PART - I

Paper Code
08
Subject
Mechanical Engg. - I

350381

PART - II

Subject : Mechanical Engg. - I

350381

Paper Code:	08
Total Pages :	
Time	3 Hours
Maximum Marks :	200

TO BE FILLED BY THE CANDIDATE

Roll No. (In words)	
Name of the candidate	
Date of Birth (DD/MM/YYYY)	
Father's Name	
Signature of the candidate	
Date of Examination	

Roll No.

0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

Invigilator must check the Roll No. and Photo ID. of the candidate, then Sign. here :

TO BE FILLED BY INVIGILATOR

If candidate found using unfair means them Invigilator should fill up this bubble with black/blue ball pen & report to the Centre Superintendent:

IMPORTANT NOTES
महत्त्वपूर्ण निर्देश

(A) Please fill up the OMR Sheet of this Question-Answer Booklet properly before answering.
प्रश्नोत्तर पुस्तिका में प्रश्न हल करने से पूर्व उसके संलग्न ओ.एम.आर. पत्रक को भली प्रकार से भर लें ।

(B) The question paper is divided into different unit and parts. The number of questions to be attempted and their marks are indicated in each unit and parts.
प्रश्न-पत्र विभिन्न यूनिट एवं भागों में विभाजित है । प्रत्येक यूनिट एवं भाग में से किये जाने वाले प्रश्नों की संख्या और उनके अंक उस यूनिट एवं भाग में अंकित किये गए हैं ।

(C) Attempt answers either in **Hindi or English**, not in both. For Language Papers, answer in concerned language and script, unless directed otherwise to write in Hindi or English specifically.
उत्तर **अंग्रेजी या हिन्दी** भाषा में से किसी एक में दीजिये, दोनों में नहीं । भाषा विषयक प्रश्नों के उत्तर उनकी संबद्ध भाषा व लिपि में ही दिए जाएँ, जब तक कि प्रश्न विशेष के लिए अलग से हिंदी या अंग्रेजी में उत्तर देने के लिए न लिखा गया हो ।

(D) The candidates should not write the answers beyond the prescribed limit of words; failing this, marks will be deducted.
अभ्यर्थियों को अपने उत्तर निर्धारित शब्दों की सीमा से अधिक नहीं लिखना चाहिए । इसका उल्लंघन करने पर अंक काटे जायेंगे ।

(E) Please write answers only in the prescribed space of booklet. Do not write any mark of identity inside the Answer Script (including Paper for rough work) i.e. name, address, telephone number, Name of God etc. or any irrelevant words other than the answer of question. Such act will be treated as unfair means. The Commission may also deduct 5 marks from the marks obtained, if Roll Number is not filled correctly on the O.M.R. Sheet.
किसी भी प्रश्न का उत्तर प्रश्नोत्तर पुस्तिका में निर्धारित स्थान पर ही लिखें । प्रश्नोत्तर पुस्तिका (रफ़ कार्य के पृष्ट सहित) के अंदर कहीं पर भी अपना नाम, रोल नंबर अथवा अन्य कोई पहचान चिह्न यथा -- प्रश्नोत्तर में नाम, पता, दूरभाष नंबर, देवताओं के नाम अथवा अन्य कोई भी प्रश्नोत्तर से असम्बंधित शब्द, वाक्य एवं अंक आदि न लिखें । ऐसा करने पर आयोग द्वारा इसे अनुचित साधन अपनाने का कृत्य माना जायेगा । ओ.एम.आर. पत्रक पर रोल नम्बर का त्रुटिपूर्ण अंकन करने पर आयोग द्वारा उसके प्राप्तांकों में से 5 अंक भी काटे जा सकते हैं ।

(F) Candidates are directed that they should not write (answer) out side the border line in every page. Answer written out side the border line will not be checked by the Examiner.
अभ्यर्थियों को निर्देशित किया जाता है कि प्रश्नोत्तर पुस्तिका में प्रत्येक पृष्ट में बनाई गई बार्डर लाईन से बाहर प्रत्युत्तर नहीं लिखें । बार्डर लाईन के बाहर लिखे गये उत्तर को परीक्षक द्वारा जाँचा नहीं जायेगा ।

(G) If there is any sort of ambiguity/mistake either of printing or factual nature then out of Hindi and English version of the question, the English version will be treated as standard.
यदि किसी प्रश्न में किसी प्रकार की कोई मुद्रण या तथ्यात्मक प्रकार की त्रुटि हो तो प्रश्न के हिन्दी तथा अंग्रेजी रूपान्तरों में से अंग्रेजी रूपान्तर मान्य होगा ।

