Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER – I (NEW) EXAMINATION – SUMMER 2017

Subject Code: 2710801 **Date:10/05/2017**

Subject Name: Advanced Machine Design

Time:02:30 P.M. to 05:00 P.M. **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain in detail the general guidelines for design of ergonomics and aesthetics. **07**

(b) Discuss Ashby material selection charts and factors affecting for the material selection. **07**

Q.2 **(a)** A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to **07**
1. Maximum principal stress 2. Maximum shear stress and
3. Maximum distortion strain energy theory of yielding.

(b) (i) Explain the concept of plan state of strain. **07**
(ii) Explain: Modified Coulomb-Mohr Theory

OR

(b) (i) Explain the fatigue design under combined stress. **07**
(ii) Discuss the importance of Strain Vs Life Curve in design for variable load.

Q.3 **(a)** (i) Explain the Miner's rule for cumulative damage in fatigue. **07**
(ii) Define: (i) Endurance strength (ii) Notch sensitivity

(b) A work cycle of a mechanical component is subjected to complete reversed bending stresses as follows: **07**
± 300 MPa for 30% of time,
± 275 MPa for 25% of time,
± 400 MPa for 10% of time,
± 325 MPa for 25% of time,
No load for remaining time.
The material has an ultimate tensile strength of 1200 MPa. Take surface finish factor as 0.8, size factor as 0.85, reliability factor as 0.897 for 90% reliability. The operating temperature is 400^0c and the temperature factor may be taken as 0.5. Assume the fatigue stress factor at the most stressed section as 0.7. Determine the life of the component.

OR

Q.3 **(a)** Draw and explain the rheological models for plastic deformation and their responses to different strain inputs. **07**

(b) A transmission shaft of cold drawn steel having σ_{ut}=500 N/mm^2 and σ_{yt}= 300 N/mm^2 is subjected to a fluctuating torque which varies from -100 N.m to +400 N.m. The factor of safety is 2 and the expected reliability is 90%. Neglecting the effect of stress concentrations, determine the diameter of shaft. Assume the distortion energy theory of failure. **07**

Q.4 **(a)** Explain the following terms in detail: **07**
(i) Sherby-Dorn and Larson-Miller creep parameters
(ii) Creep curves and stress relaxation

(b) A support rod of boiler carries a constant tensile stress of 68 MPa. The rod is made of medium carbon steel for which following data are available. **07**

Strain rate (hr^{-1})	Stress (MPa)	Temp (^0C)
5×10^{-3}	136	540
5×10^{-7}	41	540

Calculate the life time of the rod at 540^0C before it elongates by 10%.

OR

Q.4 **(a)** Explain the following: **07**

(i) Limitations of LEFM

(ii) Grifith theory and Stress intensity factor (SIF)

(b) A spherical pressure vessel is made of ASTM A517-F steel and operates at room temperature. The inner diameter is 1.5 m, the wall thickness is 10 mm, and maximum pressure is 6 MPa. Is the leak before break condition meet? What is the safety factor on k relative to K_{tc}, and what is the safety factor against yielding? Refer the following material properties. **07**

Material	Toughness K_{IC} MPa $\sqrt{m}$	Yield σ_o MPa	Ultimate σ_u MPa	Elong. $100\varepsilon f$	Red. Area % RA
ASTM A517-F	187	760	830	20	66

Q.5 **(a)** What are the different types of gear lubrication method? Explain the elastohydrodynamic lubrication in detail. **07**

(b) An overhead crane wheel runs slowly on a steel rail. What is the size of the contact patch between wheel and rail and what are the stresses? What is the depth of maximum shear stress? The diameter of wheel is 305 mm by 22.3 mm thick and the rail is flat. Both parts are steel. The radial load is 22.24 kN. **07**

OR

Q.5 **(a)** What is surface fatigue? Derive expression for size of contact patch and static stress distribution in spherical contact. **07**

(b) List down the various types of wear mechanisms. What are the design considerations to reduce the chances of an adhesive wear failure? **07**

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