SE/sem III/c-scheme R-19/Mechanical QP-10070569

14/12/24

**Time: 3 Hour** **Max. Marks: 80**

**N. B.**
1) **Question No.1** is compulsory.
2) Attempt **any three** questions from remaining five questions.
3) All questions carry equal marks.

**Q1.** Write notes on **any FOUR** **[20]**
- (a) Explain the advantages of polymer over metallic materials.
- (b) Allotropic form of iron
- (c) Critical Resolved Shear Stress (C.R.S.S.)
- (d) Ductile to Brittle Transition Temperature (DBTT)
- (e) Normalizing

**Q2.** (a) Classify various types crystal defects? Discuss line defects and their types. **[10]**

(b) State and explain Griffith's theory for brittle material with derivation **[10]**

**Q3.** (a) Draw the iron -iron carbide equilibrium diagram and write the important transformation seen in the diagram. **[10]**

(b) What is Nitriding and explain types of nitriding processes. Explain the heat treatment before nitriding. **[10]**

**Q4.** (a) What is recrystalliztion annealing? Discuss the various stages of recrystallization annealing with neat sketch **[10]**

(b) Define fatigue failure. Discuss fatigue testing. Explain interpretation of S-N curve for ferrous and non –ferrous metals. **[10]**

**Q5.** (a) Draw a binary alloy phase diagram with example. **[10]**
(b) Write note on Shape Memory alloys **[6]**
(c) Explain ceramics and its applications. **[4]**

**Q6.** (a) Write note on composites and its applications. **[8]**
(b) Explain Magnetic Particle Testing with neat sketch **[8]**
(c) Define nano materials. Discuss their applications. **[4]**

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Vidyalankar College of Engineering

QPcode: 10065958

SE Sem III rd R-19 C Scheme Mechanical

III / Mechanical / PP

30/11/24

**Duration: 3 Hours** **Total Marks- 80**

1) **First Question (Q.1) is Compulsory.**
2) **Attempt any 3 questions from the remaining 5 (Q.2 - Q.6) questions.**
3) **Figures to the right indicate full marks**
4) **Proportionate and labelled free-hand sketches would do**

**Q. 1** Solve any **Four out of Six.** **20**

**a)** Explain shell moulding process
**b)** Explain adhesive bonding process.
**c)** Write short note defects in rolling process.
**d)** Explain Internet of Things.
**e)** Discuss Laser beam machining process.
**f)** With the help of neat sketch explain working of compound die.

**Q. 2 a)** What is riser? Write the functions of risers. List types of risers and explain any one. **10**

b) Explain working oxy-acetylene gas welding. Sketch three types of flames and write its uses. **10**

**Q. 3 a)** Explain working, advantages and limitations of electro-discharge machining. **10**

b) Define extrusion process. With the help of neat sketch write the difference between direct extrusion and indirect extrusion. **10**

Q. 4 a) Explain construction and working of centre lathe. **10**

b) The tool life equation for machining C40 steel with a 18:4:1 H.S.S. cutting tool at a feed of 0.2mm/min and depth of cut 2mm is given by $VT^n = C$, where n and C are constants. The following observations have been noted :

| | | |
|---|---|---|
| V,m/min | 25 | 35 |
| T, min | 90 | 20 |

Calculate n and C.
Hence recommend the cutting speed for a desired tool life of 60 minutes. **10**

Q. 5 a) Explain the various steps in powder metallurgy. **10**

b) Write the classifications of sheet metal operations. Explain any four sheet metal operations with neat sketch. **10**

**Q. 6** Write short notes on **(Any four)** **20**

**a)** Write the difference between shaper and planer.
**b)** Classify Production Processes.
**c)** Write the difference between hot working and cold working.
**d)** Laser beam machining.
**e)** Gear hobbing.
**f)** Cloud manufacturing.

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QP code: 10068831

SE sem-III Mechanical R-19 Cscheme

III/Mechanical/T-D.