(H) It should be ensured that the Question-Answer Booklet is provided in a sealed envelope to the candidate.
अभ्यर्थी यह सुनिश्चित कर लें कि अभ्यर्थी को प्रश्नोत्तर पुस्तिका सीलबंद लिफाफे में प्रदान की गई है ।

(I) Candidate should fill up all desired details on this attached OMR sheet of Question-Answer Booklet with **blue** ball point pen. Please ensure that this OMR Sheet is not torn or damaged.
अभ्यर्थी प्रश्नोत्तर पुस्तिका के ऊपर संलग्न इस ओ.एम.आर. पत्रक पर सभी वांछित विवरण **नीले** बॉल पेन से सावधानीपूर्वक भरें । ध्यान रखें कि यह ओ.एम.आर. पत्रक कहीं से कटे-फ़टे नहीं अथवा किसी भी प्रकार से क्षतिग्रस्त नहीं हो ।

(J) This **OMR** Sheet consists of **Two** parts, in which some information is pre-printed; remaining details have to be filled by the candidate.
यह **ओ.एम.आर.** पत्रक **दो** भागों में बंटा है, जिसमें कतिपय सूचनाएँ पूर्वमुद्रित हैं । शेष की पूर्ति अभ्यर्थी को करनी है ।

(K) If the Question-Answer Booklet is torn or not printed properly, bring it to notice of invigilator and change the Question-Answer booklet, otherwise the candidate will be liable for that.
यदि प्रश्नोत्तर पुस्तिका कहीं से कटी-फटी या अमुद्रित है, तो अभिजागर के ध्यान में ला दें तथा उसे बदलवा ले, अन्यथा उसका दायित्व अभ्यर्थी का होगा ।

विशेष नोट :

अभ्यर्थी द्वारा यदि ओ.एम.आर. पत्रक पर गलत सूचना भरी जाती है या उसे किसी प्रकार की क्षति पहुँचाई जाती है अथवा उस पर किसी प्रकार का पहचान चिह्न अंकित किया जाता है, तो आयोग द्वारा संपूर्ण परीक्षा हेतु अभ्यर्थिता निरस्त की जा सकेगी और उसके लिए अभ्यर्थी उत्तरदायी होगा ।

Special Notes :

If there is any wrong information filled by the candidate or any attempt is made to damage it or any marking as identification is done, then his candidature for the entire examination shall be rejected by the commission, for which he will be liable.

SPACE FOR ROUGH WORK

Paper – I
MECHANICAL ENGINEERING – I

(Total 200 Marks)
(Total 37 Question)

PART – 1

Note : Attempt all **twenty** questions. Each question carries **2** marks. Answer should not exceed **15** words.

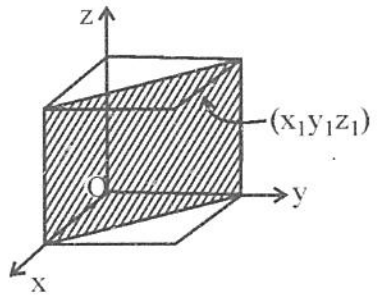
Very Short Answer Questions **2 Marks Each**

1. Which heuristic scheduling rule minimizes flow time and average number of jobs in a system ?

2. What is the 'systems principle' of material handling ?

3. What is the use of Berger's Vector in edge dislocation ?

4. Miller indices (x, y, z) for the hatched plane in the unit cell given in fig. below, are represented as



5. Which is more stable, the pearlitic or the spheroiditic microstructure ? Justify.

6. Illustrate the three stages of creep failure.

7. Give the expression for the extreme values of bending moment for a cantilever of length *l* that carries a uniformly distributed load with intensity of W/length.

8. A short column of external diameter D and internal diameter d carries an eccentric load W. Give the expression for the greatest eccentricity which the load can result on column without producing tension on its cross-section.

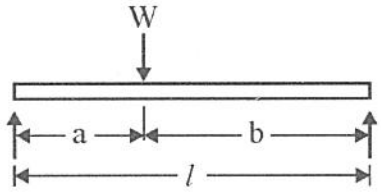
9. State Hooks' law and give the expression of Young's modulus from it.

