1999
MECHANICAL ENGINEERING
Paper 1

Time : 3 Hours ]
[ Maximum Marks : 300

INSTRUCTIONS

Each question is printed both in English and in Kannada.

Answers must be written in the medium specified (English or Kannada) in the Admission Ticket issued to you, which must be stated clearly on the cover of the answer book in the space provided for this purpose. No credit will be given for the answers written in a medium other than that specified in the Admission Ticket.

Candidates should attempt questions 1 and 5 which are compulsory, and any three of the remaining questions, selecting at least one question from each Section.

The number of marks carried by each question is indicated at the end of the question.

If any data is considered insufficient, assume suitable value.

Newton may be converted to kg using the equality 1 kilonewton (1 KN) = 100 kg, if found necessary.

(Turn over)
SECTION A

1. Answer any **three** of the following (Each answer should not exceed 200 words):

(a) A 300 kg crate hangs from a cable which passes over a pulley B and is attached to a support at H. The 100 kg boom AB is supported by a ball and socket at A and by two cables DE and DF. The centre of gravity of the boom is located at G. Determine (i) the tension in cables DE and DF, (ii) the reaction at A.

(b) A rod AB is held by a ball-and-socket joint at A and supports a 100 kg mass C at B. This rod is in the 2y plane and is inclined to the y axis by an angle of 15°. The rod is 16 m long and F is at its midpoint. Find the forces in cables DF and EB.
(3) AB 300 kg वजळ B अण B AB 100 kg वजळ A अण AB अण DE अण DF अण त्याच्या दुसऱ्या वजळित. (i) DE अण DF त्याच्या दुसऱ्या वजळित. (ii) A अण जीविकेंद्रिय अण AB AB 100 kg वजळ C अण CF 15° तील अण CF 15° तील अण. DF अण EB त्याच्या दुसऱ्या वजळित.
(c) The slider block B moves to the right with a constant velocity of 450 mm/s. Determine (i) the velocity of block A, (ii) the velocity of portion D of the cable, (iii) the relative velocity of A with respect to B, (iv) the relative velocity of portion C of the cable with respect to portion D.

(d) Sketch and explain the important facts of the following curves; for a typical system with forced vibration:

(i) Magnification factor Vs Frequency Ratio

(ii) Transmissibility Vs Frequency Ratio for different values of damping factor.

2. (a) A motor car weighs 1000 kg and the engine develops 40 b.h.p. at 3000 r.p.m. The efficiency of the transmission is 90% in the top gear of 5 to 1 and 80% in the second gear of 9 to 1. When the engine speed is 3200 r.p.m. (i) the car reaches its maximum speed of 100 km/hr, in top gear on a level road and (ii) the car is just capable of climbing a gradient by \( R = a + bV^2 \), where \( V \) is the speed in km/hr. Find the values of the constants \( a \) and \( b \).

(b) The exhaust valve of a diesel engine has a lift of 6.21 cm. It is operated by a cam to give cycloidal motion during the opening and closing periods, each of which corresponds to 60° of cam rotation. The follower is provided with a roller 7.5 cm diameter and its line of stroke radial. Draw the profile of the cam, if the minimum radius of the cam is 12 cm.

Determine the maximum values of the velocity and acceleration of the follower during outstroke for 2000 r.p.m.
(3) B ವಿದ್ಯುತ್ ಟ್ರಾನ್ಸ್‌ಫೊರ್‌ಮರ 450 ವಾಟ್‌ಗಳು/ಕೊಂಚಿ ಹೊಂದಿದ್ದು ಇರುತ್ತದೆ.  
(i) A ಮೇಲೆ ಇದುಗೊಂಡು, (ii) ಹದಿನಂತಹ D ಜೂರು ಇದ್ದು, (iii) ಬೆಂಬಲಿಗೆ A ಮೇಲೆ ಯುಕ್ತವಾಗಿದೆ, ಅಂತರೆ (iv) ಹದಿನಂತಹ D ಮೇಲೆ ಯುಕ್ತವಾಗಿದೆ C ಮೇಲೆ ಮಾರುತ್ತದೆ ಇದ್ದುಗೊಂಡು ಇರುತ್ತದೆ.

