AIKTC/KRRC/SoET/ACKN/QUES/2018-19/ **Date:** _____

School: SoET-CBCS **Branch:** MECH. ENGG. **SEM:** V

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	IC Engines	MEC501		✓	02
2	Mechanical Measurement & Controls	MEC502		✓	02
3	Heat Transfer	MEC503		✓	02
4	Dynamics of Machinery	MEC504		✓	02
5	Department Level Optional Course I Press Tool design	MEC505		✓	02

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

T.E-Sem-V - choice Based - Mech 9/5/18

Paper / Subject Code: 32601 / Internal Combustion Engines

(3 Hours) [Total Marks: 80]

N.B. 1) **Question No. 1 is compulsory**
2) Solve **Any Three** from remaining **Five** questions.
3) Assume suitable data if necessary and state it clearly.

Q1 Answer any **Four** from the following

a) Write a short note on HCCI Engine. **05**

b) Give a brief account of Exhaust Oxygen Sensor **05**

c) Briefly discuss the various efficiency and their significance associated with Engine **05**

d) Compare Air Cooling System and Liquid Cooling System. **05**

e) Explain why a rich mixture is required for Idling and sudden acceleration. **05**

Q.2 a) State the reasons for efficiency of actual cycle is much lower than the air standard cycle efficiency? List the major losses and differences in actual engine cycle and air standard cycle. Also draw actual cycle. **10**

b) Explain the working of Transistorized Coil Ignition System with the help of neat Sketch and state its merits and Demerits. **10**

Q.3 a) What are the essential properties of Lubricants? Explain with neat sketch Mist Lubrication System. **10**

b) Calculate the diameter of fuel orifice of 4 stroke engine which develops 25 kW per cylinder at 2500 rpm. The specific fuel consumption is 0.3 kg/kW h and fuel is injected at a pressure of 150 bar over a crank travel of 25°. The pressure in the combustion chamber is 40 bar. Coefficient of velocity is 0.875 and specific gravity is 0.8762. **10**

TURN OVER

Q.4 a) A 4 stroke diesel engine working at sea level (pressure = 1 bar and temperature 17°C) develops a brake power of 280 kW with a volumetric efficiency of 80% at sea level condition. Engine works at an Air-Fuel ratio of 18:1, with specific fuel consumption of 0.240 kg/kW h. The engine runs at 1800rpm. Determine the engine capacity and the bmep. The Engine is taken to an altitude of 3 km where the ambient pressure and temperature are -23°C and 0.715 bar. A mechanically coupled supercharger is fitted which consumes 12% of the total power developed. The temperature of air leaving the supercharger is 37°C. Determine degree of supercharging required to maintain the same brake power of sea level. **12**

b) Describe the CRDI System with neat sketch and state its advantages and disadvantages **08**

Q.5 a) A test on a single-cylinder, 4 stroke oil engine having a bore of 15 cm and stroke 30 cm gave the following results: speed 300 rpm; brake torque 200 Nm; Indicated mean effective pressure 7 bar; fuel consumption 2.4 kg/h; cooling water flow 5 kg/min; cooling water temperature rise 35°C; air-fuel ratio 22; exhaust gas temperature 410°C; barometer pressure 1 bar; room temperature 20°C. The fuel has a calorific value of 42 MJ/kg and contains 15% by weight of hydrogen. Take latent heat of vaporization as 2250 kJ/kg. Determine the Indicated thermal Efficiency and volumetric efficiency based on atmospheric conditions. **12**

Also draw up a heat balance sheet in terms of kJ/mn. Take C_p for dry exhaust gas as 1 kJ/kg-k and superheated steam C_p = 2.1 kJ/kg-k; R= 0.287 kJ/kg K

b) Describe in detail the various stages of combustion in SI Engine **08**

Q.6 a) What is compensation and why it is done in Carburetor **05**

b) Write a note on ratings of fuel for IC Engine **05**

c) With a help of neat sketch explain Catalytic convertor **05**

d) Explain the working of Thermostatic Cooling system **05**

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9-E_sem-V-Choice Based-Mech 15/5/19

Paper / Subject Code: 32602 / Mechanical Measurements & Control

(3 Hours) **[Total marks: 80]**

Instructions:
1. **Question 1 compulsory**.
2. Attempt any **three** questions from the remaining **five** questions.
3. Assume suitable data, **if necessary**.
4. **Figures/sketches** carry weightage.

