle is 15 degrees. Gear is expected to work 6hours/day for 10 years.	BT-6	Creating
11	A helical gear with 30 ° helix angle has to transmit 35kW at 1500 rpm with a speed reduction ratio 2.5. If the pinion has 24 teeth determine the necessary module, pitch diameter and face width for 20-degree full depth teeth. Assume 15Ni 2Cr 1 Mo15 material for both pinion and wheel.	BT-5	Evaluate
12	A helical gear speed up drive is required to drive a centrifugal compressor running at 3000 rpm. The helical gear speed up unit is driven by an electric motor running at 1000rpm. The compressor requires a nominal input power of 12.5 kW. The helix angle of 25° may be assumed for the gears. Standard involute profile 20° full depth system will be used for the gear teeth. The gear pair is required to last for at least 10,000 hrs. Design the gear drive for the following materials. Pinion: Heat treated cast steel, Gear: High Grade cast iron.	BT-5	Evaluate

13	Design a pair of helical gears to transmit 37.5kW at 1750 rpm of the pinion. The drive is subjected to heavy shock loading. The speed reduction ratio is 4 and the helix angle is 15 degrees. Select suitable material and design the gears. Check for working stresses and sketch the drive.	BT-6	Creating
14	Design a helical gear drive to transmit the power of 14.7kW. Speed ratio is 6, pinion speed is 1200 rpm and helix angle is 25°. Select suitable materials and design the gear.	BT-6	Creating
15	A speed reducing unit using spur gear is to be designed power to be transmitted is 60HP and is continuous with moderate shock loads. The speed of the shafts are 720 r.p.m. and 144 r.p.m. The centre distance is kept as small as possible. Select a suitable material and design the gears. Give the details of gears.	BT-6	Creating
16	Design a spur gear drive to transmitted 22 kW at 900 r.p.m. speed reduction is 2.5 material for pinion and wheel are C15 steel and cast iron grade 30. Take pressure angle of 20° and working life of the gears as 10000 hours.	BT-6	Creating
17	A pair of helical gears is to be designed to transmit 30 kW at a pinion speed of 1500 r.p.m. The velocity ratio is 3. Selecting suitable materials, determine the dimension of the gears.	BT-6	Creating
18	Deign a helical gear drive to transmit the power of 20 HP. Speed ratio 6, pinion speed 1200 rpm, helix angle is 25°. Select suitable materials and design the gears.	BT-6	Creating

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS

Straight bevel gear: Gear materials - Tooth terminology, tooth forces, and stresses, equivalent number of teeth, estimation of dimensions of straight bevel gears. Worm Gear: Gear materials - Tooth terminology Thermal capacity, forces and stresses, efficiency, estimation of dimensions of worm gear pair .

PART-A (2 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	Under what conditions are straight bevel gears used?	BT-2	Understanding
2	List any two materials used for bevel gears.	BT-1	Remembering
3	Define pitch cone angle in bevel gears.	BT-1	Remembering
4	What is meant by cone distance in bevel gears?	BT-1	Remembering
5	Define equivalent (virtual) number of teeth for bevel gears.	BT-1	Remembering
6	Why equivalent number of teeth is used in bevel gear design?	BT-2	Understanding
7	List the forces acting on a bevel gear tooth.	BT-2	Understanding
8	What is meant by tooth load in bevel gears?	BT-1	Remembering
9	Define bending stress in bevel gear tooth.	BT-2	Understanding
10	What is wear failure in bevel gears?	BT-2	Understanding
11	What is face width of a bevel gear?	BT-1	Remembering
12	List any two limitations of bevel gear drives.	BT-1	Remembering
13	Define worm and worm wheel.	BT-1	Remembering
14	List any two materials used for worm and worm wheel.	BT-1	Remembering
15	What is lead angle of a worm?	BT-1	Remembering
16	State the condition for self-locking in worm gear drive.	BT-2	Understanding
17	Why efficiency of worm gear drive is low compared to other gears?	BT-4	Analysing
18	Define thermal capacity of a worm gear drive.	BT-2	Understanding
19	What is meant by heat generated in worm gear drives?	BT-2	Understanding
20	List the forces acting on worm gear tooth.	BT-2	Understanding
21	What is meant by axial thrust in worm gears?	BT-1	Remembering
22	Define efficiency of worm gear drive.	BT-1	Remembering
23	What factors affect the efficiency of worm gear drives?	BT-2	Understanding
24	Why worm is usually made of harder material than worm wheel?	BT-4	Analysing
25	State any two applications of worm gear drives.	BT-1	Remembering

