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

School: SoET-CBCS **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		✓	
2	Thermodynamics	MEC302		✓	
3	Strength Of Materials	MEC303		✓	
4	Production Process-I	MEC304		✓	
5	Material Technology	MEC305		✓	

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

40+19 = (59)

SE-Sem-III - Choice-Based - Civil/Mech - AM-III

8/5/18

Q.P. Code : 39159

(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 $f(t) = e^{-t} \sin t . cos2t.$ 5

b) Show that the set of functions $\cos nx, n = 1,2,3 \ldots \ldots$ is orthogonal on $(0,2\pi)$. 5

c) The equations of lines of regression are $x + 2y = 5$ and $2x + 3y = -8$.
Find i) means of x and y, ii) coefficient of correlation between x and y. 5

d) Evaluate $\int_c (z^2 - 2\bar{z} + 1)dz$ where C is the circle $|z| = 1$. 5

2. a) Using convolution theorem, find the inverse Laplace transform of 6

$$F(s) = \frac{1}{(s^2+9)(s^2+4)}$$

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

c) Find the bilinear transformation which maps the points $z = 1, i, -1.$ onto the points $w = i, 0, -i$. Hence, find the image of $|z| < 1$ onto the w-plane. 8

3. a) If $v = e^x siny$, prove that v is a harmonic function. Also find the corresponding harmonic conjugate function and analytic function. 6

b) Using Bender –Schmidt method, solve $\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0$, subject to the conditions,

$u(0,t) = 0, u(5,t) = 0, u(x,0) = x^2(25 - x^2)$ taking $h = 1$, for 3 minutes. 6

c) Using Residue theorem, evaluate

i) $\int_0^{2\pi} \frac{d\theta}{2+cos\theta}$ ii) $\int_0^{\infty} \frac{dx}{x^2+1}$ 8

[TURN OVER]

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

$u(0,t) = 0,\ u(1,t) = 2t,\ u(x,0) = 0$ taking $h = 0.25$ for two-time steps. 6

b) 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

c) Solve $(D^2 - 3D + 2)y = 4e^{2t}$ with $y(0) = -3\ , y'(0) = 5$ where $D \equiv \frac{d}{dt}$ 8

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

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

b) Find the Laplace transform of $\frac{\sin at}{t}$. Does the L.T of $\frac{\cos at}{t}$ exist? 6

c) Obtain half range Fourier cosine series of $f(x) = x, 0 < x < 2$. Using Parseval's identity, deduce that – 8

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

6. a) Obtain Complex form of Fourier series of $f(x) = e^x\ , -1 < x < 1$ 6

b) Fit a straight line to the following data, 6

x	100	120	140	160	180	200
y	0.45	0.55	0.60	0.70	0.80	0.85

c) A string is stretched and fastened to two points distance l apart. Motion is started by displacing the string in form $y = asin(\pi x / l)$ 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

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SE-Sem-III – Choice Based – Mechanical – Thermo

16/5/18

Q. P. Code: 39992

Time: 3 Hours **Total Marks: 80**

N. B. : (1) Question No. **1** is **compulsory**.
(2) Solve any **three** out of the remaining **five** questions.
(3) Assume suitable data if required and state it clearly.
(4) Use of Steam Table and Mollier diagram is permitted.

1. Attempt any **four** out of the following **20**
   (a) State Kelvin-Plank statement and Clausius statement of the second law of thermodynamics.
   (b) Draw a neat diagram of Roots blower and explain its working.
   (c) Show that energy is property of a system.
   (d) Draw a simple schematic diagram of a thermal power plant with one reheater. Also represent this on T-S diagram
   (e) Define dryness fraction, saturation temperature, work ratio and specific steam consumption.

2. (a) Steam enters a nozzle at a pressure of 7 bar and 200^{0}C with an initial enthalpy of 2850 kJ/kg and leaves at a pressure of 1.5 bar. The initial velocity of steam at the entrance is 40 m/s and the exit velocity from the nozzle is 700 m/s. The mass flow rate through the nozzle is 14000 kg/hr, the heat loss from the nozzle is 11705 kJ/hr. Find the final enthalpy of steam and the nozzle area at exit if the specific volume at exit is 1.24 m^3/kg. **10**
   (b) State and prove the Clausius inequality. **5**
   (c) What is available energy and unavailable energy? **5**

3. (a) A heat engine is used to drive a heat pump. The heat transfers from the heat engine and the heat pump are used to heat the water circulating through the radiators of a building. The efficiency of the heat engine is 27% and the COP of the heat pump is 4. Evaluate the ratio of the heat transfer to the circulating water to the heat transfer to the heat engine. **10**
   (b) Write Maxwell's equations. **5**
   (c) State and prove Clausius theorem. **5**

4. (a) In a Rankine cycle the stream at the inlet to the turbine is at 100 bar and 500^{0}C. If the exhaust pressure is 0.5 bar, determine the pump work, turbine work, condenser heat flow and Rankine efficiency. **10**
   (b) With the help of P-V and T-S diagram, compare the efficiencies of Otto, Diesel and Dual cycle for the same compression ratio and the same heat rejection. **5**
   (c) What do you understand by multistage compression? What are its merits over single stage compression? **5**

