*Total No. of Questions: 6* *Total No. of Printed Pages:3*

**Enrollment No.....**

# Faculty of Engineering

## End Sem (Even) Examination May-2022

## EN3ES18 Basic Mechanical Engineering

Programme: B.Tech. Branch/Specialisation: All

**Duration: 3 Hrs.** **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
Steam Table may be permitted during examination.

Q.1 i. Area under stress strain diagram up to fracture point is called- **1**
(a) Strength (b) Resilience (c) Toughness (d) creep

ii. Percentage composition of carbon in cast iron is- **1**
(a) 0.3 – 0.7 (b) 0.7 -1.5 (c) 1.5 – 1.8 (d) above 2

iii. For a cyclic process, the change in the thermodynamic property is always____. **1**
(a) Zero (b) One (c) Negative (d) Data insufficient

iv. A refrigerator operates between - 3 °C and 57 °C. The COP is- **1**
(a) 5.5 (b) 4.5 (c) 19 (d) 1.22

v. Range of compression ratio for petrol engine is- **1**
(a) 6 – 12 (b) 15 – 22 (c) 1 – 5 (d) 0 - 1

vi. Number of ports in four stroke diesel engine is- **1**
(a) Three (b) Two (c) One (d) Zero

vii. Which of the following is a water tube boiler? **1**
(a) Cochran (b) Babcock & Wilcox
(c) Lancashire (d) All of these

viii. Boiler generating steam at 50 bar pressure is called- **1**
(a) High pressure boiler (b) Medium pressure boiler
(c) Low pressure boiler (d) Supercritical boiler

ix. The point at which the total area of a plane figure is assumed to be concentrated is known as ...? **1**
(a) Centre of Gravity (b) Moment of Inertia
(c) Centroid (d) None of these

x. Moment of inertia of a rectangle of base 4 cm and height 6 cm about horizontal axis, X-X, passing through CG is .... ($cm^4$) **1**
(a) 72 (b) 36 (c) 12 (d) 8

P.T.O.

Q.2 i. Define the following terms: **2**
(a) Hardness (b) Hooke's Law

ii. Explain the construction of micrometre with the help of a neat diagram. **3**

iii. A tensile force of 600 N is applied to a steel wire of 2 mm diameter and 15 mm long. The modulus of elasticity of the material is 210 GN/$m^2$. Find (a) stress in the wire, (b) strain, (c) elongation and (d) percentage elongation. **5**

OR iv. Draw a neat and labelled Iron-Carbon Diagram. Write the important equations along with temperature and percentage composition. **5**

Q.3 i. State Kelvin Planck and Clausius statement of second law of thermodynamics. **2**

ii. Air enters a compressor at 1 bar and 25 °C having volume of 1.8 $m^3$/kg and is compressed to a pressure of 5 bar isothermally. Determine the work done and heat transferred. **3**

iii. Explain construction and working of vapour compression refrigeration system with neat sketch. **5**

OR iv. Find the enthalpy of steam at pressure of 15 bar when the steam is- **5**
(a) Wet and its quality is 0.8.
(b) Dry and Saturated
(c) Superheated to temperature of 300°C
Use specific heat at constant pressure for superheated steam as 2.3 kJ/kg. K

Q.4 i. What are the differences between two-stroke and four-stroke engines? (at least 8 points). **4**

ii. Derive the formula for efficiency of Otto cycle. Draw neat P-V and T-S diagram. Clearly state the assumptions made. **6**

OR iii. An engine working on an ideal diesel cycle is supplied with air at 0.1MPa and 40°C. The compression ratio is 18 and heat supplied is 1500 kJ/kg. Calculate (a) cut-off ratio (b) cycle efficiency and (c) work done per unit mass of air. **6**

Q.5 i. Write in brief about the following: **4**
(a) Mountings (b) Accessories
(c) Mechanical draught (d) Steam jet draught



ii. A boiler generates 2500 kg of dry and saturated steam per hour at a pressure of 15 bar from the feed water entering at 25 °C. Coal burnt is 350 kg/hour on the grate with calorific value 32000 kJ/kg. Calculate its equivalent evaporation "from and at 100 °C" and efficiency of boiler. **6**

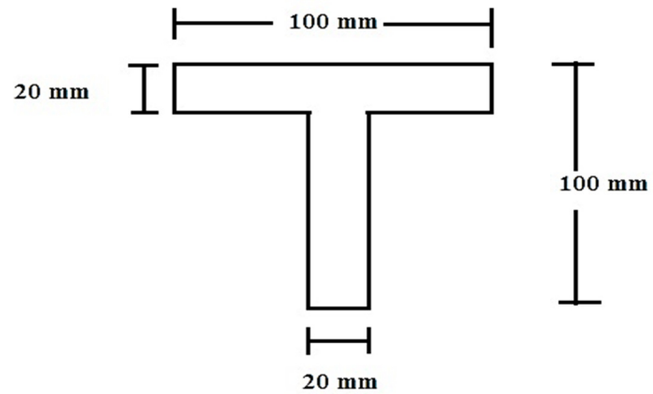
OR iii. Explain construction and working of Cochran Boiler with the help of neat sketch. **6**

Q.6 Attempt any two:

i. State and prove perpendicular axis theorem. **5**

ii. Derive expression for moment of inertia of a triangular section (with base 'b' and height 'h') about an axis passing through its- **5**
(a) Base (b) CG

iii. Determine the moment of inertia of the section about horizontal axis passing through centre of gravity of section. **5**