PART-B (16 Marks)			
Q.No	QUESTIONS	BT Level	Competence
1	Design a pair of bevel gears to transmit 10 kW at 1440 rpm of the pinion. The velocity ratio should be about 4. Material for gear is 15Ni2Cr1Mo15 Steel. The tooth profiles of the gears are of 20° composite form.	BT-6	Creating
2	Design a cast iron bevel gear drive for a pillar drilling machine to transmit 1875 Watts at 800 rpm to a spindle at 400 rpm. The gear is to work for 40 hrs /week for 3 years. Pressure angle is 20°.	BT-6	Creating
3	Design a Bevel gear drive to transmit 4 kW. Speed ratio = 4. Driving shaft speed 225 rpm. The drive is non-reversible. Assume a life of 25000 hours.	BT-6	Creating
4	A Pair of bevel gears is to be used to transmit 14 kW from a pinion rotating at 400 rpm to a gear mounted on shaft which is running at 200 rpm. The axes of the two shafts are at 90°. Design the pair of bevel gears.	BT-5	Evaluate
5	Design a pair of bevel gears for two shafts whose axes are at right angle to transmit 10 kW at 1440 rpm. The speed of the gear is 720 rpm. Use Lewis and Buckingham's equation.	BT-6	Creating
6	Design a straight bevel gear drive between two shafts connected at right angles to each other. Speed of the pinion shaft is 360 rpm and the speed of gear wheel shaft is 120 rpm. Pinion is made of steel and wheel is made of cast iron. Each gear is expected to work 2 hrs /day for 10 years.	BT-6	Creating
7	A hardened steel worm rotates at 1440 rpm and transmits 12 kW to a phosphor bronze gear. The speed of the worm wheel should be $60 \pm 3\%$ rpm. Design the worm gear drive if an efficiency of at least 82% is desired.	BT-6	Creating
8	A steel worm running at 240 rpm receives 1.5 kW from its shaft. The speed reduction is 10:1. Design the drive so as to have an efficiency of 80%. Also determine the cooling area required, if the temperature rise is restricted to 450° C. Take overall heat transfer coefficient as 10 W/m ² C.	BT-5	Evaluate
9	Design the worm gear drive and determine the power loss by heat generation of Hardened steel worm rotates at 1440 rpm and transmits 12 kW to a phosphor bronze gear with gear ratio of 16.	BT-6	Creating

10	A hardened steel WORM rotates at 1260 rpm and transmits 8 kW to a phosphor bronze gear with gear ratio of 18. Design the worm gear drive and determine the power loss by heat generation.	BT-6	Creating
11	Design a worm gear drive to transmit 22.5kW at a worm speed of 1440 rpm. Velocity ratio is 24:1. An efficiency of at least 85% is desired. The temperature raise should be restricted to 40°C. Determine the required cooling area.	BT-6	Creating
12	Design a bevel gear drive, to transmit 10 kW power at 1440 rpm. Gear ratio is 3, and life of gears 10,000 hrs. Pinion and gear are made of C45 steel and minimum number of teeth as 20.	BT-6	Creating
13	A hardened steel work rotates at 1600 rpm and transmits 15 kW phosphor bronze gear. The speed of the worm wheel should be $65 \pm 2\%$ rpm. Design a worm gear drive if an efficiency of at least 82% is desired.	BT-6	Creating
14	Design a worm gear drive to transmit 22.5 kW at a worm speed of 1440 rpm. Velocity ratio is 24:1. An efficiency of at least 85% is desired. The temperature raise should be restricted to 40°C. Determine the required cooling area.	BT-5	Evaluating
15	Design worm and gear speed reducer to transmit 22 kW at a speed of 1400 r.p.m. The desired velocity ratio is 24:1. An efficiency of atleast 85% is desired. Assume that the worm is made of hardened steel and the gear of phosphor bronze. Take the center distance as 100 mm.	BT-5	Evaluating
16	A pair of cast iron bevel gears connected two shafts at right angles. The pitch diameters of the pinion and gear are 80mm and 100mm respectively. The tooth profile of the gears is of $14\frac{1}{2}^\circ$ and composite form. The allowable static stress for both gears is 55 Mpa. If the pinion transmits 2.75Kw at 1100 r.p.m. find the module and number of teeth on such gears and check the design. Take surface endurance limit as check the design. Take surface endurance limit as 630 Mpa and modulus of elasticity for cast iron as 84 kN/mm ² .	BT-5	Evaluating