5. (a) 0.06 m^3 of air at 5 bar and 200^{0}C expands isentropically until the pressure becomes 2 bar. It is then heated at constant pressure until the enthalpy increase during this process is 80 KJ. Calculate the work done in each process and the total work done. **10**

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(b) In an I.C. engine operating on the dual cycle, the temperature of the working fluid (air) at the beginning of the compression is 27^0C. The ratio of the maximum and minimum pressures of the cycle is 70 and compression ratio is 15. The amounts of heat added at constant volume and constant pressure are equal. Compute the air standard thermal efficiency of the cycle. **10**

6. (a) Derive an expression of air standard efficiency for diesel cycle. **10**

(b) A single stage reciprocating air compressor has a swept volume of 2000 cm^3 and runs at 800 rpm. It operates on a pressure ratio of 8, with a clearance of 5% of the swept volume. Assume NTP room conditions and at inlet (p = 101.3 kPa, T = 15^0C) and polytropic compression and expansion with n = 1.25. Calculate: **10**

(a) Indicated power
(b) Volumetric efficiency
(c) Mass flow rate
(d) Free air delivery
(e) Isothermal efficiency, and
(f) The actual power needed to drive the air compressor, if the mechanical efficiency is 85%

3x

SE-sem III- Choice Based - Mech-SOM 22/5/18

QP CODE : 27637

(Three Hours) **Marks 80**

- ***Q1** is **compulsory**. Answer **any three** from the remaining **five** questions.*
- *Assume suitable data, wherever required.*
- *State the assumptions and justify the same.*
- *Illustrate answers with sketches, wherever required.*
- *Write legibly with blue or black ink pen. Use pencil only to draw diagrams and graphs.*

I Answer any four of the following.

a. Define bulk modulus. Derive an expression for Young's modulus, in terms of bulk modulus and Poisson's Ratio. *[05]*

b A short column of external diameter 400 mm and internal diameter 200 mm carries an eccentric load of 80 kN. Find the greatest eccentricity, which the load can have without producing tension on the cross section.

c. State the assumptions in the theory of pure bending and derive the formula, *[05]*

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

d. Find the maximum shear stress induced in a solid circular shaft of diameter 150 mm, when it transmits 150 kW power at 180 rpm. *[05]*

e. A steel bar of 50 mm x 50 mm in section and 3 m length is subjected to an axial pull of 140 N. Calculate the strain energy stored in the bar. Find also the extension of the bar. Take E= 200 GPa *[05]*

f. A cantilever of length 4 m carries uniformly varying load of intensities zero at free end and 2 kN/m at fixed end. Draw shears force and bending moment diagrams for the beam. *[05]*

II a. A compound tube consists of a steel tube of 140 mm internal diameter and 160 mm external diameter; and an outer brass tube of 160 mm internal diameter and 180 mm external diameter. Both the two tubes are of 1.5 m length. If the compound tube carries an axial compressive load of 900 kN, find its reduction in length. Also, find the stresses and the loads carried by each tube. *[10]*

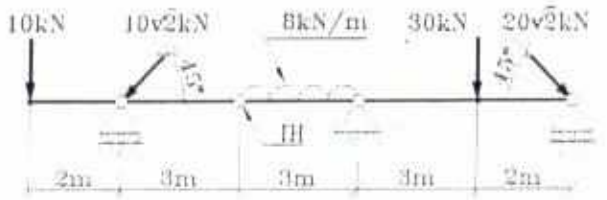
$$E_s = 2 \times 10^5 N/mm^2,\ E_b = 1 \times 10^5 N/mm^2$$

b. A point load of 10 kN applied to a simply supported beam at mid-span, produces a deflection of 6 mm and a maximum bending stress of 20 N/mm^2. Calculate the maximum value of the momentary stress produced, when a weight of 5 kN is allowed to fall through a height of 18 mm on the beam at the middle of the span. *[10]*

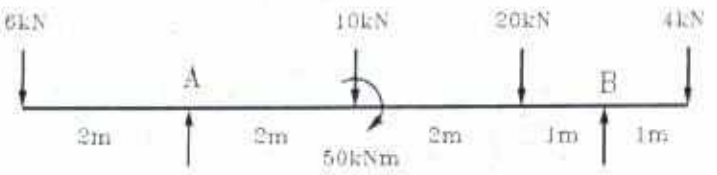
III a. Two mutually perpendicular planes of an element of material are subjected to tensile stress of 105 N/mm^2, compressive stress of 35 N/mm^2 and shear stress of 70 N/mm^2. Find graphically or otherwise, *[10]*

i. Magnitude and the direction of principal stresses
ii. Magnitude of the normal and the shear stresses on a plane, on which the shear stress is maximum

b. Draw axial force , shear force and bending moment diagrams for the beam loaded as shown in figure. Locate all important points. *[10]*



