AIKTC/KRRC/SoET/ACKN/QUES/2018-19/ **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		✓	02
2	Thermodynamics	MEC302		✓	02
3	Strength Of Materials	MEC303		✓	02
4	Production Process-I	MEC304		✓	02
5	Material Technology	MEC305		✓	02

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

(148)

SE - sem-III - Choice Based - Mech/Civil

Paper / Subject Code: 50801 / APPLIED MATHEMATICS- III

8/5/19

(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 $f(t) = t\int_0^t e^{-2u}sin4u\,du$. 5

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

c) Calculate Spearman's rank correlation coefficient R, from the given data. 5

X:	12,	17,	22,	27,	32.
Y:	113,	119,	117,	115,	121

d) Find the constants a, b, c, d, e if
$f(z) = ax^3 + bxy^2 + 3x^2 + cy^2 + x + i(dx^2y - 2y^3 + exy + y)$
is analytic. 5

2. a) Find Laplace transform of the periodic function, defined as
$f(t) = \begin{cases} t, & 0 < t < 1 \\ 0, & 1 < t < 2 \end{cases}$ and $f(t+2) = f(t)$ for $t > 0$ 6

b) If $v = 3x^2y + 6xy - y^3$, show that v is harmonic and find the corresponding analytic function $f(z) = u + iv$. 6

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

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

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

$$F(s) = \frac{1}{s^2(s+5)^2}$$

b) Solve $\frac{\partial^2 u}{\partial x^2} - 16\frac{\partial u}{\partial t} = 0$, subject to the conditions,
$u(0,t) = 0, u(1,t) = 3t, u(x,0) = 0, \quad 0 \le x \le 1$, taking $h = 0.25$
up to 3 seconds only by using Bender –Schmidt method. 6

c) Using Residue theorem, evaluate,
i) $\int_0^{2\pi} \frac{d\theta}{17 - 8cos\theta}$ ii) $\int_0^{\infty} \frac{dx}{(x^2+1)^2}$ 8

[TURN OVER]

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

$u(0,t) = 0,\ u(1,t) = 0, u(x,0) = 100(x - x^2)$, with $h = 0.25$ for one-time step. 6

b) Evaluate $\int_c \frac{z}{(z-2)(z+1)^2} dz$, $C: |z| = 3$. 6

c) Solve $(D^2 - 2D + 1)y = e^{-t}$ with $y(0) = 2, y'(0) = -1$ where $D \equiv \frac{d}{dt}$ 8

5. a) Obtain all possible Taylor's and Laurent series which represent the function $f(z) = \frac{z}{z^2-5z+6}$ indicating the region of convergence. 6

b) Evaluate $\int_0^\infty te^t cos^2 t\, dt$ 6

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

$$\frac{\pi^4}{90} = \frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} + \cdots\cdots$$

6. a) Find the image of the circle $|z| = 2$ under the transformation $w = z + 3 + 2i$. Draw the sketch. 6

b) A rectangular metal plate with insulated surfaces of width l and so long as compared to its breadth that it can be considered infinite in length without introducing an appreciable error. If the temperature along one short edge $y = 0$ is given by $u(x,0) = u_0 \sin\left(\frac{\pi x}{l}\right)$ for $0 < x < l$ and other long edges $x = 0$ and $x = l$ and the short edges are kept at zero degrees temperature, find the function $u(x,y)$ describing the steady state, assuming that in the steady state the heat distribution function $u(x,y)$ satisfies the Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$. 6

c) Production (in metric kiloton) of wheat in a country is given by the following data.

Year (x)	2005	2007	2009	2011	2013	2015	2017
Production (y)	8	12	15	19	21	22	25

Fit a straight line to the data and estimate the production in the year 2010. 8

SE- Sem III - Choice Based - Mech

14/5/19

Paper / Subject Code: 51602 / Thermodynamics

Q. P. Code: 39994

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) What is the difference between a closed and an open system

(b) Define Mech. Efficiency in case of reciprocating air compressor and state the methods used to improve isothermal efficiency?

(c) Define: available energy, dead state and irreversibility

(d) Draw a simple schematic diagram of a thermal power plant with one reheater. Also represent this on T-S diagram

(e) Write four Maxwell relations.