(4) ಮಾಧ್ಯಮದ ಅಂತರ್ಜಾನ ಮೇಲೆ ಯಂತ್ರ ಬೇರ್ಪ್ರಾರ್ಣಿಕ ಮತ್ತು ಸೇರೆಸರ್ವಿಕೆತ ಸಂಸ್ಥೆಯಿರುತ್ತಾದರೆ ಇದೆ.  
(i) ಮಾಧ್ಯಮದ ಹೈವಿಡ್ Vs ಯಂತ್ರವನ್ನು ಅಂತರ್ಜಾನ.  
(ii) ವಿಪರೀತ ಅಗ್ಗೇಶಿನ ಪ್ರಾರುಣಗಳ ಅಂತರ್ಜಾನಿಕತೆ (Transmissibility) Vs ಯಂತ್ರವನ್ನು ಅಂತರ್ಜಾನ.

2. (a) ಮೇಲೆ ಬೇರ್ಪ್ರಾರ್ಣಿಕ ಮೇಲೆ 1000 kg; ಹೆಸರು ಸಾಕಷ್ಟು 3000 r.p.m. ಎಂದು 40 b.h.p. ಹೊಂದಿದ್ದು ಅಂತರ್ಜಾನಿಕತೆ 5 ಹೆಸರು 1 ಎಂಡಿ ಗೀತಿನ ಪ್ರತಿ ಅಂತರ್ಜಾನಿಕತೆ 90%; ಹೆಸರು 9 ಹೆಸರು 1 ಎಂಡಿ ಗೀತಿನ ಪ್ರತಿ 85% ಅಂತರ್ಜಾನಿಕತೆ. ಕೃಷ್ಣನು 3200 r.p.m. ಎಂದು (i) ಮಾಧ್ಯಮದ ಹೈವಿಡ್ Vs ಯಂತ್ರವನ್ನು ಅಂತರ್ಜಾನಿಕತೆ 100 ಹೆಸರು 50% ಹೊಂದಿದ್ದು ಅಂತರ್ಜಾನಿಕತೆ; (ii) ಎಂದು R = a + bv² ಹೆಸರು ಇತ್ಯಾದಿ (gradient) ಎಂದು ಹೊಂದಿದ್ದು ಮಾಧ್ಯಮದ ಹೈವಿಡ್ Vs ಯಂತ್ರವನ್ನು ಅಂತರ್ಜಾನಿಕತೆ a, b ಎಂಬುರು b ಹೆಸರುಗಳು ಇತ್ಯಾದಿಯೇ ಹೊಂದಿದ್ದು.

(5) ಮೇಲೆ ಪ್ರತ್ಯೇಕ ನಿರ್ದೇಶಿತ ಹೆಸರು ಕಂಡುದಾದ 6-21 ದಿನಾಂಕ ಎಂಬುರು ಹೊಂದಿದ್ದು. ಈ ವ್ಯವಹಾರ ಮೇಲೆ ಮಾಧ್ಯಮದ ಹೆಸರು ಹೊಂದಿದಲ್ಲಿ ಪರಿಬಳಿತ ಮತ್ತು ಹೇಳೆಂದರೆ ಮತ್ತು ಹೇಳೆಂದರೆ ಮೂಲಕ ನಿರ್ದೇಶಿತ ಹೆಸರು ಕಂಡುದಾದ 60° ಹೊಂದಿದ್ದು. 75 ದಿನಾಂಕ ಮೇಲೆ ಬೇರ್ಪ್ರಾರ್ಣಿಕ ಮೇಲೆ ನಿರ್ದೇಶಿತ ಹೆಸರು ಹೊಂದಿದಲ್ಲಿ ಹೇಳೆಂದರೆ 75 ದಿನಾಂಕ ಮೇಲೆ ಬೇರ್ಪ್ರಾರ್ಣಿಕ ಮೇಲೆ ನಿರ್ದೇಶಿತ ಹೆಸರು ಕಂಡುದಾದ 60°. ಅಂತರೆ ಮೇಲೆ ಹೆಸರು 12 ದಿನಾಂಕ ಎಂಬುರು ಅಂತರೆ ಮೇಲೆ ಬೇರ್ಪ್ರಾರ್ಣಿಕ ಮೇಲೆ ನಿರ್ದೇಶಿತ ಹೆಸರು ಕಂಡುದಾದ 60°.  

2000 r.p.m. ಎಂದು ಪ್ರತ್ಯೇಕ ಹೆಸರು ಹೊಂದಿದಲ್ಲಿ ಹೇಳೆಂದರೆ ಮೇಲೆ ಬೇರ್ಪ್ರಾರ್ಣಿಕ ಮೇಲೆ ನಿರ್ದೇಶಿತ ಹೆಸರು 60°.
3. (a) Describe one form of mechanism, consisting of turning pairs only, that will give an exact straight-line motion to a given point. Prove that the path followed by the point is a true straight line.