25/11/2024

Time : 3 Hours Total Marks:80

N.B. : **(1) Question No 1 is Compulsory.**
**(2) Attempt any three questions out of the remaining five.**
**(3) All questions carry equal marks.**
**(4) Assume suitable data, if required and state it clearly.**
**(5) Use of steam table and Mollier Diagram is permitted.**

1 Solve **Any Four** 20

a State Perpetual Motion Machine (PMM) - I & II.

b State the similarities and dissimilarities between heat and work transfer.

c Define the following term,
(i) Saturation temperature (ii) Sensible heat
(iii) Critical point (iv) Triple point

d Draw P-V and T-S diagram of Otto cycle and Brayton cycle.

e Discuss the Mach number corresponding to
(i) Subsonic flow
(ii) Sonic Flow
(iii) Supersonic flow

2 a In a gas turbine, the gases flow at the rate of 5 kg/s. The gases enter the turbine at a pressure 7 bar with a velocity 120 m/s. The turbine is insulated. The exit pressure and velocity are 2 bar and 250 m/s. If the enthalpy of the gas at the inlet is 900 kJ/kg and at the outlet is 600 kJ/kg, determine the capacity of the turbine. 10

b Discuss generation of steam from ice at – 5°C at 1 atm with the help of T–S and P–V diagrams. 10

3 a A heat pump working on a Carnot cycle takes in heat from a reservoir at 5 °C and delivers heat to a reservoir at 60 °C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir 840 °C and reject heat to a reservoir at 60 °C. The reversible heat engine also drives a machine that absorbs 30 kW. If the pump extracts 17 KJ/s from the 5 °C reservoir, Determine 10

(i) the rate of heat supply from 840 °C source and

(ii) the rate of heat rejection to the 60 °C sink.

| | | | |
|---|---|---|---|
| | b | Explain the concept of available and unavailable energy. When does the system become dead state? | 05 |
| | c | Describe reheat cycle and compare it with simple Rankine cycle. | 05 |
| 4 | a | Derive the Clausius theorem. | 10 |
| | b | Write the equations of Maxwell's Relations. | 05 |
| | c | During a thermodynamic cycle of processes (A-B-C-D-A), the heat transferred during each process are: 120 kJ, −16 kJ, −48 kJ and 12 kJ respectively. Estimate network transferred during the thermodynamic cycle, direction of work transfer, change in internal energy using the first law of Thermodynamics. | 05 |
| 5 | a | Derive the expression of efficiency of Diesel cycle and state the assumptions. | 10 |
| | b | Steam turbine working on Rankine cycle is supplied with dry saturated steam at 20 bar and the exhaust takes place at 0.3 bar. For a steam flow rate of 10 kg/s. Determine the quality of steam at end of expansion and Rankine efficiency, | 10 |
| 6 | a | An aeroplane is flying at 1000 km/h through still air having a pressure of 78.5 $kN/m^2$ (abs.) and temperature – 8°C. Calculate on the stagnation point on the nose of the plane : (i) Stagnation pressure, (ii) Stagnation temperature, (Take for air : R = 287 J/kg K and $\gamma = 1.4$ ) | 10 |
| | b | In an air standard diesel cycle, the compression ratio is 15 and the properties at the beginning of compression are 100 kPa and 300 K. For a peak temperature of 1600 K, Calculate the percentage of stroke at which cut- off occurs and the cycle efficiency | 10 |

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QPcode: 10066930

SE Sem-III R-19 C Scheme Mechanical

3 Hours | III | Mechanical | SM | 14/11/2024 | Total Marks: 80

- **Question-1 is compulsory.**
- **Answer any three from remaining five questions.**
- **Assume any suitable data, wherever required, but justify the same. Assumptions made should be clearly stated.**
- **Illustrate the answers with sketches, wherever required.**

1 *Answer any four of the following:*

a. A material has Young's modulus of $2\times10^5$ N/mm$^2$ Poisson's ratio of 0.32, determine rigidity and Bulk modulus of the material. *(05)*

b. A rectangular beam 300mm deep is simply supported over a span 4m. What uniformly distributed load the beam can carry if the bending stress is not to exceed 120MPa. Take I $=8\times10^6$ mm$^4$. *(05)*

c. A water main 800mm diameter contains water at a pressure head of 100m. If the weight of water 10kN/m$^3$, find the thickness of metal required for the water main if permissible stress in metal is 20N/mm$^2$. *(05)*

d. State the assumptions made in the analysis of struts and columns by Euler's buckling theory. *(05)*

e. Draw shear stress distribution for I section, T section and rectangular section. *(05)*

f. Establish the relationship between shear force, bending moment and rate of loading. *(05)*