Q1) a) Determine the stability using Routh Hurwitz Criterion of the following characteristic equation: 05

$$S^5 - S^4 - 2S^3 - 2S^2 - 3S - 15 = 0$$

b) Differentiate between open and closed loop systems with their respective block diagrams and examples 05

c) Explain the following terms with respect to static characteristics of the measuring instruments: 05
I)Hysteresis II) Accuracy and Precision III) Resolution IV) Drift

d) Explain the principle of LVDT with a neat sketch 05

Q2) a) Convert the following state space system into a transfer function 10

$$\dot{X}(t)=\begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -2 & -5 \end{pmatrix} x(t) + \begin{matrix} 0 \\ 0 \\ 10 \end{matrix} u(t)$$

$$Y(t) = [1 \;\; 0 \;\; 0] \; x(t)$$

Here x(t) are state variables, u(t) is a force vector and y(t) being the system response

b) Explain the construction and working of an Optical Pyrometer with a neat sketch 10

Q3) a) A rectangular steel rod of width 'b' and depth'd' is supported at its end and is loaded at its center by load 'W'. If the length of the rod between supports is 'l' and 'd_m' where - 12

$$d_m = \frac{Wl^2}{4Ebd^3}$$

Where;
b = 4.942 ± 0.42 cm ;
d = 5.25 ± 0.25 cm ;
l = 1000 ± 0.5 cm,
d_m = 2.622 ± 2.25%
W= 1500N.

Find value of modulus of elasticity, % of uncertainty in various quantities, % of uncertainty in various quantities.

b) For a unity feedback system having open loop transfer function, 08

$$G(s) = \frac{14(s+3)}{s(s+5)(s^2+2s+2)}$$

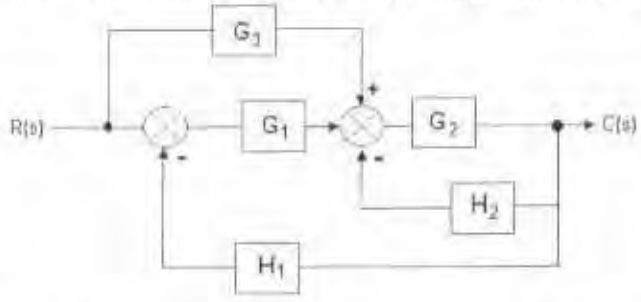
Determine (i) Type and order of the system (ii) All error coefficients

(iii) Steady state error for input $1 - 4t - \frac{t^2}{2}$

Q4) a) Prove Gauge factor, $K = \frac{\Delta\rho/\rho}{\Delta L/L} + 1 + 2\upsilon$ 10

b) Enumerate the types of pressure measurement devices w.r.t. to pressure levels. Explain the construction and working of Bourdon tube with a neat sketch 10

Q5) a) Obtain transfer function C(s) / R(s) using block diagram reduction technique. 10



b) A feedback system has G(s) H(s) = 242 (s+5) / s (s^2 + 5s + 121) (s +1). . Draw Bode plot and comment on its stability. 10

Q6) a) Sketch the Root Locus for the given system having G (s). H (s) = K(s + 5) / (s^2 + 4s+ 20). Comment on its stability 10

b) Explain the construction and working of non contact type of speed measurement system with a neat sketch 10

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(94)

BE - sem-V - Choice Based - Mech

21/5/19

Paper / Subject Code: 32603 / Heat Transfer

Duration: 3 Hours **Max Marks: 80**

Note:

i) Question no.1 is compulsory.
ii) Attempt any **THREE** from question no. 2 to 6.
iii) Assume suitable data whenever necessary.