(b) A pair of 20 involute gears has module of 5 mm. The pinion has 20 teeth and gear has 60 teeth. Addenda on a pinion and gear wheel in terms of module is 1. Find the following:

(i) Number of parts in contact.

(ii) Angle turned through by the pinion and gear wheel one pair in contact.

4. (a) Sketch the Davis steering gear and show that it satisfies the required conditions for correct steering.

If the distance between the pivots of the front axles is 150 cm and the wheel base is 250 cm, find the inclination of the track arms to the longitudinal axis of the car when the car is moving along a straight path.

(b) Design and draw a friction clutch with two plates, both of each plate being effective. The coefficient of friction between the contact surfaces may be assumed as 0.2 and the intensity of pressure between the contact surfaces limited to 0.7 kg/cm². The external diameter of the plates used in the clutch is 1.5 times the internal diameter and the clutch is to transmit 60 h.p. at 1500 r.p.m. Assume suitable material for plate and clutch body.
3. (a) ಕಮಾನು ಸ್ಥಳವನ್ನು ಹಸ್ತದ ಸ್ಥಾನದಲ್ಲಿರುವ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯನ್ನು ವಿಶೇಷಿಸಿ, ಮತ್ತು ಪ್ರವೃತ್ತಿಯಲ್ಲಿರುವ ಶಾಲೆಯನ್ನು ವಿಶೇಷಿಸಿ ಕರೆತಾರೆ. ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಹುದ್ದೆಯನ್ನು ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಹುದ್ದೆಯನ್ನು ಸೇರಿಸಿರುವ ಶಾಲೆಯ ಹುದ್ದೆಯನ್ನು ಇಳುಬಳಿಸುವ ಪ್ರಕಾರ.

(b) 20 ವರ್ಷಗಳು ಕಾಲಕ್ರಮದಲ್ಲಿ ಕೊಡುತ್ತಿರುವ 5 ವರ್ಷದ ಉದ್ದರಬಾಗುವ ಚಿತ್ರಾಜ.

ಇದ್ದುವುಯಾದರೂ 20 ವರ್ಷಗಳಿಂದ 60 ವರ್ಷಗಳು ಚಿತ್ರಾಜ. ಮಳೆಯುಳ್ಳ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ 1. ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

(i) ಶಾಲೆಯದ ಪ್ರಸಿದ್ಧಿಯ ರಾಖುವು.

(ii) ಶಾಲೆಯದ ಪ್ರಸಿದ್ಧಿಯ ರಾಧಿಸುವು ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

4. (a) ಕಮಾನು ಸುಲಭದ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಮಣ್ಣು ಸುಲಭದ ಸ್ಥಳದಲ್ಲಿ ಮಣ್ಣು ಸುಲಭದ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

ಇದ್ದುವು 150 ವರ್ಷದ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಮಣ್ಣು ಮಣ್ಣು 250 ವರ್ಷಗಳಿಂದ ಮಣ್ಣು ಮಣ್ಣು ಸ್ಥಳದಲ್ಲಿರುವ ಜಾತಿಕೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

(b) ವ್ಯಾಪಕ ಮಂದಿರದಲ್ಲಿರುವ ಶಾಲೆಯ ಮಂದಿರ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ. ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

ವ್ಯಾಪಕ ಮಂದಿರದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ. 0.2 ಮಣ್ಣು ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

ಇದ್ದುವು 0.7 kg/cm² ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ. 1500 r.p.m. ತೊಡು 60 ಹ.ಪ. ಮಣ್ಣು ಸ್ಥಳದಲ್ಲಿರುವ ಶಾಲೆಯ.

|Turn over|
SECTION B

5. Answer any three of the following (Each answer should not exceed 200 words):

(a) (i) Sketch and explain the principle of ECM process.
    (ii) Mention its process parameters and their effects.

(b) (i) Explain the principle and process parameters of explosive forming process.
    (ii) What is 3-2-1 principle of location?

(c) A firm manufactures 3 products A, B and C. The profits are Rs. 30, Rs. 20 and Rs. 40 respectively. The firm has two machines and the required processing time in minutes for each machine on each product are given below:

<table>
<thead>
<tr>
<th>Products</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machines X</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Y</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Machines X and Y have 2000 and 2500 machine minutes respectively. The firm must manufacture 100 of A, 200 of B and 50 of C but not more than 150 of A. Formulate into a LP problem to maximise profit and solve it.

