

CSM – 54/16
Mechanical Engineering
Paper – I

Time : 3 hours

Full Marks : 300

The figures in the right-hand margin indicate marks.

*Candidates should attempt Q. No. 1 from Section – A and Q. No. 5 from Section – B which are compulsory and **three** of the remaining questions, selecting at least **one** from each Section.*

SECTION – A

1. Answer any **three** of the following questions :

[20×3 = 60]

- Explain the term instantaneous center. Explain the different types of instantaneous centers with examples.
- Explain stress strain diagrams for ductile and brittle materials.
- A close coiled helical spring is to carry a load of 5000N with a deflection of 50 mm and a maximum shearing stress of 400 N/mm^2 .

If the number of active turns or active coils is 8. Estimate following :

- (i) Wire diameter
- (ii) Mean coil diameter
- (iii) Weight of the spring

Assume $G = 83,000 \text{ N/mm}^2$; $\rho = 7700 \text{ kg/m}^3$.

- (d) Explain the three basic steps encountered during precipitation hardening. Explain why most precipitation hardening alloys are suitable for low temperature applications.
2. (a) A multi cylinder engine is to run at a speed of 600 rpm. On drawing the turning moment diagram on scale of $1\text{mm} = 250\text{N-m}$ and $1\text{mm} = 3^\circ$, the areas above and below the mean torque line in mm^2 are : +160, -172, 168, -191, 197, -162. The speed of the engine is to be kept $\pm 1\%$ of its mean speed. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of the rectangular flywheel if the breadth to thickness ratio is 2. The density of cast iron is 7250 kg/m^3 and its hoop stress

is 6MPa. Assume that the rim contribute 90% of the flywheel effect. **[30]**

- (b) In a spring controlled governor of the Hartung type, the length of the ball and sleeve arms are 70 mm and 110 mm respectively. The load travel of the sleeve is 25 mm. In the mid position each spring is compressed by 50 mm and the radius of the rotation of the mass centre is 140 mm. Each ball has a mass 4 kg and spring stiffness is 10kN/m of compression. The equivalent mass of the governor at the sleeve is 16 kg. Neglecting the moment of due to the revolving masses when the arms are inclined, determine the ratio of the range of speed to the mean speed of the governor. Find the speed in the mid position. **[30]**

3. (a) Draw the shear and bending moment diagrams for the beam shown in Fig. 1: **[30]**

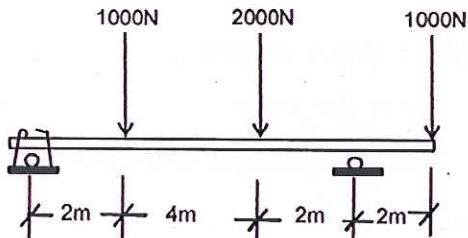


Fig. 1

- (b) Explain failure theories suitable to brittle and ductile materials. Can the failure theory adopted for ductile materials can be adopted for brittle and materials ? Justify. [30]
4. (a) Explain reasons, why carburizing heat treatment is done generally on low carbon steels. [15]
- (b) State the advantages of composite materials and their applications. [15]
- (c) Explain the processes of Carburizing and Annealing. [15]
- (d) What do you mean by Miller indices and state important features of Miller indices. [15]

SECTION – B

5. Answer any **three** of the following question :

[20×3 = 60]

- (a) Explain the gating and risering system. What are the precautions that should be taken to have optimized gating and risering system ?
- (b) What is ABC analysis ? Explain its importance in inventory control.

- (c) Briefly explain with neat sketches and their application of Jigs and Fixtures.
- (d) Explain the different data types and explain them in detail.
6. (a) Discuss the following methods of sand mould casting process : bench moulding, floor sand moulds and dry sand core moulds. **[30]**
- (b) Explain the following : **[30]**
- (i) Merchant's force diagram
 - (ii) Taylor's tool life equation
 - (iii) High energy rate forming
7. (a) What is a critical path analysis in project management ? Explain with an example. **[15]**
- (b) What is ABC analysis ? What are the basic principles adopted for material requirement planning ? **[15]**
- (c) What is standard maximization problem ? Explain with a case study. **[15]**
- (d) What is the difference between value engineering and cost reduction techniques ? Discuss the different areas of application of value engineering. **[15]**

8. (a) Explain the importance of flow chart. What are the common shapes used in flow chart ? Explain in detail. **[15]**
- (b) What are the different variables and pointers in C – language ? Explain with examples. 15
- (c) What are the different types of constants ? Explain them in detail. **[15]**
- (d) What are the common features of FORTRAN and C – languages ? Explain latest developments in C – language. **[15]**

