

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, November-December 2018

B. Tech in Mechanical Engineering V Semester

Roll No.....

ME507: Theory of Machines

Time: 3 hours

Max. Marks: 80

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1 Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. According to Kutzbach criterion, the mobility of a rigid body is given by the formula:
(a) $3(n+1)-2P_1-P_2$ (b) $3(n+1)+2P_1+P_2$
(c) $3(n-1)+2P_1+P_2$ (d) $3(n-1)-2P_1-P_2$
- ii. Which relation is used to denote condition for equal speeds, when driving and driven shafts are connected by Hook's joint?
(a) $\tan \theta = \pm \sqrt{\cos \alpha}$ (b) $\tan \theta = \pm \sqrt{\cot \alpha}$
(c) $\tan \theta = \pm \sqrt{\sin \alpha}$ (d) $\cot \theta = \pm \sqrt{\cos \alpha}$
- iii. Why is double Hooke's joint used?
(a) To obtain uniform velocity ratio (b) To obtain variable velocity ratio
(c) Both a. and b. (d) None of the above
- iv. A slider crank chain consists of following numbers of turning and sliding pairs
(a) 1,3 (b) 2,2
(c) 3,1 (d) 4,0
- v. The total number of instantaneous centres for a mechanism consisting of n links are
(a) $n/2$ (b) n
(c) n-1 (d) $n(n-1)/2$
- vi. The coriolis component of acceleration exists whenever a point moves along a path that has
(a) linear displacement (b) rotational motion
(c) gravitational acceleration (d) tangential acceleration
- vii. The radial distance from the top of a tooth to the bottom of a tooth in a meshing gear, is called (a) velocity of slider (b) angular velocity of the link
(c) both a and b (d) none of the above
- viii. The method of obtaining different mechanisms by fixing in turn different links in a kinematic chain, is known as

$$T_{A4} = 90 \quad T_{S4} = 41$$

If the input shaft E rotates at a uniform speed of 640 rpm, determine the speeds of the output shaft F when different gears are engaged.

Q.5A Write a short note on Hart's mechanism. 05

Q.5B The driving shaft of a Hooke's joint has a uniform speed of 280 rpm. Determine the maximum permissible angle between the axes of the shafts to permit a maximum variation in speed of the driven shaft by 8% of the mean speed. 05

Q.6 The mass of each ball of proell governor is 3 kg and the weight on the sleeve is 20 kg. Each arm is 220 mm long and the pivots of the lower and upper arm are 20 mm from the axis. For the midposition of the sleeve, the extension link of the lower arm are vertical, the height of the governor is 180 mm and the speed is 150 rpm. Determine the lengths of the extension links and the tension in the upper arms. 10

OR

Q.6 In a Hartnell governor, the lengths of the ball and sleeve arm are equal. The extreme radii of rotation of the ball are 60 mm and 80 mm and the corresponding speeds are 160 rpm and 175 rpm. Each ball has a mass of 2 kg. Find the spring stiffness and the initial compression of the spring. 10

Q.7 Two 20° involute gears having a velocity ratio of 2.5 mesh externally. The module is 4 mm and the addendum is equal to 1.23 module. The pinion rotates at 150 rpm. Find the: 10
(i) Minimum number of teeth on each wheel to avoid interference
(ii) Minimum number of pairs of teeth in contact

OR

Q.7 Derive expression for any TWO:
(i) Piston Effort (ii) Thrust Along Connecting Rod (iii) Thrust on sides of the cylinder (iv) Thrust on the bearings 10

Q.8 The number of teeth on the gear and the pinion of two spurs gears in mesh are 30 and 18 respectively. Both the gears have module of 6 mm and the pressure angle of 20° . If the pinion rotates at 400 rpm, what will be the sliding velocity, at the moment the tip of the tooth of pinion has contact with the gear flank? Take addendum equal to one module. Also find maximum velocity of sliding. 10

Q.9 Area above and below the mean mean torque line in a turning moment diagram of a multi-cylinder engine are as follows (mm^2): 10

-30, 374, -242, 300, -310, 234, -362, 251, -215

The diagram has been drawn to a scale of 1mm = 325 N-m vertically and 1 mm = 3° horizontally. The mean speed of engine is 600 rpm. If the radius of flywheel is 700 mm, determine the mass of the flywheel. The fluctuation of speed is limited to $\pm 1.8\%$ of the mean speed.