(d) Distinguish between chance causes and assignable causes with examples.

6. (a) (i) Derive for the EOQ of the basic inventory model.
    (ii) What are the assumptions made in the above model?
    (iii) What is ABC analysis? What is its use?
5. (a) একটি অর্থনীতিসম্পর্কে মাত্রা মূল্য সময় নির্দেশনা মাত্রার; অর্থনীতির মাত্রায় 200 সময় মূল্য নির্দেশকমাত্রার।

(2) (i) ECM যুক্তার্থে মূল্যনির্ণয় পদ্ধতি কল্পনা।
(ii) একটি যুক্তার্থ মূল্যনির্ণয় কল্পনা অর্থনীতি মূল্যনির্ণয় কল্পন।

(3) (i) শুধুমাত্র বাণিজ্যর সমস্ত মূল্য অর্থনীতি কল্পনা মূল্যনির্ণয় কল্পন।
(ii) 3-2-1 নূতন মূল্য (principle of location) কল্পনা?

(4) হেলেঁ স্কুলের মধ্যে A, B এবং C অন্তর্ভুক্ত যুক্তার্থক সমস্ত কল্পনা।

(5) হেলেঁ স্কুলের A, B এবং C অন্তর্ভুক্ত যুক্তার্থক সমস্ত কল্পনা।

ঢালকোন তালিকা

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

X এবং Y নির্দেশনা অর্থনীতির 2,000 সময় 2,500 সময়-রীতিপথ।

প্রতিদিন 100 A সময়কালে, 200 B সময়কালে এবং 50 C সময়কালে অর্থনীতির মাত্রার।

(6) হেলেঁ স্কুলের মাত্রা অর্থনীতির মাত্রা কল্পনা মাত্রার।

6. (a) (i) মূল্য বিন্দু মূল্যকল্পনা EOQ কল্পনা কল্পন।
(ii) শুধুমাত্র যুক্তার্থক সমস্ত কল্পনা কল্পন।
(iii) ABC যুক্তার্থক সমান্তরাল কল্পনা কল্পন।

I Turn over
(b) (i) Solve the following transportation model and give the optimum transportation plan.

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>120</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>150</td>
</tr>
</tbody>
</table>

Demand: 90 160 120

(ii) What is an operating characteristic curve? What is its significance?

7. (a) (i) Derive the relationship for the shear angle by Merchant's theory of metal cutting.

(ii) What are the assumptions made in the above?

(b) Discuss the various methods of surface roughness measurement.

8. (a) Discuss the principle, applications and process parameters of ultrasonic machining.

(b) What is work sampling? What are its applications?
(२) (i) 

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>नमूनें</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>120</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>150</td>
</tr>
</tbody>
</table>

पूर्ती 90 160 120

(ii) का प्रमाणण कैसे किया गया है? अर्थात् जानकारी?

7. (२) (i) 

(ii) का प्रमाणण कैसे किया गया है?

(२) का प्रमाणण कैसे किया गया है?

8. (२) 

(ii) का प्रमाणण कैसे किया गया है?

(२) का प्रमाण कैसे किया गया है?
INSTRUCTIONS

Each question is printed both in English and in Kannada. Answers must be written in the medium specified (English or Kannada) in the Admission Ticket issued to you, which must be stated clearly on the cover of the answer book in the space provided for this purpose. No credit will be given for the answers written in a medium other than that specified in the Admission Ticket.

Candidates should attempt questions 1 and 5 which are compulsory, and any three of the remaining questions, selecting at least one question from each Section.

The number of marks carried by each question is indicated at the end of the question.

If any data is considered insufficient, assume suitable value.

Newton may be converted to kg using the equality 1 kilonewton (1 KN) = 100 kg, if found necessary.
SECTION A

1. Answer any three of the following parts (Answer to each part should not exceed 200 words):

(a) An ideal gas of molecular weight 30 and specific heat ratio 1.38 is compressed according to the law, PV = Constant from a pressure of 1 bar absolute and 15°C to a pressure of 16 bar absolute. Calculate the temperature of the gas at the end of compression, the heat received or rejected and the work done by the gas during the process. Assume the mass of the gas to be 1 kg. Use the calculated value of $C_v$.