10. Define the fundamental deviation in Limits, Fits and Gauges.

11. A leadscrew with a 7.5 mm pitch drives a worktable in an NC positioning system. The leadscrew is powered by a stepping motor which has 200 step angles. The worktable is programmed to move a distance of 120 mm from its present position at a travel speed of 300 mm/min. Determine the number of pulses required to move the table to the specified distance.

12. Give the expression of permeability number of sand along with notations used.

13. Give the expression for deflection (δ) at the point load for the beam shown in the following figure.



14. What is a Globoidal Cam ?

15. In a closed coil springs of radius R, wire radius r and length L, the ratio of strain energy due to transverse shear to strain energy due to torsion will be proportional to ?

16. A car is moving on a curved horizontal road of radius 100 m with a speed of 20 m/s. The rotating masses of the engine have an angular speed of 100 rad/s in clockwise direction when viewed from the front of the car. The combined moment of inertia of the rotating masses is 10 kg-m^2. Calculate the magnitude of the gyroscopic moment (in N-m).

17. Define the recrystallization temperature for a metal.

18. A seamless spherical shell, 900 mm in diameter and 10 mm thick is being filled with a fluid under pressure until its volume increases by 150×10^3 mm^3. Calculate the pressure exerted by the fluid on the shell, taking modulus of elasticity for the material of the shell as 200 kN/mm^2 and Poisson's ratio as 0.3.

19. The cutter of a broaching machine is pulled by square threaded screw with mean diameter of 50 mm and 10 mm pitch. If the operating nut takes the axial load of 400 N with total torque required as 4410 N-mm, then calculate the efficiency of the screw (in %).

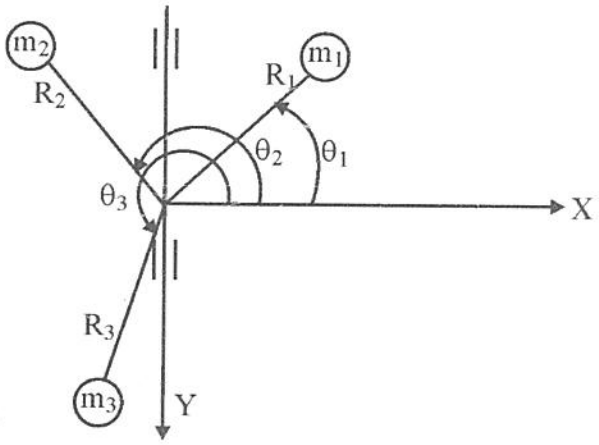
20. Explain the fly back (snap back) method of stopwatch used during work study.

PART – 2

Note : Attempt all **twelve** questions. Each question carries **5** marks. Answer should not exceed **50** words.

Short Answer Questions : **5 Marks each**

21. Figure below shows a rotor with the properties :



where $\theta_1 = 45°$, $\theta_2 = 135°$, $\theta_3 = 240°$, $m_1 = 4$ kg, $m_2 = 3$ kg, $m_3 = 2.5$ kg, $R_1 = 75$ mm, $R_2 = 85$ mm and $R_3 = 50$ mm. Determine the amount and angle of the counter mass at a radial distance of 75 mm required for the static balance.

22. What is the difference between the states of phase equilibrium and metastability ?

23. Derive the atomic packing factor for BCC and FCC crystalline materials.

24. A transmission shaft is subjected to a maximum torque of 7500 N-cm and a maximum bending moment of 12000 N-cm. The loads are suddenly applied with minor shocks having shock & fatigue factors 2.0 and 1.5 for bending and torque respectively. The allowable shear stress is 420 N/cm^2. Find the diameter of shaft.

25. Compare soldering with fusion-welding processes in terms of
    (a) preheating of workpiece
    (b) temperature requirements
    (c) strength of joint
    (d) post process mechanical properties of workpiece
    (e) post process requirements of heat treatment

26. A new medical facility is to be located in Delhi. The location factors, weights and scores (1 = poor, 5 = excellent) for two potential sites are given in the following table. Which is the best location based on total weighted scores ?

S. No.	Location Factor	Weight	Scores	
			Location 1	Location 2
1.	Facility Utilization	25	3	5
2.	Total patient km per month	25	4	3
3.	Average time per emergency trip	25	3	3
4.	Land and Construction Costs	15	1	2
5.	Employee preferences	10	5	3

27. A factory producing only one item, which it sells for ₹ 12.50 per unit, has a fixed cost of ₹ 60,000 and variable cost of ₹ 7.50 per unit. Find the number of units to be produced to earn a profit of ₹ 12000.

