AIKTC/KRRC/SoET/ACKN/QUES/2017-18/ **Date:** _____

School: SoET-CBSGS **Branch:** MECH. ENGG. **SEM:** III

To,
Exam Controller,
AIKTC, New Panvel.

Dear Sir/Madam,

Received with thanks the following **Semester/Unit Test-I/Unit Test-II (Reg./ATKT)** question papers from your exam cell:

Sr. No.	Subject Name	Subject Code	Format		No. of Copies
			SC	HC	
1	Applied Mathematics- III	MEC301		✓	02
2	Thermodynamics	MEC302		✓	02
3	Strength Of Materials	MEC303		✓	02
4	Production Process-I	MEC304			

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

(26) SE-sem-(I) _ CBGS- Civil/Mech 20/11/18

Paper / Subject Code: 49201 / APPLIED MATHEMATICS III

Q. P. Code: 25571

(3hours) [Total marks: 80]

N.B. 1) Question No. 1 is compulsory.
2) Answer **any Three** from remaining
3) Figures to the right indicate full marks

1. a) Verify Laplace equation for $u = \left(r + \frac{a^2}{r}\right) cos\,\theta$. 5

b) Find Laplace transform of $f(t) = e^{-3t}\, sin\, 2t\, .\, cos 3t$. 5

c) Obtain Fourier series for $f(x) = x$ in $(-\pi, \pi)$. 5

d) Evaluate $\int_C (z^2 + 3z^{-4})\, dz$ where C is the upper half of the unit circle from (1,0) to (-1,0). 5

2. a) Obtain the Taylor's and Laurent series which represent the function $f(z) = \frac{z}{(z+1)(z-2)}$ in the regions, i) $|z| < 1$ ii) $1 < |z| < 2$ 6

b) Obtain Complex form of Fourier series for $f(x) = cos\, hx$ in $(-\pi, \pi)$ 6

c) Using Laplace transform, solve the differential equation:

$\frac{dx}{dt} + 2x = sin\omega t$, with $x(0) = 1$. 8

3. a) Solve $\frac{\partial^2 u}{\partial x^2} - 100\frac{\partial u}{\partial t} = 0$ with $u(0,t) = 0, u(1,t) = 0, u(x,0) = x(1-x)$ taking $h = 0.1$ for three time steps up to $t = 1.5$ by Bender –Schmidt method. 6

b) Find the bilinear transformation which maps the points $z = 1, i, -1$ into the points $w = 0, 1, \infty$. 6

c) Obtain half range Fourier sine series for $f(x) = \begin{cases} x, & 0 < x \leq \pi/2 \\ \pi - x, & \pi/2 \leq x < \pi \end{cases}$ 8

Hence, prove that –

$$\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \cdots.$$

[TURN OVER]

4. a) Find the orthogonal trajectory of the family of curves $2x - x^3 + 3xy^2 = c$ 6

b) Find the Fourier series for $f(x) = x|x|$ in $(-1, 1)$. 6

c) Find the inverse Laplace transform of:-

i) $F(s) = \frac{1}{s(s^2+16)}$, using Convolution theorem, ii) $F(s) = cot^{-1}(s+1)$. 8

5. a) Solve by Crank –Nicholson simplified formula $\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0$,

$u(0,t) = 0,\ u(5,t) = 100,\ u(x,0) = 20$ taking $h = 1$ for one-time step. 6

b) Find the image of the circle $|z| = 4$ in the z-plane under the transformation $w = z + 4 + 3i$. Draw the sketch. 6

c) Find the analytic function $f(z) = u + iv$ if

$$u - v = \frac{cos\, x + sin\, x - e^{-y}}{2\, cos\, x - e^{y} - e^{-y}}$$

when $f\left(\frac{\pi}{2}\right) = 0$. 8

6. a) Using Residue theorem, evaluate, $\int_0^{2\pi} \frac{d\theta}{5 - 3\cos\theta}$ 6

b) Using Laplace transform, evaluate $\int_0^{\infty} e^{-t}(1 + 3t + t^2)H(t-2)dt$ 6

c) A tightly stretched string with fixed end points $x = 0$ and $x = l$, in the shape defined by $y = kx(l - x)$ where k is a constant is released from this position of rest. Find $y(x,t)$, the vertical displacement if $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$. 8