(b) In a heat exchanger, air is heated from temperature $T_1 = 400°C$ and the gases are cooled from temperature $T_3 = 450°C$ to $T_4 = 200°C$. The heat lost from the heat exchanger to the surroundings amounts to 20% of the heat transferred from the gas. Determine the fall in efficiency per kg of the gas flowing through the heat exchanger due to the irreversibility of the heat transfer process. Assume the gas and air to be ideal gases possessing the properties of air. The heat capacities of the air and gas are assumed to be constant. Ambient temperature $T_0 = 25°C$.

(c) Explain in detail about the hydrodynamic boundary layer concept over a flat plate as per the Prandtl's mixing length theory.

(d) A flat plate 1.5 m wide and 2.0 m long is exposed to longitudinal air flow at a temperature of 293 K with a velocity of 4.0 m/s. Calculate the heat transfer coefficient and the heat flow, if the surface temperature of the plate is 353 K.

2. (a) Explain in detail about the Buckingham's $\pi$ theorem used for dimensionless analysis and also state its advantages while using for the above analysis.
1. ( )

2. ( ) 1.5 2.0 293 K 4.0 m/s 353 K 25
Show that the mean coefficient of drag for turbulent boundary layer on a smooth flat plate

\[ C_f = \frac{0.072}{Re^{0.2}} \]

and also comment on the experimental validation of the above result.

3. (a) Determine the heating surface of a counterflow heat exchanger, if the inlet temperature of the hot water is 97°C and its rate of flow is equal to 1 kg/s. The hot water flows along an internal steel tube having diameters \( d_2/d_1 = 40/37 \) mm. The thermal conductivity of the steel tube = 50 W/m-k. The cold water moves along the annular passage formed between the tubes of the heat exchanger and is heated from 17°C to 47°C. The inside diameter of the external tube is 54 mm. The rate of cold water flow is 1.14 kg/s.

(b) A non-insulated steel heater is installed in a workshop. The surface of the heater is heavily oxidized and its emission coefficient is 0.2 W/m²-k¹; the temperature of the outside surface 430 K; the length of the heater is 2 m, its diameter is 1 m; room temperature is 300 K and the emission coefficient of the walls 3.5 W/m²-k¹; the room is 10 m long, 8 m wide and 4 m high. Determine the quantity of heat exchange by radiation between the surfaces of the heater and walls of the room.

4. (a) Determine the coefficient of heat transfer from vapour to the vertical tube of a condenser. The outside diameter of the tube is 30 mm, height 3 m and the tube surface temperature is 11°C. Saturated vapour condenses on the tube surface at a pressure 0.04 bar and temperature 29°C.

The physical properties are:

- \( T_{av} = 20°C \)
- Density = 998.2 kg/m³
- Thermal Conductivity = \( 1.006 \times 10^{-6} \) m²/s at 29°C, and
- the heat of vaporization = 2432.3 kJ/kg.
(b) Determine the quantity of heat transferred through 1 m² of a finned wall whose finning factor is \( \frac{P_2}{P_1} = 12 \). The wall is fabricated from iron with a thermal conductivity 63 W/m-k and wall thickness is 12 mm. The coefficient of heat transfer from the working medium to the wall is 250 W/m²-k and 12 W/m²-k. The temperature of the working medium is 117°C and ambient air temperature is 17°C.
(2) \( C_f = \frac{0.072}{R_e^{0.2}} \)

3. (a) \( \text{जिक मिळ्यात वाद्य 97° C ते } 1 \text{ kg's का } \)

4. (a) \( \text{तर्कसार्थक वाद्य 30 mm, क्रमानुसार } 3 \text{ mm, तर्क } \)

\( \text{मूल्यांकन } T = 20^\circ C, \text{ उपशुल्क } 998.2 \text{ kg/m}^3; \)

\( \text{मूल्यांकन } 1006 \times 10^{-6} \text{ m}^2/\text{s } 29^\circ C \text{ का } \)

\( \text{मूल्यांकन } 2432.3 \text{ kJ/kg}. \)
SECTION B

5. Answer any three parts out of the following four parts (Answer to each part should not exceed 200 words):

(a) A boiler generates 750 kg of steam per hour at 11 bar absolute and with 40°C superheat, and burns 100 kg of coal per hour. If the calorific value of coal is 29300 kJ/kg, feed water temperature is 15°C and specific heat of superheated steam is 209 kJ/kg-k, calculate (i) the factor equivalent evaporation, (ii) the equivalent evaporation from and at 100°C per kg of coal and (iii) boiler efficiency.