2 (a) A fluid system contained in a piston cylinder machine, passes through a complete cycle of four processes. The sum of all heat transfer during the cycle is -170 KJ. The system completes 100 cycles/min. Complete the following table showing the method for each process and compute the net rate of work output in KW. 12

Process	Q(KJ/min)	W(KJ/min)	ΔE(KJ/min)
1-2	0	2170	----
2-3	21000	0	----
3-4	-2100	----	-36600
4-1	----	----	----

(b) Derive and show that the efficiency of Brayton cycle depends on the pressure ratio. 8

3 (a) Air enters a compressor operating at steady state at a pressure of 1 bar, a temperature of 290 K and a velocity of 6 m/s through an inlet with an area of 0.1 m^2. At exit the pressure is 7 bar, the temperature is 450 K and the velocity is 2 m/s. Heat transfer from the compressor to the surroundings occur at the rate of 180 kJ/min. Employing the ideal gas model , calculate the power input to the compressor. 10

(b) Calculate the decrease in exergy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of surroundings being 15°C. 10

4 (a) Explain the Carnot heat engine cycle executed by a) a stationary system and b) a steady flow system. 8

(b) Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If the work output of A is twice that of B, find a) intermediate temperature between A and B b) efficiency of each engine and c) the heat rejected to the cold sink. 12

5 (a) 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°C. 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

(b) Air initially occupying 1 m^3 at 1.5 bar, 20°C undergoes an internally reversible compression for which PV^n = constant to a final state where the pressure is 6 bar and temperature is 120°C. Determine i) the value of n ii) the work and heat transfer iii) change in entropy 10

6 (a) In a Rankine cycle the stream at the inlet to the turbine is at 100 bar and 500°C. If the exhaust pressure is 0.5 bar, determine the pump work, turbine work, condenser heat flow and Rankine efficiency. 10

(b) What is meant by complete and perfect intercooling in case of multistage air compressor? What is the effect of multi staging over the volumetric efficiency of reciprocating air compressor? 10

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Q. P. Code: 39566

3 Hours **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 answers with sketches wherever required.

1 Answer any four of the following:

Ia. A material has Young's Modulus of 2×10^3 N/mm^2 and Poisson's Ratio of 0.32. Calculate the Modulus of Rigidity and Bulk Modulus of the material. *05*

Ib. Derive the relationship between the rate of loading, shear force and bending moment in a beam. *05*

Ic. A simply supported beam of span 4 m with EI constant throughout the span is subjected to a load of 24 kN at 3 m from left end support. Find total strain energy of the beam in bending. *05*

Id. State the assumptions made in the theory of pure bending and derive the formula. *05*

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

Ie. A short column of external diameter 400 mm and internal diameter 200 mm carries an eccentric load of 90 kN. Find the greatest eccentricity, which the load can have without producing tension on the cross section. *05*

IIa. For a beam loaded as shown in figure, calculate the value for UDL, w so that bending moment at C is 50 kNm. Draw the shear force and bending moment diagrams for the beam for the calculated value of w. Locate the point of contra flexure, if any. *12*

IIb. An elemental cube is subjected to tensile stresses of 30 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress. *08*

IIIa. A box beam supports the loads as shown in figure. Compute the maximum value of P that will not exceed bending stress $\sigma = 8$ MPa or shear stress $\tau = 1.2$ MPa for section between the supports. Also, draw the shear stress distribution diagram at a section where shear force is maximum. *12*

IIIb. Find the principal moments of inertia and directions of principal axes for the angle section shown. All dimensions are in cm. *08*

IVa. A stepped round bar ABCD is fixed to unyielding support at sections A&D as shown in figure. It is subjected to axial loads at sections B and C. Determine, stresses in each portion of the bar and deflections of sections B and C. Take E= 200 GN/m^2 *10*

IVb. A cylindrical vessel of 1.5 m diameter and 4 m long is closed at ends by rigid plate. It is subjected to an internal pressure of 3 N/mm^2. If maximum circumferential stress is not to exceed 150 N/mm^2, find the thickness of the shell. Find change in diameter, length and volume of the shell. *10*

Assume E= 2 x 10^5 N/mm^2 and Poisson's ratio= 0.25.

