AIKTC/KRRC/SoET/ACKN/QUES/2018-19/ **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

(18)

9/5/19

SE - sem-II - CBSGS - civil/Mech

(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) Find Laplace transform of $f(t) = e^{-9t}\int_0^t u \sin 3u\, du$. 5

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

c) Show that $\{\sin nx, n = 1,2,3 \ldots\}$ is a set of orthogonal function over an interval $(-\pi, \pi)$. 5

d) Evaluate $\int_0^{3+i} |z|^2\, dz$ along the line $3y = x$ 5

2. a) Obtain two distinct Laurent's series for $f(z) = \frac{2z-3}{z^2-4z+3}$ indicating the region of convergence. 6

b) Find complex form of Fourier series of $f(x) = \cosh 2x$ in $(-3,3)$. 6

c) Using Laplace transform, solve the differential equation $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 1$ where $y(0) = 0, y'(0) = 1$ 8

3. a) Solve $\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0$ with $u(0,t) = 0, u(5,t) = 0, u(x,0) = x^2(25 - x^2)$ taking $h = 1$ up to $t = 3$ seconds by Bender –Schmidt method. 6

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

c) Obtain half range Cosine Series of $f(x) = \sin x$ in the interval $(0, \pi)$. Use Parseval's identity to prove that –

$$\frac{1}{1^2 \cdot 3^2} + \frac{1}{3^2 \cdot 5^2} + \frac{1}{5^2 \cdot 7^2} + \ldots = \frac{\pi^2 - 8}{16}.$$ 8

[TURN OVER]

4. a) Find the orthogonal trajectory of the family of curves, $x^3y - xy^3 = c$, where c is a constant. 6

b) Obtain Fourier Series of $f(x) = |x|$ in $(-\pi, \pi)$ 6

c) Find the inverse Laplace transform of :-

i) $F(s) = \frac{1}{s(s^2+4)}$, using Convolution theorem, ii) $F(s) = \frac{e^{-3s}}{(s-2)^4}$. 8

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

$u(0,t) = u(1,t) = 0, u(x,0) = 200(x - x^2)$

taking $h = 0.25$ for one-time step. 6

b) Find an analytic function $f(z) = u + iv$, if 6

$$u = e^{-x}\{(x^2 - y^2)\cos y + 2xy \sin y\}$$

6

c). Obtain Fourier series of $f(x) = x^2$ in $(0,2\pi)$. Hence, deduce that – 8

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + + \cdots$$

6. a) Using Residue theorem, evaluate, $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+1)(x^2+4)} dx$ 6

b) Find the Laplace transform of

$f(t) = \begin{cases} t, & 0 < t < 1 \\ 0, & 1 < t < 2 \end{cases}$ and $f(t+2) = f(t)$ for $t > 0$. 6

c) A string is stretched and fastened to two points distance l apart. Motion is started by displacing the string in form $y = a\sin(\pi x / l)$ from which it is released at a time $t = 0$. If the vibrations of a string is given by $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ show that the displacement of a point at a distance x from one end at time t is given by $y(x,t) = a\sin(\pi x / l)\cos(\pi ct / l)$. 8

SE-Sem-IV-~~CBSGS~~ CBSGS- Mechanical

Paper / Subject Code: 50002 / THERMODYNAMICS

14/5/11

Q.P.Code: 21492

3 Hrs 80 Marks

NOTE:

- Question No 1 is **COMPULSORY**.
- Attempt any **THREE** questions out of remaining questions.
- Assume suitable data wherever required.
- Illustrate answers with sketches wherever required.
- Use of steam table, Gas table and Mollier chart is permitted.

Q. 1 Solve the following **(any FIVE)** **20**

(a) Define isothermal process. Draw PV and TS diagram and derive equation for work done.

(b) Differentiate between Intensive and extensive properties with example.

(c) Explain Closed, Open and Isolated system with neat sketch.

(d) Explain Carnot cycle with help of P-V and T-S diagram.

(e) What is Joule-Thomson coefficient? State its significance.

(f) Define Calorific value, enthalpy of formation and enthalpy of combustion.

Q. 2 (a) Define available and unavailable energy. **04**

(b) Define dead state and irreversibility. **04**

(c) A perfect gas undergoes a cycle comprises of three processes. It is first compressed isothermally from 1 bar and 27 °C to one-eighth of its initial volume. The energy is then added at constant pressure, increasing the temperature of gas and the cycle is completed by isentropic expansion to original conditions. Take Cp =1.25 kJ/kgK and R = 0.5 kJ/kg.K. Determine: (i) maximum cycle temperature and pressure (ii) net work done per kg of gas. Draw P-V diagram. **12**

Q. 3 (a) Define Dryness fraction, Degree of superheat, critical point, triple point. Show the critical and triple point on p-T diagram for water. **08**