(b) Explain in detail the construction and working of pressurised-water reactor and also write in detail about the generalised reactor operation.

(c) A 5 ton refrigerating machine operating on Bell-Coleman Cycle has an upper limit of pressure of 12 bar. The pressure and temperature at the start of compression are 1 bar and 17°C. The compressed air cooled at constant pressure to a temperature of 40°C enters the expansion cylinder. Assuming both expansion and compression processes to be adiabatic with a specific heat ratio of 1.4, determine

(i) C.O.P.
(ii) Quantity of air in circulation per minute
(iii) Piston displacement of compressor and expander
(iv) Bore of compressor and expansion cylinder.

The unit runs at 250 r.p.m. and is double acting. Stroke length = 20 cm.

(d) A four cylinder engine running at 1200 rpm delivers 20 KW. The average torque when one cylinder was cut is 110 Nm. Find the indicated thermal efficiency if the calorific value of the fuel is 43 MJ/kg and the engine uses 360 grams of gasoline per KW-hour.
(2) $\frac{F_2}{F_1} = 12$ ಸಮಯದಲ್ಲಿ ಎಣ್ಣೆಯ ಗಳಿಗೆ 1 m$^2$ ಎಣ್ಣೆಯ ಗಳೂರು ಬೊರೆಯಾಗಿ ಗೂಡಲು ನೀಡಲಾಗುತ್ತದೆ. ಕ್ರಮವಾಗಿ 63 W/m-k ಮತ್ತು 40 W/m-k ಸಾಮರ್ಥ್ಯವಿರುವ ಗೂಡು ಸೃಷ್ಟಿಸುತ್ತದೆ. ಗೂಡುಗಳ ಸರಾಸರಿ 12 mm ಎಣ್ಣೆಯ ಗಳೂರು. ಮೂರು ಕಂದುಬಿಡಿಗಳುಗಳ ಕೊಂಡಿರುತ್ತದೆ ಗೂಡುಗಳಿಗೆ 250 W/m$^2$-k ಮತ್ತು 12 W/m$^2$-k. ಪ್ರತಿ ಮತ್ತು 1300 C; ರೈತಿಗೊಳ್ಳುತ್ತದೆ 170 C.
5. ការប្រួលប្រព្មាចំការដែលបង្ការ មិនអាច ធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា ។ (សូមសរសេរ នូវពាក្យ 200 មាតារនិង មានគំនិត) ៖

(ii) ប្រួលប្រព្មាចំការដែល មាន 11 ម៉ែត្រ ក្រោយមុន តែងហើយ ៤០⁰ C បន្ថែមទុកស្រាប់ តំបន់ 750 kg បុណ្ណ់ភ្លឺ បណ្តាលប្រព្មាចំ ៨០ kg បុណ្ណ់ភ្លឺ 100 kg បុណ្ណ់ភ្លឺ បណ្តាលប្រព្មាចំ តំនិញបំផុត ក្រោយមុន ២ ៧១៨ ០ MJ/kg; តំនិញ វិញ្ញាណ ក្រោយមុន ៤៥⁰ C; អន្តរជាតិ ក្រោយមុន ២ ០៩ MJ/kg.k ស្ថិតឯនៃ (i) ឯកសារ រស់ឈាមសេស  (ii) មិន ក្រោយមុន ៤៥⁰ C បន្ថែម រស់ឈាម សេស សម្រាប់ រស់ឈាមសេស សភាព រាករស់ឈាម  (iii) រស់ឈាមសេស រស់ឈាម សេស សម្រាប់ រស់ឈាមសេស ។

(iii) ប្រួលប្រព្មាចំការអាចត្រូវបាន បន្ថែមប្រព្មាចំការក៏ដោយ ប្រួលប្រព្មាចំការជាតិ មិនបាន ធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា ។ ប្រួលប្រព្មាចំការសំខាន់ ក្រោយមុន នឹងធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា។

(iv) ប្រួលប្រព្មាចំការអាចត្រូវបាន បន្ថែមប្រព្មាចំការក៏ដោយ ប្រួលប្រព្មាចំការជាតិ មិនបាន ធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា ។ ប្រួលប្រព្មាចំការសំខាន់ ក្រោយមុន នឹងធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា។

(i) C.O.P.