Q1) Solve any **Four** **20**

a) A refrigerator stands in a room where the air temperature is 30 °C. The surface temperature on the outside of the refrigerator is 25 °C. The sides are 30 mm thick and have an equivalent thermal conductivity of 0.1 W/m K. The heat transfer coefficient on the outside is 10 W/m^{2}K. Assuming one dimensional conduction through the sides, calculate the net heat flow per m^2 and the surface temperature on the inside.

b) Define and explain physical significance of Reynolds and Nusselt number.

c) Explain Fin efficiency and Fin effectiveness. Explain in brief factors affecting fin effectiveness.

d) Exhaust gases (C_p=1.12 kJ/kg °C) flowing through a tubular heat exchanger at the rate of 1000 Kg/hr are cooled from 300 °C to 120 °C. The cooling is affected by water (C_p= 4.18 kJ/Kg °C) that enters the system at 20 °C at the rate of 1200 Kg/hr. If the overall heat transfer coefficient is 140 W/m^2 K, what heat exchanger area is required to handle the load for parallel flow arrangement?

e) Define intensity of radiation. What is solid angle? Explain.

Q2) a) Derive general equation of heat conduction in Cartesian coordinate system and reduce it to all three forms. **10**

b) Air at atmospheric pressure and 20 °C flows with 5 m/s velocity through main duct of an air conditioning system. The duct is rectangular in cross-section and measures 40 cm x 80 cm. Determine heat loss per meter length of duct corresponding to unit temperature difference. The relevant thermo-physical properties of air are **10**

$\nu = 15 \times 10^{-6}$ m^2/s , $\alpha = 7.7 \times 10^{-6}$ m^2/hr , k = 0.026 W/m K

Use Dittus Boelter correlation : $Nu = 0.023 \times (Re)^{0.8} \times (Pr)^{0.4}$

Q3) a) Water flows at the rate of 65 kg/min through a double pipe counter flow heat exchanger. Water is heated from 50°C to75°C by oil flowing through the tube. The specific heat of oil is 1.780 kJ/kg K. The oil enters at 115°C and leaves at 70°C. The overall heat transfer co-efficient is 340 W/m^2 K. Calculate the following **8**

(i) Heat exchanger area
(ii) Rate of heat transfer

Use LMTD method.

b) The following data pertains to the junction of a thermocouple wire used to measure the temperature of a gas stream : 6

$\rho = 8500$ Kg/m^3 ; $C_p = 325$ J/kg K ; k = 40 W/m K and the heat transfer coefficient between the junction and gas h = 215 W/m^2 K.

If thermocouple junction can be approximated as 1 mm diameter sphere, determine how long it will take for the thermocouple to read 99 percent of the initial temperature difference?

c) Define the following terms: (i) Absorptivity (ii) Reflectivity (iii) Transmissivity. (iv) Emissivity. Explain Kirchoff's law. 6

Q4) a) A rod of 10 mm diameter and 70 mm length with thermal conductivity 15 W/m K protrudes from a surface at 180 ^{0}C. The rod is exposed to air at 30 ^{0}C with a convection coefficient of 25 W/m^2 K. How does the heat flow from this rod get affected if the same material volume is used for two fins of the same length? Assume short fin with end insulated. 8

b) In which mode of heat transfer is the convection heat transfer coefficient usually higher, natural convection or forced convection? Why? 4

c) Derive an expression for LMTD for parallel flow type heat exchanger. 8

Q5) a) Determine the radiant heat exchange in W/m^2 between two large parallel steel plates of emissivities 0.8 and 0.5 held at temperatures of 1000 K and 500 K respectively, if a thin copper plate of emissivity 0.1 is introduced as a radiation shield between the two plates. 10

Take $\sigma = 5.67 \times 10^{-8}$ W/m^2 K^4

b) What do you mean by critical thickness of insulation? State its importance. Derive an expression for critical radius of insulation for sphere of thermal conductivity k and outside film coefficient h_o. 10

Q6) a) Draw a neat boiling curve for water showing different regions of boiling. Explain each regime in brief. 6

b) Estimate the heat transfer from a 40W incandescent bulb at 125 ^{0}C to 25 ^{0}C in quiescent air. Approximate the bulb as a 50 mm diameter sphere. What percent of power is lost by free convection? The appropriate correlation for the convection coefficient is 8

$$Nu = 0.60 \times (Gr\ Pr)^{0.25}$$

The thermo-physical properties of air at mean film temperature are :$\nu = 20.55 \times 10^{-6}$ m^2/s ,

k = 0.03 W/m K , Pr = 0.693

c) A 250 x 250 mm ingot casting, 1.5 m high and at 1025 K temperature, is stripped from its mold. The casting is made to stand on end on the floor of a large foundry whose wall, floor and roof can be assumed to be at 300 K temperature. Make calculation for the rate of radiant heat interchange between the casting and the room. The casting material has an emissivity of 0.85. 6