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## Marking Scheme
## EN3ES18 Basic Mechanical Engineering

| | | | | |
|---|---|---|---|---|
| Q.1 | i. | Area under stress strain diagram up to fracture point is called-<br>(c) Toughness | | **1** |
| | ii. | Percentage composition of carbon in cast iron is-<br>(d) above 2 | | **1** |
| | iii. | For a cyclic process, the change in the thermodynamic property is always____.<br>(a) Zero | | **1** |
| | iv. | A refrigerator operates between - 3 °C and 57 °C. The COP is-<br>(b) 4.5 | | **1** |
| | v. | Range of compression ratio for petrol engine is-<br>(a) 6 – 12 | | **1** |
| | vi. | Number of ports in four stroke diesel engine is-<br>(d) Zero | | **1** |
| | vii. | Which of the following is a water tube boiler?<br>(b) Babcock & Wilcox | | **1** |
| | viii. | Boiler generating steam at 50 bar pressure is called-<br>(b) Medium pressure boiler | | **1** |
| | ix. | The point at which the total area of a plane figure is assumed to be concentrated is known as ...?<br>(c) Centroid | | **1** |
| | x. | Moment of inertia of a rectangle of base 4 cm and height 6 cm about horizontal axis, X-X, passing through CG is .... ($cm^4$)<br>(a) 72 | | **1** |
| Q.2 | i. | (a) Hardness | 1 mark | **2** |
| | | (b) Hooke's Law | 1 mark | |
| | ii. | Construction of micrometre | 1.5 marks | **3** |
| | | Diagram | 1.5 marks | |
| | iii. | Cross section area = $3.142 \times 10^{-6}\ m^2$ | 1 mark | **5** |
| | | Stress = 190 MPa or 0.19 GPa | 1 mark | |
| | | Strain = $0.91 \times 10^{-3}$ | 1 mark | |
| | | Elongation = 13.6 mm | 1 mark | |
| | | % elongation = 0.091 % | 1 mark | |
| OR | iv. | Fe-C diagram | 2 marks | **5** |
| | | Equations | 1.5 marks | |
| | | Carbon percent and temperature | 1.5 marks | |
| Q.3 | i. | Kelvin Planck statement | 1 mark | **2** |
| | | Clausius statement | 1 mark | |
| | ii. | Determine the work done and heat transferred | | **3** |
| | | Work done = - 125 kJ/kg | 1 mark | |
| | | Internal energy change is Zero | 1 mark | |
| | | Heat transfer = -125 kJ/kg | 1 mark | |
| | iii. | Diagram of VCR system | 2 marks | **5** |
| | | Construction and working | 3 marks | |
| OR | iv. | $T_{sat}$ = 198.3° C, $h_f$ = 844.7 kJ/kg, $h_g$ = 2789.9 kJ/kg | 2 marks | **5** |
| | | Enthalpy of wet steam = 2400.8 kJ/kg | 1 mark | |
| | | Enthalpy of dry and saturated steam = 2789.9 kJ/kg | 1 mark | |
| | | Enthalpy of superheated steam = 3023.81 kJ/kg | 1 mark | |
| Q.4 | i. | Differences between two-stroke and four-stroke engines | | **4** |
| | | At least 8 points 0.5 mark for each point | (0.5 mark * 8) | |
| | ii. | PV , TS Diagram | 1 mark | **6** |
| | | Assumptions | 1 mark | |
| | | Derivation | 4 marks | |
| OR | iii. | Cut off ratio= 2.5 | 2 marks | **6** |
| | | Formula of diesel efficiency | 0.5 mark | |
| | | Efficiency of engine = 60.93 % | 2 marks | |
| | | Work done = 914kJ/kg | 1.5 mark | |
| Q.5 | i. | Write in brief about the following: | | **4** |
| | | (a) Mountings | 1 mark | |
| | | (b) Accessories | 1 mark | |
| | | (c) Mechanical draught | 1 mark | |
| | | (d) Steam jet draught | 1 mark | |
| | ii. | Enthalpy of feed water = 104.77 kJ/kg | 1 mark | **6** |
| | | Enthalpy of steam = 2789.9 kJ/kg | 1 mark | |
| | | Equivalent evaporation = 8.5 kg/kg of coal | 2 marks | |
| | | Boiler efficiency = 59.93 % | 2 marks | |
| OR | iii. | Cochran diagram | 2 marks | **6** |
| | | Construction | 2 marks | |
| | | Working | 2 marks | |

Q.6 Attempt any two:

i. State and prove perpendicular axis theorem. **5**

| | |
|---|---|
| Statement | 1 mark |
| Diagram | 1 mark |
| Proof | 3 marks |

ii. Derivation of MOI about base 2.5 marks **5**
Derivation of MOI about CG 1.5 marks
Diagram 1 mark

iii. Determine the moment of inertia of the section about horizontal axis passing through centre of gravity of section **5**

| | |
|---|---|
| $A_1 = 20\ cm^2$, $A_2 = 16\ cm^2$, $Y' = 6.77$ cm | 1 mark |
| $I_{G1} = 6.67\ cm^4$ , $I_{G2} = 85.33\ cm^4$ | 1 mark |
| $I_{XX1} = 105.501\ cm^4$ | 1 mark |
| $I_{XX2} = 208.72\ cm^4$ | 1 mark |
| $I_{XX} = 314.221\ cm^4$ | 1 mark |

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