2 a) A solid circular shaft has to transmit 300 kW power at 100 rpm. If the shear stress is not to exceed 80 N/mm$^2$, find the diameter of the shaft. If this shaft were replaced by a hollow one whose internal diameter is 0.6 of its external diameter, What will be the % of saving of material. The length, material and shear stress are kept same. *(10)*

2 b) A composite bar is made of Steel and Aluminium is held between two supports as shown in fig 1. The bars are stress free at temp 38°C. What will be the stress in the two bars when temperature decreased to 21°C, the supports come near to each other by 0.1mm. Take Es $=210$ GN/m$^2$, $E_{Al}=100$ GN/m$^2$, $\alpha_s = 11.7\times10^{-6}$/°C and $\alpha_{Al} = 23.4\times10^{-6}$/°C *(10)*

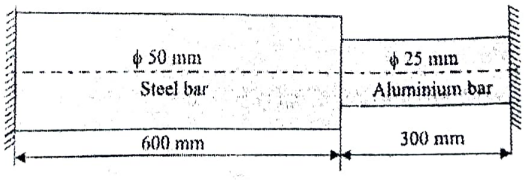


Fig.1

3 a) A T section (Flange =200mm×10mm, web=10mm×240mm) is used as struts which is 6m long, one end is hinged and other end is fixed. Determine the buckling load using Euler's formula. E=200×10$^3$ N/mm$^2$ *(10)*

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**3 b)** Figure 2, shows a C section subjected to a shear force of 18 kN intensity. Draw the shear stress distribution diagram across the section and obtain the shear stress values at all the salient points including the neutral axis. *(10)*

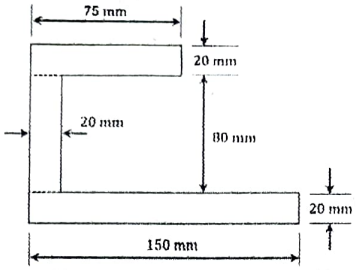


Fig.2

**4 a)** A cylindrical vessel of 1.5m diameter and 4m long is closed at ends by rigid plate. It is subjected to an internal pressure of $3N/mm^2$. If the maximum circumferential stress is not to exceed $150N/mm^2$, find the thickness of shell. Also change in diameter length and volume of the shell. Take $E=2\times10^5$ $N/mm^2$, 1/m =0.25 *(10)*

**4 b)** Draw shear force and bending moment diagram for beam shown in fig. 3 *(10)*

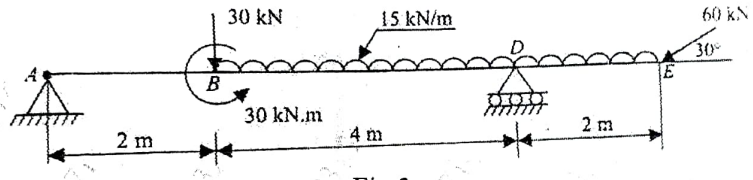


Fig.3

**5 a)** The beam has a T-shaped cross-section with a top flange measuring 90 mm × 20 mm and a web measuring 20 mm × 90 mm. The beam is a simply supported on a span of 8m and subjected to 1200N/m over entire span. Determine bending stresses in compression and tension, also sketch the bending stress distribution. *(10)*

**5 b)** Find the slope at A and deflection at a point C for the beam loaded shown in fig.4. Assume moment of inertia and modulus of elasticity as $I=20\times10^6$ $mm^4$ and E =200 $kN/mm^2$. *(10)*

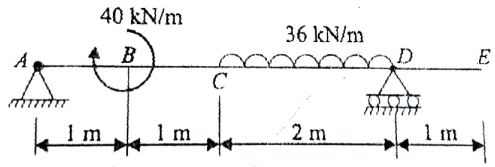


Fig. 4

**6 a)** Two mutually perpendicular plane of an element subjected to $\sigma_x$ =100MPa (tensile) and $\sigma_y$ =40MPa (compressive) and shear stress =30MPa. Locate the principal planes and determine the principal stresses, maximum shear stresses using Mohr's circle verify answers with analytical method. *(10)*