Va. Determine the diameter of a solid steel shaft that will transmit 150 kW at a speed of 3 rev/sec, if the allowable shearing stress is 85 MPa. Also, determine the diameter of a hollow steel shaft, whose inside diameter is ¾th of its outside diameter for the same conditions. What is the ratio of angle of twist per unit length for these two shafts? *10*

Vb. An overhanging beam ABC is loaded as shown in figure. Find the slopes over each support and the deflection at the right end. Take E= 2 x 10^5 N/mm^2 and I= 5 x 10^8 mm^4 *10*

VIa. A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly fixed at each end. If at a temperature of 10 °C, there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200 °C. Take E for steel and copper as 2.1 x 10^5 N/mm^2 and 1 x 10^5 N/mm^2 respectively. The value of coefficient of linear expansion for steel and copper is given as 11 x 10^{-6}/°C and 18 x 10^{-6}/°C respectively. *10*

VIb. From the following data, determine the thickness of cast iron column. Assume both the ends of the column are fixed. *10*

Length of the column= 3 m	Factor of Safety= 5
External diameter= 200 mm	Ultimate compressive stress= 570 N/mm^2
Safe working load= 600 kN	Rankine constant= 1/ 1600

SF . sem-iii. chcla Based - Mech

20

24/5/19

Paper / Subject Code: 51604 / Production Process -I

Time: 3 Hours **Max Marks: 80**

Instructions:

1. **Question no. 1 is compulsory.**
2. **Answer any three questions of the remaining five questions.**
3. **Make suitable assumptions wherever necessary.**
4. **Figures to the right indicate full marks.**

Q.1. Attempt the following two questions: (10 marks each).

a. Classify Production Processes in detail. 10

b. Compare wood and metal as pattern materials. 10

Q.2. Attempt the following two questions: (10 marks each).

a. Describe the CO2 Shell Moulding Process. 10

b. Differentiate between MIG welding and TIG welding. 10

Q.3. Attempt the following two questions: (10 marks each).

a. Describe Rolling process in general with a neat labeled sketch. 10

b. Compare Drop Forging with Hammer Forging process. 10

Q.4. Attempt the following two questions: (10 marks each).

a. Describe the Blow Moulding process for plastics. 10

b. Describe Reaction Moulding of polymers with a neat labeled sketch. 10

Q.5. Attempt the following two questions: (10 marks each).

a. How does a Gear Cutting process differ from a Gear Generating process? 10

b. How can a lathe machine be specified for the purpose of purchasing? 10

Q.6. Attempt the following two questions: (10 marks each).

a. What is meant by a 'Closed Loop Control System' and an 'Open Loop Control System'? 10

b. What is a Transfer Line Machine? Draw a neat labeled sketch. 10

SE-sem-II - Choice Based-Mech

30/5/19

29

Paper / Subject Code: 51605 / Mateial Technology

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:- **(20)**
a) Explain thermal fatigue of metal.
b) What are smart materials? Where are they used?
c) Write the difference between ductile fracture and brittle fracture.
d) Explain Hume- Rothery's rules of solid solubility.
e) Explain the transformation of austenite to Bainite.

Q. 2 a) What is dislocation? What are the sources of dislocation? Compare edge and screw dislocation. **(10)**
b) What is recrystalliztion annealing? Discuss the various stages of recrystallization annealing. **(05)**
c) Write the difference hot working and cold working. **(05)**

Q. 3 a) What are the characteristic of brittle fracture? Discuss Griffith's theory and derive its equation. **(10)**
b) Discuss ductile-brittle transition in steel. **(05)**
c) Define creep and explain stages of creep. **(05)**

Q. 4 a) Draw Fe-Fe_3C diagram indicating all important temperatures, phases and compositions. Explain slow cooling of an alloy containing 0.9% carbon when cooled from 1600^0 C temperature to room temperature. **(10)**
b) Write short note on allotropic forms iron. **(05)**
c) Draw and explain Isomorphous phase diagram. **(05)**

Q. 5 Write short notes on following : **(20)**
a) Nano-materials
b) Discuss the process of nitriding.
c) What are composites? Write its characteristics
d) Explain the effect of retained austenite on steels.
e) What are stainless steels? Give brief of classification of stainless steels

Q. 6 a) Draw TTT curve for a eutectoid steel and explain the effects of various cooling curves on transformation products **(10)**
b) Write the classification of tool steels **(05)**
c) Explain induction hardening process **(05)**
