

Total No. of Questions : 7]

SEAT No. :

P2679

[Total No. of Pages : 2

M.E. (Mechanical) (CADME)
ADVANCED MACHINE DESIGN
(2012 Pattern) (502402)

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) *Answer any five questions.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Use of electronics pocket calculator is allowed.*
- 4) *Assume suitable data if necessary.*

Q1) Derive the compatibility equations in Cartesian and Polar co-ordinate system. **[10]**

Q2) a) Explain Rayleigh-Ritz method and discuss important characteristics. **[4]**

b) Explain the following theories of failures with graphical representation and applications. **[6]**

- i) Von misses
- ii) Octave

Q3) a) What is profile modification in gear's. **[3]**

b) Two 20° full depth gear of 20 and 30 teeth are to be designed on the extended centre distance system using the recommended values for clearance $f = (0.25/P_d)$. Make the calculations for $P_d = 1$. Find the following: **[7]**

- i) Values of q_1 and q_2 .
- ii) The actual angle ϕ .
- iii) The radius of actual pitch circle and centre distance.
- iv) The tooth thickness on actual pitch circle.

Q4) a) Explain the following terms in context with creep: **[4]**

- i) Estimated time to rupture.
- ii) Stress relaxation.

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- b) Following creep data at a certain temperature is known [6]

$$S_1 = 10.50 \text{ MPa} \quad \epsilon_1 = 0.012 \% \text{ per 1000 hrs}$$

$$S_2 = 14.00 \text{ MPa} \quad \epsilon_2 = 0.025 \% \text{ per 1000 hrs}$$

Determine the constants of the hyperbolic sine law and calculate the creep rates for stresses 20 MPa and 28 MPa.

- Q5)** a) What is difference between design for finite and infinite life problem. [3]

- b) The work cycle of a mechanical component subjected to completely reversed bending stresses consists of the following three elements: [7]

i) $\pm 350 \text{ N/mm}^2$ for 85% of time

ii) $\pm 400 \text{ N/mm}^2$ for 12% of time

iii) $\pm 500 \text{ N/mm}^2$ for 3% of time

The material for the component is 50C4 ($S_{ut} = 660 \text{ N/mm}^2$) and the corrected endurance limit of the component is 280 N/mm^2 . Determine the life of the component.

- Q6)** a) Explain Classical lamination theory of composite materials. [4]

- b) Consider a graphite-epoxy laminate, whose elastic constants along and perpendicular to the fibres are as follows,

$E_{xx} = 181 \text{ GPa}$; $E_{yy} = 10.3 \text{ GPa}$; $G_{xy} = 7.17 \text{ GPa}$; $\nu_{xx} = 0.28$; $\nu_{xy} = 0.01594$. Obtain the compliance coefficients appropriate to $x^1 y^1$ axes which are at [6]

i) $+ 30^\circ$ (counter-clockwise) to xy axes and

ii) $+ 9^\circ$ to xy axes.

- Q7)** a) What is Belleville spring? What are the advantages and applications of Belleville spring. [3]

- b) A disc spring is made of 3mm sheet with an outside diameter of 125mm and an inside diameter of 50mm. The spring is dished 4.5mm. The maximum stress is to be 560 N/mm^2 . Determine: [7]

i) The load that may be safely carried.

ii) The deflection at this load.

iii) Stress produced at outer edge.