28. A firm buys castings of P and Q type of parts and sells them as finished product after machining, boring and polishing. The purchasing cost for castings are ₹ 3 and ₹ 4 each for parts P and Q and their selling costs are ₹ 8 and ₹ 10, respectively. The per hour capacity of machines used for the machining, boring and polishing for the two products is given below :

Capacity per hour	**Parts**	
	P	**Q**
Machining	30	50
Boring	30	45
Polishing	45	30

The running cost for the machining, boring and polishing are ₹ 30, ₹ 22.5 and ₹ 22.5 per hour, respectively. Formulate the linear programming problem to find out the product mix to maximize the profit.

29. A vibrating system consists of a mass of 50 kg; a spring of stiffness 30 kN/m and a damper. The damping provided is only 20% of the critical value. Determine : (i) the damping factor (ii) the critical damping coefficient and (iii) natural frequency of damped vibration.

30. State or mention the applications of neutral, reducing and oxidizing types of flame those are generated during oxy-acetylene gas welding.

31. A manufacturing company purchase 10000 units of a raw material for its annual requirements. The ordering cost per order is Rs. 150 and carrying cost per unit is ₹ 75 Calculate the economic ordering quantity, total annual inventory cost and the number of orders per year.

32. State the assumptions of simple bending theory for beams.

PART – 3

Note : Attempt **all** questions. Each question carries **20** marks. Answer should not exceed **200** words.

Long & Descriptive Answer Questions **20 marks each**

33. A hydraulic circuit utilizes a spherical pressure tank, which is connected to a piston-cylinder to move the piston. Pressure inside the tank is maintained at 28 N/cm^2. Assume efficiency as 100%. Determine :

(a) The thickness of the wall-plate of the tank, if diameter of tank is 80 cm. The allowable tensile strength of the steel wall-plate used is 525 N/cm^2.

(b) Assuming a pressure drop of 2.1 N/cm^2 between tank and piston-cylinder, determine the piston diameter required to produce an operating Force of 2250 N. Assume an allowance for friction in the cylinder is equal to 10 percent of the force.

(c) Determine the thickness of cylinder wall, if the safe tress is 280 N/cm^2.

34. A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2. Calculate the axial load which the spring can carry and the deflection per active turn by considering :

(a) neglecting the effect of curvature.

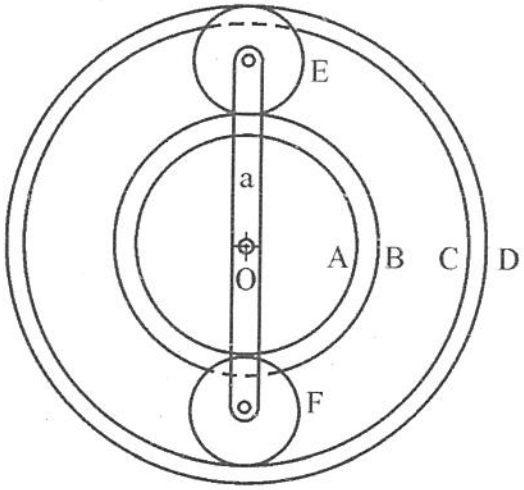
(b) the effect of curvature.

35. Explain the Ultra-Sonic Machining process. Discuss the effect of process parameters on Material Removal Rate (MRR).

36. In an epicyclic gear train the compounded wheels A and B as well as internal wheels C & D rotate independently about axis O. The wheels E and F rotate on pins fixed on arm 'a' All wheels are of same module. The number of teeth on the wheels are $T_A = 52$, $T_B = 56$, $T_E = T_F = 36$. Determine speed of C when,

(a) wheel D is fixed and arm 'a' rotates at 200 rpm clockwise.

(b) wheel D rotates at 200 rpm counter-clockwise and arm 'a' rotates at 20 rpm counter-clockwise.



37. A project consists of 7 jobs. Jobs A and F can be started and completed independently. Jobs B and C can start only after job A has been completed. Jobs D, E and G can start only after jobs B, (C and D) and (E and F) are completed, respectively. Time estimates of all the jobs are given in the following table

Job	Time Estimates (Days)		
	Optimistic	Pessimistic	Most Likely
A	3	7	5
B	7	11	9
C	4	18	14
D	4	12	8
E	4	8	6
F	5	19	12
G	2	6	4

Draw the network and determine the critical path, and its expected duration (T_e). What is the probability of completing the project in 32 days ? Also, determine the total and free slacks of all the jobs.

SPACE FOR ROUGH WORK

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