**6 b)** Determine instantaneous stress and deformation of a rod of length 1.2m and the diameter 8mm. If a mass of 90kg falls through a height f 15cm and strike the bottom of the rod. The rod is freely suspended and fixed at the top. Take E=210GPa. *(10)*

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QPcode : 10065696

SE sem-III Mechanical R-19 Cscheme

III | Mech | EM-III

*(3 Hours)* *Total Marks :80*

***Note: 1) Question No.1 is compulsory***
***2) Attempt any Three from the remaining***

**Q1**

**A)** Find $L\left\{\int_0^t e^{-u}\, u^n\, du\right\}$ **5**

**B)** Prove that $f(z) = e^z$ is analytic everywhere. **5**
Hence find $f'(z)$

**C)** Find half range sine series of $f(x) = x$ in $(0, \pi)$ **5**

**D)** If A=$[a_{ij}]$ is a matrix of order 3×3 such that $a_{ij} = \begin{cases} 1, & if\ i \neq j \\ 0, & if\ i = j \end{cases}$ **5**

Find an eigen value of
i) A
ii) adjoint of A
iii) $A^2 - 2A + 2I$

**Q2**

**A)** If L[f(t) ] = $\frac{1}{9s^2-3s+1}$ then Find L[te$^t$ f(3t)] **6**

**B)** Find Fourier series for $f(x) = x \quad , if\ 0 < x < 2\pi$ **6**
and $f(x + 2\pi) = f(x)$

**C)** Find analytic function f(z) in terms of z where **8**
$u = y^2 - x^2$

**Q3**

**A)** A string is stretched and fastened to two points distance $l$ apart. Motion is started by displacing the string in the form **6**
y=a sin(πx/ $l$) from which it is released at time t=0.Show that the displacement of a point at a distance x from one end at time t is given by y = a sin(πx/ $l$) cos (πct / $l$)

**B)** Prove that **6**
$u = e^x cosy$ is harmonic function hence find it's harmonic conjugate function

**C)** Find the Fourier Series for $f(x)$ in $(-\pi, \pi)$where **8**

$$f(x) = |x|$$

**Q4**

**A)** Evaluate $\int_0^\infty \left[\frac{cos2t-cos4t}{t}\right] dt$ **6**

**B)** Find Inverse Laplace transform of $\frac{s+1}{(s-1)^2(s-2)}$ **6**

**C)** *Is the matrix* $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ Diagonalizable? If so find the Diagonal form of A and transforming matrix of A **8**

**Q5**

**A)** If A=$[a_{ij}]$ is a matrix of order 3 × 3 such that 6

$$a_{ij} = \begin{cases} 2, & if\ i = j \\ -1 & ,if\ i + j = 3\ or\ 5 \\ 1\ , & if\ i + j = 4\ and\ i \neq j \end{cases}$$

Compute: $A^9 - 6A^8 - 9A^7 - 4A^6 + A^5 - 12A^4 - 18A^3 - 8A^2 + 2A + I$

**B)** Solve by Crank-Nicholson simplified formula $\frac{\partial^2 u}{\partial x^2} - 16\frac{\partial u}{\partial t} = 0$, 6

$0 \leq x \leq 1$ subject to the condition $u(0,t) = 0, u(1,t) = 100t$,

$u(x,0)$=0 h=0.25 for one-time step

**c)** Find inverse Laplace transform of $(i)\ log[z^2 - 4]$ $(ii)\ \frac{s+2}{(s+16)^2}$ 8

**Q6**

**A)** Find the Laplace Transform of $\int_0^t \cos(u)\sin(u)du$ 6

**B)** Find the solution of 6

$$4\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0, 0 < x < 8, \quad u(x,0) = 4x - \frac{1}{2}x^2, \text{ u(0,t)=0, u(8,t)=0}$$

Taking $h = 1, k = \frac{1}{8}$ $for\ 0 \leq t \leq 5/8$

Where h is the step length for $x\ axis$ and k is the step size in time direction using Bender –Schmidt method

**C)** Find inverse Laplace transform of $\frac{1}{(s^2+16)((s^2+49)}$ using convolution theorem 8

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