Take $\sigma = 5.67 \times 10^{-8}$ W/m^2 K^4

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(95)

TE - sem-V - choice Based - Mech

Paper / Subject Code: 32604 / Dynamics of Machinery

27/5/19

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

N.B. 1. Question **No.1** is **compulsory.**
2. Answer **any three** questions from remaining questions.
3. Assume suitable data if required.
4. Figure to the right indicates full marks.

Q. 1 Solve any **FIVE** **20**

a) State the different types of governors.
b) Explain the term critical speed of rotating shaft.
c) Explain Gyroscopic Couple
d) Discuss the effect of damping on vibratory system.
e) Why is balancing necessary for rotors of high speed engines?
f) Explain in details condition monitoring and fault diagnosis.

Q. 2 a) The length of the arms of a Porter governor is 300mm long. The upper and lower arms are pivoted to links at 50mm and 60mm, respectively, from the axis of the rotation. The mass of each ball is 5kg and the sleeve is of mass 60kg. The frictional force on the sleeve is 35N.Determine speed range for extreme radii of rotation of 120mm and 150mm. **10**

b) The total mass of a four wheel trolley car is 1800kg. The car runs on rails of 1.6m gauge and round a curve of 24m mean radius at 36 km/hr. The track is banked at 10^0. The diameter of the wheels is 600mm. Each pair of wheels with axle has a mass of 180kg and radius of gyration of 240mm. The height of the C.G. of car above the wheel base is 950mm.Determine the pressure on each rail. **10**

Q. 3 a) Explain Dynamically Equivalent System and correction Couple. **10**

b) In a damped vibrating system, the mass having 20kg makes 40 oscillations in 25sec. The amplitude of natural vibrations decreases to one eighth of the initial value after 8 oscillations. Determine (i) the logarithmic decrement (ii) damping factor & damping coefficient (iii) spring stiffness. **10**

Q. 4 a) How to convert multi-springs, multi dampers into a single spring and damper with linear or rotational coordinate system? **10**

b) A machine part having a mass of 2.5kg vibrates in a viscous medium. A harmonic exciting force of 30N acts on the part and causes a resonant amplitude of 14mm with a period of 0.22 sec. Find the damping coefficient. If the frequency of the exciting force is changed to 4Hz, determine the increase in amplitude of forced vibrations upon the removal of the damper. **10**

Q. 5 a) Determine the natural frequency of oscillation of a half solid cylinder of mass 'm' and radius 'r' when it is slightly displaced from mean position and released. **10**

b) How does the force transmitted to the base change as the speed of the machine increases? Explain using an equation and the corresponding graph. **10**

Q. 6 a) Explain the principle of vibration measuring instruments and working principle of any one amplitude measuring instrument. **10**

b) Each crank and connecting rod of a four crank in-line engine are 200mm and 800mm respectively. The outer cranks are set at 120^0 to each other and each has a reciprocating mass of 200kg. The placing between adjacent planes of cranks are 400mm, 600mm and 500mm. If the engine is in complete primary balance, determine the reciprocating masses of the inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210rpm. **10**

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TE-Sem-V - Chose Based - Mech

Paper / Subject Code: 32605 / Elective - I Press Tool Design

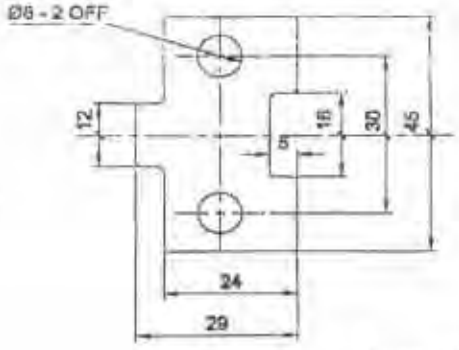
31/5/19

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

Note: (1) **Question No. 1** is compulsory.
(2) Attempt **any three** questions out of the remaining five questions.
(3) Assume suitable data wherever necessary and justify it.
(4) Figures to the right indicates full marks.