(b) Air flows steadily at the rate of 0.5 kg/s through an air compressor entering at 7 m/s velocity, 100 kPa pressure and 0.95 m^3/kg specific volume and leaving at 5 m/s, 700 kPa and 0.19 m^3/kg respectively. The internal energy of the air leaving is 90 kJ/kg greater than of air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58kW. Calculate (i) Power input to the compressor (ii) ratio of inlet pipe diameter to outlet pipe diameter. **12**

Q. 4 (a) A reheat Rankine cycle has steam generated at 50 bar, 500°C for being sent to high pressure turbine and expanded upto 5 bar before supplied to low pressure turbine. Steam enters at 5 bar, 400°C into low pressure turbine after being reheated in boiler. Steam finally enters condenser at 0.05 bar and subsequently feed water is sent to boiler. Determine cycle efficiency. **10**

(b) State and prove Clausius inequality theorem. **10**

TURN OVER

Q. 5 (a) Define compression ratio, clearance ratio, cutoff ratio, expansion ratio and mean effective pressure. Show on PV diagram of cycle. **05**

(b) Find the internal energy of 1 kg of steam at a pressure of 10 bar when the condition of the steam is wet with $x = 0.5$ and superheated with degree of superheat = 50°C. **05**

(c) Determine the enthalpy of combustion of liquid octane C_8H_{18} at 25 °C and 1 atm using following data: **10**
Enthalpy of formation for CO_2 at 25°C & 1 atm = −3935000 kJ/kmol
Enthalpy of formation for H_2O (*l*) = −286 MJ/kmol
Enthalpy of formation for C_8H_{18} (*l*) = −250 MJ/kmol
Calculate in mJ/kg of C_8H_{18}. Take molar mass of C_8H_{18} = 114 kg/kmol.

Q. 6 (a) In an air standard Diesel cycle, at the beginning of compression, cylinder volume is 1500 cm^3 and at the end of heat addition process it is 150 cm^3. Compression ratio is 15. Air is at 101 kPa and 20°C at the beginning of compression process. Calculate: pressure at the beginning of heat rejection, net work done and mean effective pressure. **12**

(b) Write Maxwell equations. **04**

(c) Explain low and high calorific values. Write equations also. **04**

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(3)

SE - Sem - III - CBSGS - Mech

20/5/19

Paper / Subject Code: 50003 / STRENGTH OF MATERIALS

QP CODE : 40717

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) Draw the shear force and bending moment diagram for a simply supported beam carrying a concentrated load not at mid span. **05**

(b) Write a short note on Macaulay's method **05**

(c) Obtain the core of section for Rectangular Section. **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 = $12 \times 10^{-6}/^0 C$

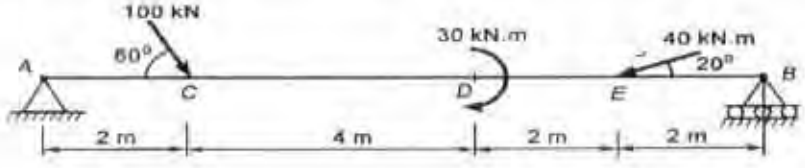
Coefficient of thermal expansion of copper = $18 \times 10^{-6}/^0 C$.

(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**

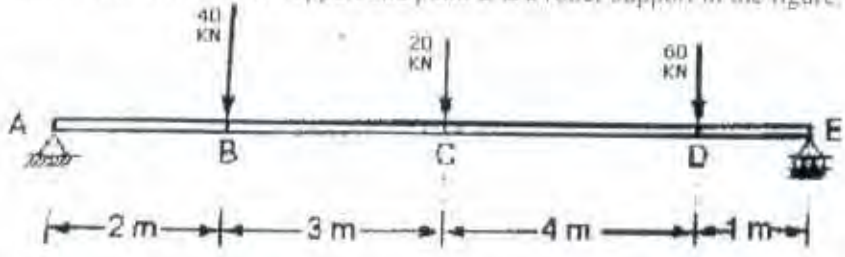


Q4. (a) 4a) A hollow circular shaft having 5 mm thickness is used for transmitting 250 kW power at 500 rpm. Determine the external and internal diameters of the shaft, if the permissible shear stress for the material of shaft is 50 N/mm^2. The maximum torque being 20% greater than mean torque. Take G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

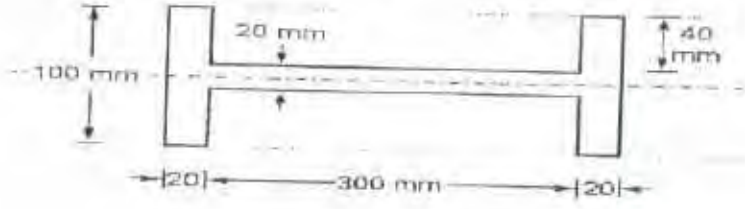
Q5. (a) Find thedeflections of points B and C for the beam shown in figure. Assume EI constant. Point A is a fixed support and point E is a roller support in the figure. 12



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

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

Q6. (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^2 in section. If the maximum instantaneousextension is known to be 3 mm, what is the corresponding stress and the value ofthe unknown weight?Take E = 2 x 10^5 N/mm^2. 10