17	A pair of bevel gears is to be used to transmit 12kW from a pinion rotation at 360 r.p.m. to a gear mounted on a shaft which intersects the pinion shaft at an angle of 70° . Assuming that the pinion is to have an outside pitch diameter of 200mm, a pressures angle of 20° , a face width of 40 mm and the gear shaft is to rotate at 120 r.p.m. determine (i) the pitch angle for the gears and (ii) the forces on the gears.	BT-5	Evaluating
18	Design a worm gear drive to transmit 22.5 Kw at a worm speed of 1440 r.p.m. velocity ration is 24:1. An efficiency of atleast 85% is desired. The temperature rise should be restricted to 40°C . Determine the required cooling area.	BT-5	Evaluating



UNIT IV GEAR BOXES

Need - Design of sliding and constant mesh gearboxes: Speed selection - Geometric progression - Standard step ratio - Ray diagram, kinematic layout – Determination of a number of teeth. Design of multi-speed gearbox for machine tool applications, Variable speed gearbox, Fluid Couplings, and Torque Converters for automotive applications.

PART-A (2 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	State the need for a gear box in machine tools.	BT-1	Remembering
2	What is meant by speed range of a gear box?	BT-1	Remembering
3	Define step ratio in a gear box.	BT-2	Understanding
4	What is geometric progression in speed selection?	BT-2	Understanding
5	Why are machine tool speeds arranged in geometric series?	BT-4	Analysing
6	Define standard step ratio.	BT-1	Remembering
7	List any two advantages of constant mesh gear box.	BT-2	Understanding
8	Distinguish between sliding mesh and constant mesh gear box.	BT-2	Understanding
9	What is a ray diagram?	BT-1	Remembering
10	State the purpose of ray diagram in gear box design.	BT-2	Understanding
11	What is meant by kinematic layout of a gear box?	BT-2	Understanding
12	List the basic rules to be followed while designing a gear box.	BT-1	Remembering
13	Define structural formula of a gear box.	BT-1	Remembering
14	What factors influence the determination of number of teeth in gears?	BT-2	Understanding
15	What is meant by multi-speed gear box?	BT-1	Remembering
16	State any two applications of multi-speed gear boxes.	BT-1	Remembering
17	What is a variable speed gear box?	BT-2	Understanding
18	List any two advantages of variable speed gear box.	BT-2	Understanding
19	Define fluid coupling.	BT-1	Remembering
20	State the principle of operation of a fluid coupling.	BT-2	Understanding
21	List any two advantages of fluid coupling.	BT-1	Remembering
22	Define torque converter.	BT-1	Remembering
23	How does a torque converter differ from a fluid coupling?	BT-4	Analysing