(8) SE-sem-II – CBSGS – Mechanical 28/11/18

Paper / Subject Code: 50002 / THERMODYNAMICS

Q. P. Code: 26051

(3 Hours) **[Total Marks 80]**

N. B. : (1) Question No **1** is **compulsory.**
(2) Solve any **three** questions from remaining **five** questions.
(3) Assume suitable data if required.
(4) Use of Mollier Chart, Steam table is permitted.

1. Explain any **four** of the following: - **20**
   (a) Explain Zeroth law of thermodynamics with its significance.
   (b) Explain principle of increase of entropy.
   (c) What do you mean by available energy and unavailable energy? Explain with suitable example
   (d) Explain Rankine cycle with reheat.
   (e) Explain Atkinson cycle with T-S and H-S diagrams.
   (f) Explain adiabatic flame temperature with its practical significance.

2. (a) What do you mean by steady flow process. Write equation for steady flow process for compressor and boiler. **8**
   (b) A reversible heat engine operates between 875 K and 310 K and drives a reversible refrigerator operating between 310 K and 255 K. The engine receives 2000 kJ of heat and the net work output from the arrangement equals 350 kJ. Make calculations for the cooling effect. **12**

3. (a) Explain:- **8**
      i. State
      ii. Property
      iii. Pure substance
      iv. system
   (b) A lump of steel of mass 8 kg at 1000 K is dropped in 80 kg of oil at 300K Make calculations for the entropy change of steel, the oil and the universe. Take specific heats of steel and oil as 0.5 kJ/kg K and 3.5 kJ/kg K, respectively. **8**
   (c) Show that entropy is a property of system **4**

4. (a) Water at 25^0C is to be heated to 80^0C by utilizing the heat available from a source at a steady temperature of 500^0C. If the ambient temperature is 20^0C, what would be the (i) gain in availability of the water? (ii) Effectiveness of the heating process? **8**
   (b) A steam power plant operates ideally in the basic Rankine cycle. It receives 4 Mpa steam from the boiler firing coal to liberate heat at a steady rate of 100 MW. The steam after expansion in the turbine is exhausted to a condenser that operates at 7.5 kPa. **8**
   Calculate the:-
      i. cycle efficiency
      ii. work ratio for the cycle
      iii. power output (MW) of the plant
      iv. mass flow rate of the working fluid
      v. specific steam consumption

[TURN OVER]

SE-sem-III - CBSGS-Mech

4/12/18

Paper / Subject Code: 50003 / STRENGTH OF MATERIALS

Time -03 Hours **Total marks - 80**

N.B.: 1. Question No **1** is **compulsory**
2. Attempt any **Three** questions from the remaining five questions.
3. Assume any **suitable data** if necessary with justification.
4. Figures to the right indicate full marks.

Q1. Attempt any **four** of the following questions.

(a) State the physical significance of core of section. What is the limit of eccentricity of Section of solid rectangular column and hollow circular cylinder **05**

(b) Draw the relativity of stress with strain for ductile and brittle material **05**

(c) What are the limitations of Euler's theory? State the corrections made by Rankin Also state the different end conditions for column. **05**

(d) What is pure Torsion? State the assumption made in the theory of pure torsion. **05**

(e) What do you mean by temperature stresses? Explain. **05**

Q2. **(a)** A 10 mm steel rod passes centrally through a copper tube of 25mm external diameter and 15 mm internal diameter and 2.5 m long.Tube is closed at each end by 25 mm thick steel plates secured by nuts.The nuts are tightened until the copper tube is reduced in length by 0.8 mm.The complete assembly then raised in temperature by 30 degree centigrade. Determine the stresses in steel and copper tubes before and after the rise in temperature. **12**