(ii) មិន បន្ថែមប្រព្មាចំការក៏ដោយ ប្រួលប្រព្មាចំការជាតិ មិនបាន ធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា ។

(iii) មិន បន្ថែមប្រព្មាចំការក៏ដោយ ប្រួលប្រព្មាចំការជាតិ មិនបាន ធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា ។

(iv) មិន បន្ថែមប្រព្មាចំការក៏ដោយ ប្រួលប្រព្មាចំការជាតិ មិនបាន ធ្វើឱ្យការប្រើប្រាស់ បានដូចគ្នា ។

20

(2) 1200 rpm នឹង មាន ២ ០០០ MJ/kg ស្ថិតឯនៃ បន្ថែម គ្រប់ប្រព្មាចំការ ក្រោយមុន 20 KW នឹងប្រើប្រាស់ និង មាន អន្តរជាតិ ក្រោយមុន ២ ០០០ MJ/kg ២ ០០០ MJ/kg ស្ថិតឯនៃ បន្ថែម គ្រប់ប្រព្មាចំការ ក្រោយមុន 360 KW នឹងប្រើប្រាស់ និង មាន អន្តរជាតិ ក្រោយមុន ២ ០០០ MJ/kg ស្ថិតឯនៃ បន្ថែម គ្រប់ប្រព្មាចំការ ក្រោយមុន ។

*Turn over*
6. (a) Explain in detail premixed and diffusion combustion in C.I. engines with proper illustrations.

(b) Calculate the diameter of the fuel orifice of a four-stroke engine which develops 25 kW per cylinder at 2500 rpm. The specific fuel consumption using 0.3 kg/kW-h fuel of 30° API. The fuel is injected at a pressure of 150 bar over a crank travel of 25°. The pressure in the combustion chamber is 40 bar. Coefficient of velocity is 0.875 and specific gravity is given by

$$\text{S.G.} = \frac{141.5}{131.5 + 0.9^\text{API}}$$

7. (a) An air refrigeration system operating on Bell-Coleman Cycle, takes in air from cold room at 5°C and compresses it from 1 bar to 5.5 bar. The index of compression being 1.25. The compressed air is cooled to 27°C. The ambient temperature is 20°C. Air expands in an expander where the index of expansion is 1.35. Calculate

(i) C.O.P. of the system.
(ii) Quantity of air circulated per minute for production of 1500 kg of ice per day at 0°C from water at 20°C.
(iii) Capacity of the plant in terms of kJ/s.

Take $C_p = 4.18$ kJ/kg-k for water and $C_p = 1.005$ kJ/kg-k for air.

Latent heat of ice = 335 kJ/kg.

(b) In a laboratory test, a psychrometer recorded dry bulb temperature as 36°C and wet bulb temperature 30°C. Calculate

(i) Vapour pressure
(ii) Relative humidity
6. (ii) ក្រុមហ៊ុនម្នាក់ មានគ្រូកំពុង ឈុត និង គ្រូស្មើនីអាហារម្នាក់ មាន់ ជំនូយកុម្មតិច ឈុតស្មើនី ឈុតស្មើនី 

   (vi) 2500 rpm គ្រូ គួរ គឺជាង 25 kW នៃលក្ខណៈស្រប បាន់ ស្មើនី រាប់ម៉ូស៊ីន (orifice) អាហារម្នាក់ ជំនូយកុម្មតិច។ 30°C API នៃ 0.3 kg/kWh នៃលក្ខណៈស្រប បាន់ៗ គ្រូស្មើនី មានប្រេ ច្រូះ មានប្រៀបធៀប។ រ៉ូល់ស្មើនី 150 ម៉៊ីត មាន់ម៉ោង 25°C គ្រូស្មើនី មានព្រឹម ប្រៀបធៀបការខ្លែង។ មាន់ស្មើនីប្រៀបធៀប 40 ម៉៊ីត មាន់ៗ ជំនូយកុម្មតិច។ ស្មើនី 

   ស្មើនី 0.875 គ្រូស្មើនី ជំនូយកុម្មតិច

   \[
   \text{S.G.} = \frac{141.5}{131.5 + ^0\text{API}}
   \]