24	List any two applications of torque converters in automobiles.	BT-1	Remembering
25	Why torque converters are preferred in automatic transmission systems?	BT-4	Analysing
PART-B (16 Marks)			
Q.No	QUESTIONS	BT Level	Competence
1	Design the six speed gear box is to provide the speeds in the range of 160 to 500 rpm and transmit a power of 5 kW at 710 rpm. Draw the speed diagram and kinematics diagram. Determine the number of teeth module and face width of all gears, assuming suitable Materials for the gears.	BT-6	Creating
2	Design a 9 speed gear box for the following data. Minimum speed: 180 rpm, Maximum speed: 1800 rpm. Using standard step ratio, draw the speed diagram, kinematic layout. Also find the number of teeth on each gear.	BT-6	Creating
3	Design a nine speed gear box for a machine to provide speeds ranging from 100 to 1500 rpm. The input is from a motor of 5 kW at 1440 rpm. Assume any alloy steel for the gear.	BT-6	Creating
4	Design 12 speed gear box for a minimum speed of 160 rpm and a maximum speed of 2000 rpm. The input speed of motor is 1600rpm. Draw the speed diagram, kinematic diagram and indicate the number of teeth on each gear.	BT-6	Creating
5	Design the layout of a 12 speed gear box for a milling machine having an output of speeds ranging from 100 to 1200 rpm. Power is applied to the gear box from a 5 kW induction motor at 1440 rpm. Choose standard step ratio and construct the speed diagram. Decide up on the various reduction ratios and number of teeth on each gear wheel sketch the arrangement of the gear box.	BT-6	Creating
6	Design the headstock gear box of a lathe having nine spindle speeds ranging from 50 to 1500 rpm. The power of the machine may be taken as 6 kW and speed of the motor is 1450 rpm. Minimum number of teeth on the gear is to be 2x3. (a) Draw the speed diagram (b) Sketch the layout of the gear box. (c) Calculate the number of teeth on all gears.	BT-6	Creating

7	Illustrate the ray diagram and kinematic lay out of a gear box for an all geared head stock of a lathe. The maximum and minimum speeds are to be 2800 and 63 rpm respectively. The number of steps is 12 and drive is from a 3 kW electric motor running at 1440rpm.	BT-5	Evaluating
8	Select speeds for an 18 speeds Gear box for a minimum speed of 35 rpm and maximum speed 650 rpm. Draw speed diagram and a kinematic arrangement of the gear box showing the number of teeth in all the gears.	BT-6	Creating
9	The spindle of a pillar drill is to run at 12 different speeds in the range of 100 rpm and 355 rpm. Design a three stage gear box with a standard step ratio. The gear box receives 5kW from an electric motor running at 360 rpm. Sketch the layout of the gear box, indicating the number of teeth on each gear. Also sketch the speed diagram.	BT-6	Creating
10	Design a 16 speed gear box for the following data. Minimum speed: 100 rpm, step ratio is 1.25. The input is from a 5 kW, 1000rpm motor. Draw the speed diagram, kinematic diagram and indicate the number of teeth on each gear.	BT-6	Creating
11	A 16 speed gear box is required to furnish output speeds in the range of 100 to 560 rpm. Sketch the kinematic arrangement and draw the speed diagram.	BT-6	Creating
12	The range of maximum and minimum speeds of nine speed box are to be 600 rpm and 100 rpm respectively. The drive is from an electric motor giving 3kW at 1440rpm. Design the gear box. Construct the speed diagram and sketch the arrangement of gear box.	BT-6	Creating
13	Design a six speed gear box for a machine to provide speeds ranging from 100 rpm to 560 rpm. The input shaft speed is 560rpm. The intermediate shaft to have three speeds. Assume any alloy steel for the gears.	BT-6	Creating
14	Draw the ray diagram and kinematic lay out of a gear box for an all geared head stock of a lathe. The maximum and minimum speeds are to be 600 rpm and 23 rpm respectively. Number of step is 12 and drive is from a 3000 W electric motor running at 1440 rpm.	BT-6	Creating
15	Write down all the possible structural formula for 6,8,9,12,14,15,16 & 18 speed gear box.	BT-2	Understanding
16	Explain in detail the selection of standard speeds from preferred numbers using step ratio with suitable examples.	BT-2	Understanding

17	A nine speed gear box used as a head stock gear box of a turret lathe, is to provide a speed range of 180 r.p.m. Using standard steep ratio, draw the speed diagram and the kinematic layout. Also find and fix the number of teeth on all gears.	BT-6	Creating
18	Design a 12 speed gear box for an all geared heat stock of a lathe. Maximum and minimum speeds are 600 r.p.m. and 25 r.p.m. respectively. The drive is from an electric motor giving 2.25kW at 1440 r.p.m.	BT-6	Creating

UNIT V - CLUTCHES AND BRAKES

Design of single and multi-plate clutches, cone clutches, internal expanding rim clutches, and Electromagnetic clutches. Design of brakes: External shoe brakes - Single and Double Shoe, Internal expanding shoe brakes, and Band brakes.