Take, $E_s = 2 \times 10^5 N/mm^2$, $E_c = 1 \times 10^5 N/mm^2$,

Coefficient of thermal expansion of steel = $12 \times 10^{-6}/^0 C$

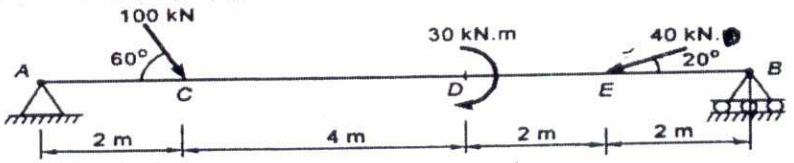
Coefficient of thermal expansion of copper = $18 \times 10^{-6}/^0 C$.

(b) A4 m long cast iron hollow column with both ends firmly fixed supports an axial load of 400 KN.The inside diameter of the column is 0.6 times the external diameter. Determine the section of the column. Assume factor of safety to be 5. **08**

Take $\sigma_c = 560 N/mm^2$ and $\alpha = 1/1600$.

Q3. **(a)** A cantilever beam has a length of 2 m. It is of 'T' section with the flange of 100 mm x 15 mm, web 200 x 10 mm. Determine the maximum load per m run that can be applied if the maximum tensile stress is not to exceed 25 N/mm^2. **12**

(b) Drawshear force and bending moment diagram for the beam loaded as shown in the figure. **08**

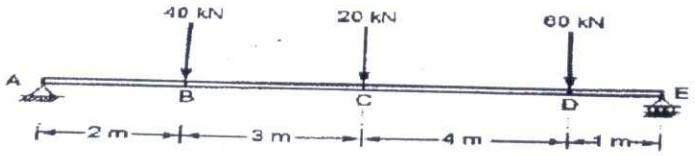


Q4. **(a)** A hollow circular shaft having 5 mm thickness is used for transmitting 250 kW power at 500 rpm. Determine the external and internal diameters of the shaft, if the permissible shear stress for the material of shaft is 50 N/mm^2.The maximum torque being 20% greater than mean torque. Take $G = 8 \times 10^4 N/mm^2$. **10**

(b) A load of 75 KN is carried by a column made of cast iron. The external and internal diameters are 200 mm and 180 mm respectively. If the eccentricity of the load is 35 mm, find: 1.The maximum and minimum stress intensities. 10

2. Upto what eccentricity there is no tensile stress in the column?

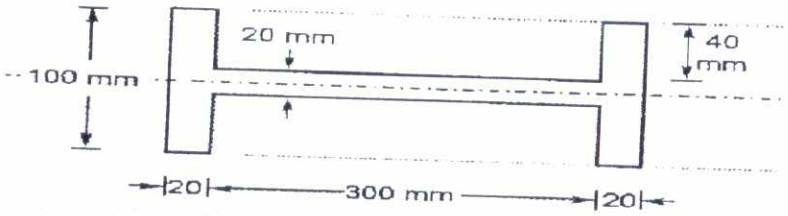
Q5. (a) Find the deflections of points B and C for the beam shown in figure. Assume EI = constant. Point A is a fixed support and point E is a roller support in the figure. 12



(b) State the assumptions made in the theory of pure bending and prove: 08

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

6. (a) A symmetrical I-section has flanges 100 mm x 20 mm and web 300 mm x 20 mm. Draw shear stress distribution diagram for a the section when web is horizontal as shown in figure. Take SF=100KN. 10



(b) An unknown weight falls though 8 mm on to a collar rigidly connected to the lower end of the vertical bar 4m long and 800 mm^2in section. If the maximum instantaneous extension is known to be 3 mm, what is the corresponding stress and the value of the unknown weight? Take E = 2 x 10^5 N/mm^2. 10

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