   គ្រូស្មើនីជំនូយកុម្មតិច។

7. (v) រ៉ូល់-ការសុទ្ធតែ មានន័យ ឈុត កម្មវិធីការសុទ្ធតែ មាន់ រ៉ូល់ 

   រ៉ូល់-ជីវជំនួយ ឈុត ឈុត គ្រូស្មើនី មាន់ រ៉ូល់ 

   5°C បាន់ ឈុត ឈុត ឈុត ឈុត ឈុត ឈុត 

   10°C បាន់ 5°C មាន់ រ៉ូល់-ជីវជំនួយ 

   រ៉ូល់-ជីវជំនួយ 1.25 ម៉ែ. រ៉ូល់-ជីវជំនួយ 25°C ក្នុង 

   ការសុទ្ធតែ ស្មើនី 20°C. គ្រូស្មើនី ឈុត ឈុត ឆ្នោត 

   ឈុត ឈុត ឈុត ឈុត ឈុត ឈុត ឈុត ឈុត ឈុត ឈុត 

   ១. មាន់ការសុទ្ធតែ មាន់ 1.35. 

   រ៉ូល់-ជីវជំនួយ ជំនូយកុម្មតិច

   (i) ការសុទ្ធតែ C.O.P.

   (ii) 20°C អំពីបញ្ហាដើម្បី 0°C បាន់ ឈុត ឈុត 1500 kg 

   ការសុទ្ធតែ មាន់ រ៉ូល់-ជីវជំនួយ ឈុត ឈុត 

   ឧបត្ថម្ភនេះ ក្នុងការត្រូវបានការសុទ្ធតែ 

   (iii) \( \text{kJ/s} \) ឧបត្ថម្ភនេះ ស្មើនី 

   ការសុទ្ធតែ \( C_p = 4.18 \text{ kJ/kg-k} \) មាន់ 

   ឧបត្ថម្ភធំ \( C_p = 1.005 \text{ kJ/kg-k} \) មាន់ ហាមិត្តក្បាល, 

   ឧបត្ថម្ភធំ \( C_p = 335 \text{ kJ/kg} \) 

   (vi) មាន់ ឧបត្ថម្ភធំមាន់ មាន់ ឈុត ឈុត ធំមាន់ 

   36°C មាន់ ឈុត ឈុត ធំមាន់ 30°C មាន់ ឈុត 

   ធំមាន់ : 

   (i) ឧបត្ថម្ភធំ 

   (ii) ឧបត្ថម្ភធំ 

   [Turn over]
(iii) Specific humidity

(iv) Degree of saturation

(v) Dew point temperature and

(vi) Enthalpy of the mixture

Barometer = 1.01325 bar.

8. (a) A single stage single acting reciprocating air compressor has clearance volume of 6% of stroke volume. The compressor takes in air at 1 bar and delivers at 6 bar.

It is proposed to increase the delivery pressure to 8 bar by changing the clearance volume. There is no change in r.p.m. and indicated power.

If the law of compression and re-expansion is the same in two cases PV = Constant, determine the percentage increase in clearance volume and percentage decrease in mass of air delivered.

(b) Show that the maximum efficiency of a person's reaction turbine is given by \( \frac{2 \cos^2 \alpha}{1 + \cos^2 \alpha} \) where \( \alpha \) is the angle with the direction of motion of the blade at which steam enters the blade.
(iii) अधिक अवधि
(iv) परिशोधित अवधि
(v) त्यो स्वाभाविक अवधि
(vi) अंतराल अवधि (Enthalpy)


cell diameter = 1.01325 mm.

8. (b) विभाजन, थर्मल स्निक्क, स्वतंत्रता अलग अनुभवें मुंगें तांत्रिककारण ठेवू गोडे 6% गोडे तांत्रिककारण ठेवू करू. मात्र एक 1 वेळे रूप अनुभवें मुंगें 6 मजे नबु व्राह्यात्मक स्वतंत्रता.

पायलेव्या, यांत्रिककारण थर्मल स्निक्क, थर्मल स्निक्क, स्वतंत्रता 8 मजे अनुभवें वर्षात्मक स्वतंत्रता. r.p.m. वर्षात्मक वर्षात्मक वर्षात्मक वर्षात्मक.

या अनुसार स्वतंत्रता तांत्रिककारण ठेवू मुंगें तांत्रिककारण ठेवू. या अनुसार PV 1.3 = तांत्रिककारण, स्वतंत्रता तांत्रिककारण ठेवू. मुंगें तांत्रिककारण प्रथम तत्त्वात्मक तांत्रिककारण ठेवू.

(b) अनेक संदर्भात्मक प्राथमिकता अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि.

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\frac{2 \cos^2 \alpha}{1 + \cos^2 \alpha}
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हून अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि अवधि.