PART-A (2 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	Define clutch and state its primary function in a transmission system.	BT-1	Remembering
2	What are the main requirements of a good clutch?	BT-1	Remembering
3	List any two materials used for clutch friction linings.	BT-1	Remembering
4	Distinguish between single plate and multi-plate clutches.	BT-2	Understanding
5	Why are multi-plate clutches preferred in limited space applications?	BT-2	Understanding
6	Define torque transmitting capacity of a clutch.	BT-1	Remembering
7	State the condition for uniform wear in a clutch.	BT-1	Remembering
8	State the condition for uniform pressure in a clutch.	BT-1	Remembering
9	Write the expression for torque transmitted by a single plate clutch under uniform wear theory.	BT-2	Understanding
10	What is a cone clutch? Mention one advantage and one disadvantage.	BT-2	Understanding
11	Define cone angle in a cone clutch.	BT-1	Remembering
12	Why are cone clutches not preferred in heavy-duty applications?	BT-2	Understanding
13	What is an internal expanding rim clutch?	BT-1	Remembering
14	Mention two applications of internal expanding rim clutches.	BT-1	Remembering
15	Define electromagnetic clutch.	BT-1	Remembering
16	State the principle of operation of an electromagnetic clutch.	BT-2	Understanding
17	List any two advantages of electromagnetic clutches over mechanical clutches.	BT-2	Understanding

18	Define brake and state its function.	BT-1	Remembering
19	What is meant by braking torque?	BT-1	Remembering
20	Differentiate between clutch and brake.	BT-2	Understanding
21	What is an external shoe brake?	BT-1	Remembering
22	Distinguish between single shoe brake and double shoe brake.	BT-2	Understanding
23	What is an internal expanding shoe brake?	BT-1	Remembering
24	Define band brake and mention one application.	BT-1	Remembering
25	What is self-energizing brake?	BT-2	Understanding

PART-B (16 Marks)

Q.No	QUESTIONS	BT Level	Competence
1	A single plate sketch, effective on both sides, is required to transmit 25kW at 3000 rpm. Determine the outer and inner diameter of frictional surfaces if the coefficient of friction is 0.25, ratio of diameter is 1.25 and the maximum pressure is not to exceed the value of 0.1 N/mm ² . Determine (i) the face width required and (ii) the axial spring force necessary to engage the clutch.	BT-5	Evaluate
2	A plate clutch with maximum diameter 60mm has maximum lining pressure of 0.35 MPa. The power to be transmitted at 400 rpm is 135 kW and $\mu = 0.3$. Find inside diameter and spring force required to engage the clutch. Springs with spring index 6 and material spring steel with safe shear stress 600 MPa are used. Find the diameters if 6 spring are used.	BT-5	Evaluate
3	A multi disk clutch consists of five steel plates and four bronze plates. The inner and outer diameters of friction disks are 75mm and 150mm respectively. The coefficient of friction is 0.1 and the intensity of pressure is limited to 0.3. N/mm ² . Assuming the uniform wear theory, calculate (i) The required operating force, and (ii) Power transmitting capacity at 750 rpm.	BT-5	Evaluate
4	A plate clutch has 3 discs on the driving shaft and 2 discs on the drive shaft, providing 4 pairs of contact surfaces. The outer diameter of contact surface is 240mm and inner diameter is 120mm. Assuming uniform pressure and $\mu = 0.3$, find the total spring load for pressing the plates together to transmit 25kW at 1575 rpm. If there are 6 springs each of stiffness 13kN/m and each of contact surfaces have worn away by 1.25mm, find the power that can be transmitted, assuming uniform wear.	BT-5	Evaluate