IV a. Determine the position and the amount of maximum deflection for the beam shown in the figure. Take, $EI = 1.8 \times 10^4\ kNm^2$. *[10]*



b. A weight of 200 kN is supported by three adjacent short pillars in a row, each 500 mm² in section. The central pillar is made of steel and the outer ones are of copper. The pillars are adjusted such that at 15 °C, each carries equal load. The temperature is then raised to 115 °C. Estimate the stresses in each pillar at 15°C and 115 °C. Take: $E_s=2\times10^5$ N/mm², $E_c= 0.8\times10^5$ N/mm², $\alpha_s= 1.2\times10^{-5}$/°C, $\alpha_c= 1.85\times10^{-5}$/°C *[10]*

V a. A hollow shaft, having an internal diameter 40% of its external diameter, transmits 562.5 kW power at 100 rpm. Determine external diameter of the shaft, if shear stress is not to exceed 60 N/mm², and the twist in a length of 2.5 m should not exceed 1.3°. Assume that the maximum torque is 1.25 time the mean torque and $G = 9 \times 10^4\ N/mm^2$. *[10]*

b. A closed cylindrical vessel made of steel plates 4 mm thick with plane ends carries fluid under a pressure of 3 N/mm². The diameter of the cylinder is 250 mm and the length is 750 mm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the changes in diameter, length and volume of the cylinder. *[10]*

$$E = 2.1 \times 10^5 N/mm^2, \qquad \frac{1}{m} = 0.286$$

VI a. A hollow cast iron column of 200 mm external diameter, 150 mm internal diameter and 8 m long has both ends fixed. It is subjected to axial compressive load. Taking factor of safety as 6, $\sigma_c = 560\ N/mm^2$, $\alpha = \frac{1}{1600}$, determine the safe Rankine load. *[08]*

b. A simply supported beam carries a UDL of intensity 2.5 kN/m over a span of 5 m. The cross-section is T-section having flange 125 mm x 25 mm and web 175 mm x 25 mm. Calculate maximum bending stress and shear stress for the section of the beam. Also, draw the shear stress distribution diagram for maximum shear force. *[10]*

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(25) SE-sem-III - Choice Based - Mech - P.P-I 2/6/18

QP Code : 50737

03 Hours **[80 Marks]**

N.B. a. Question no.1 is **compulsory**.
b. Attempt any three questions out of remaining five questions
c. Figures to right indicates full marks

Q1 Attempt any **four** of the following [20]
a. Describe automatic machines.
b. What is thread rolling?
c. How are seamless tubes manufactured?
d. Explain explosive welding
e. Differentiate between arc welding and electron beam welding.

Q2. a. With a neat sketch explain the principle and working of laser beam welding. Also discuss its advantages, limitations and application. [08]
b. Differentiate between the open loop and close loop system. [06]
c. Explain gas cutting operation. [06]

Q3. a. Compare thermoplastics and thermosetting plastics. [08]
b. Describe the desirable properties of moulding sand. [06]
c. What are transfer machines? [06]

Q4. a. Describe types of drilling machines and there application. [08]
b. Explain blow moulding process with a neat sketch. [06]
c. What is riser? Discuss its types and application. [06]

Q5. a. Discuss various defects found in welding. [08]
b. Define weldability and describe the factors affecting it. [06]
c. Differentiate between hot working and cold working processes. [06]

Q6. a. What are the constituents of moulding sand? Discuss their function. [08]
b. Describe machining the operations performed on lathe machine. [06]
c. Define the terms 'Spread', 'Elongation' and 'Draft' with respect to rolling process. [06]

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34 SE-sem-III- choice Based - Mech - MT 1/6/18

Q. P. Code: 37936

Time: 3 hours Marks: 80

N. B. 1) Question No. 1 is compulsory.
2) Attempt any three questions from remaining five questions.
3) Figures at right indicate marks.

Q. 1 Write notes on **any four:-** (5x4=20)
a) Smart materials
b) Creep Test
c) Effect of Alloying elements on properties of steel.
d) Critical resolved shear stress
e) Classification of Stainless steels

Q. 2 a) What do you understand by Composite materials? Explain their properties and applications. (10)
b) What is Fatigue? Explain fatigue testing in detail. (10)

Q. 3 a) Draw Fe-Fe_3C Diagram and Explain cooling of 0.9 % C alloy in the Fe-Fe_3C Diagram. (10)
b) How are dislocations regenerated at Frank Reed Source? Explain with neat diagram. (10)

Q. 4 a) Draw and explain construction of Time Temperature Transformation (TTT) diagram. Also indicate various cooling patterns on the diagram. (10)
b) Derive an expression for Griffith theory of brittle fracture. Explain Orowan's Modification. (10)

Q. 5 a) Explain slip and twin mechanism of plastic deformation. (10)
b) Classify Crystal Imperfections. Distinguish between Edge and Screw dislocation. (10)

Q. 6 Write short notes on **any four** (5x4=20)
a) Hardenability test
b) Martempering
c) Synthesis of Nanomaterials
d) Recrystallisation annealing
e) Rule of mixtures for composites

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