1. (a) Give Reasons for **any five** of the following statements. **15**
   i) Segmental (insert type) die construction is preferred over solid die.
   ii) Cutting and non-cutting operations are not combined in one station of progressive die.
   iii) Heel is provided for notching punch in a progressive die.
   iv) Hydraulic press is preferred over mechanical press.
   v) Rigid press is required for coining operation.
   vi) Provision of shear on punch and die reduces maximum cutting force requirement.
   (b) Explain the effect of insufficient clearance and excessive clearance on the edge of blank with neat sketches. **5**

2. A component shown in figure no. 1 is to be produced on a progressive die. Determine following.
   (a) Economic stock strip layout considering the sheet size of 350 mm x 1200 mm. (Material: copper sheet, ultimate Shear strength = 35 kgf/mm^2, sheet thickness = 1.6 mm) **8**
   (b) Calculate the press tonnage required for manufacturing the component and suggest suitable press. **4**
   (c) Draw the following views of designed progressive die. **8**
   i) Sectional front view
   ii)Top view of bottom assembly of die set



Material: Copper Sheet
Thickness: 1.6 mm
All the dimensions are in mm
Ultimate Shear Strength: 35 kgf/mm^2
Unspecified Radii: 1 mm

Figure No: 1

3. (a) A circular cup as shown in figure no. 2 is manufactured by using deep drawing operation. (Material: MS Cup, Thickness: 2mm, Yield Strength: 35 kgf/mm^2). Determine following. **20**
   i) Blank size
   ii) Percentage reduction
   iii) Number of draws
   iv) Radius on punches and dies
   v) Die clearance, punch diameter and die opening size at each draw
   vi) Drawing force and blank holding force

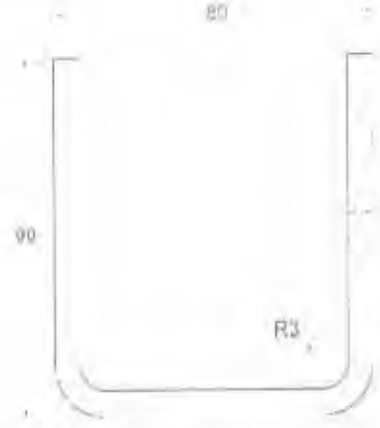


Fig No.2
Deep Drawn Component
(All Dimensions are in mm)

4. (a) Calculate the developed length of the part shown in fig no. 3. 5
(Material: Steel, Ultimate tensile strength: 450 N/mm^2, thickness: 3mm)

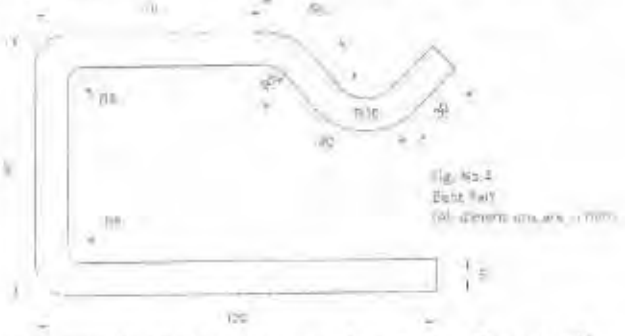


Fig No.3
Bolt Rail
(All dimensions are in mm)

(b) With your own example explain how to determine the coordinates of the centre of pressure of blanked part. 5

(c) Explain the condition of energy overloading of press. 5

(d) Differentiate between stopper and pilot. 5

5. (a) Discuss safety procedures and devices adopted for both press operator and equipment. 7

(b) Discuss methods of feeding the strip/coil material in the press. 7

(c) Explain working and construction of embossing die. 6

6. Answer the following **(Any four)**. - 20

(a) Explain with neat sketch construction and working of shaving dies.

(b) What is spring back in bending operation? How spring back is prevented in V dies and wiping dies.

(c) List drawing defects, also explain probable causes for the development of any four defects.

(d) Explain the following terms in relation to mechanical press:
i) press tonnage ii) throat iii) distance between uprights.

(e) Draw a neat and dimensioned sketch of Acron type pilot to be used in locating hole of 18mm diameter.

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