5	A multi disc wet clutch is to be designed for a machine tool driven by an electric motor of 12.5 kW running at 1440 rpm. Space restrictions limit the outside disc diameter to 100mm. Determine the appropriate value of inside diameter, total number of discs and clamping force.	BT-5	Evaluate
6	An engine developing 45kW at 1000 rpm is fitted with a cone clutch built inside the fly wheel. The cone has a face angle of 12.5 degree and a maximum mean diameter of 500 mm. The coefficient of friction is 0.2. The normal pressure on the clutch face is not exceeded 0.1N/mm ² . Determine (i) The face width required (ii) the axial spring force necessary to engage the clutch.	BT-5	Evaluate
7	A single block brake, the diameter of drum is 250mm and the angle of contact is 90 degrees, the operating force of 700N is applied at the end of lever which is at 250mm from the center of the brake block. Determine the torque that may be transmitted. Fulcrum is at 200mm from the center of brake block with an offset of 50mm from the surface of contact. The coefficient of friction is 0.35.	BT-5	Evaluate



10	An internal expanding shoe brake has the following dimensions: Diameter of the drum = 300 mm, distance between the fulcrum centers is 80 mm, distance of fulcrum centers and that of cam axis, both from the drum center=100 mm, distance of the line of action of braking force from the cam axis = 90 mm, distance between the points where the cam acts on the two brake shoes = 30 mm. Each shoe subtends an angle of 90° at the drum Centre. If the braking force is 750 N and the coefficient of friction is 0.3, Find the braking torque on the drum. Assume the reaction between the brake shoes and the drum passes through the point bisects the contact angle. Also assume that forces exerted by the cam ends on the two shoes are equal.	BT-5	Evaluate
11	A power of 20 kW is to be transmitted through a cone clutch at 500 rpm. For uniform wear condition find the main dim of clutch and shaft. Also determine the axial force required to engage the clutch. Assume coefficient of friction as 0.25, the max normal pressure on the friction surface is not to exceed 0.08 MPa and take the design stress for the shaft material as 40 MPa.	BT-5	Evaluate
12	Design a differential band for a winch lifting a load of 20 kN through a steel wire rope wound around a barrel of 600 mm diameter. The brake drum, keyed to barrel shaft is 800 mm diameter and the angle of lap of the band over the drum is about 240 degree. Operating arms of the brake are 50 mm and 250 mm. The length of operating level is 1.6m.	BT-6	Creating
13	Derive the expression to determine the braking torque for an internal expanding shoe brake.	BT-2	Understanding
14	An automobile engine has an output of 80 kW at 3000 rpm. The mean diameter of the clutch is 200 mm with a permissible pressure of 0.2 N/mm ² . Friction lining is of asbestos with $\mu = 0.22$. What should be the inner diameter of the disc? Take both sides of plates with friction lining as effective. There are 8 springs and axial deflection in spring is limited to 10 mm. Given $G = 80 \text{ kN/mm}^2$. Spring index may be taken as 6.	BT-5	Evaluate

15	<p>A plate clutch having a single driving plate with contact surfaces on each side is required to transmit 110 kW at 1250 r.p.m. The outer diameter of the contact surfaces is to be 300 mm. The coefficient of friction is 0.4. (a) Assuming a uniform pressure of 0.17 N/mm²; determine the inner diameter of the friction surfaces. (b) Assuming the same dimensions and the same total axial thrust, determine the maximum torque that can be transmitted and the maximum intensity of pressure when uniform wear conditions have been reached.</p>	BT-5	Evaluate
16	<p>A single dry plate clutch is to be designed to transmit 7.5 kW at 900 r.p.m. Find :1. Diameter of the shaft, 2. Mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4, 3. Outer and inner radii of the clutch plate, and 4. Dimensions of the spring, assuming that the number of springs are 6 and spring index = 6. The allowable shear stress for the spring wire may be taken as 420 MPa.</p>	BT-5	Evaluate

17	<p>A multiple disc clutch, steel on bronze, is to transmit 4.5 kW at 750 r.p.m. The inner radius of the contact is 40 mm and outer radius of the contact is 70 mm. The clutch operates in oil with an expected coefficient of 0.1. The average allowable pressure is 0.35 N/mm². Find: 1. the total number of steel and bronze discs; 2. the actual axial force required; 3. the actual average pressure; and 4. the actual maximum pressure.</p>	BT-5	Evaluate
18	<p>A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The inside diameter of the contact surface is 120 mm. The maximum pressure between the surface is limited to 0.1 N/mm². Design the clutch for transmitting 25 kW at 1575 r.p.m. Assume uniform wear condition and coefficient of friction as 0.3.</p>	BT-5	Evaluate

