AIKTC/KRRC/SoET/ACKN/QUES/2019-20/ Date: 15/01/2020

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	MDC505		✓	02

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

T.E -sem-V- Choice Based -Mech 15/11/19

Time : 3 Hrs **Marks : 80**

Note: 1 Q.No.1 is **compulsory.**
2. Attempt any **Three** question from Q.No.2 to Q.No.6
3. Make suitable assumptions if required

Q.No.1 Solve Any **Four** **(5*4)**

a) Define the following terms.
i) Stroke ii) C.R. iii) TDC iv) Clearance Volume v) Displacement Volume.

b) List the types of combustion chamber for S. I. Engine and illustrate any one.

c) Classify the diesel injection system and illustrate any one.

d) State advantages and Disadvantages of HCCI Engine

e) List five reasons why there are HC emissions in the exhaust of an automobile.

Q.No.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. **(10)**

b) A single cylinder engine operating at 2000 rpm develops a torque of 8 N-m. The indicated power of the engine is 2.0 kW. Determine loss due to friction as the percentage of brake power. **(05)**

c) Why does the optimum ignition timing change with engine operating conditions? State the advantages of electronic ignition **(05)**

Q.No.3 a) Illustrate the phenomenon of knocking in S.I. engines with the help of P-θ and P - V plots. State harmful effect of knocking. **(10)**

b) Evaluate the air-fuel ratio of a 4-stroke, single cylinder, air cooled engine with fuel consumption time for 10 cc as 20.0 sec. and air consumption time for 0.1 m^3 as 16.3 sec. The load is 16 kg at speed of 3000 rpm. Also evaluate brake specific fuel consumption in g/kWh and brake thermal efficiency. Assume the density of air as 1.175 kg/m^3 and specific gravity of fuel to be 0.7. The lower heating value of fuel is 44 MJ/kg and the dynamometer constant is 5000. **(10)**

Q.No.4 **a)** Describe the Engine Pollution, list the methods to control pollution and state the EURO and BHARAT norms. **(10)**

b) A four-cylinder, four-stroke diesel engine develops a power of 180 kW at 1500 rpm. The *b.s.f.c.* is 0.2 kg/kWh. At the beginning of injection pressure is 30 bar and the maximum cylinder pressure is 50 bar. The injection is expected to be at 200 bar and maximum pressure at the injector is set to be about 500 bar. Determine the total orifice area required per injector if the injection takes place over 15^0 crank angles. Use following assumptions: C_d for injector = 0.7, *S.G.* for fuel = 0.875, Atmospheric pressure = 1 bar, Effective pressure difference = Average pressure difference over the injection period. **(10)**

Q.No.5 **a)** List Exhaust Gas Oxygen sensors and state their importance in ECM. **(06)**

b) An air compressor is being run by the entire output of a supercharged 4-stroke cycle diesel engine. Air enters the compressor at 25°C and is passed on to a Cooler where 12.10 KJ per mm is rejected. The air leaves the cooler at 65°C and 1.75 bar. Part of this air-flow is used to supercharge the engine which has a volumetric efficiency of 72% based on induction manifold condition of 65°C and 1.75 bar. The engine, which has six cylinders of 100 mm. bore and 110 mm stroke runs at 2000 rpm and delivers an output torque of 150 Nm. The mechanical efficiency of engine is 80%. Evaluate:— **(14)**

(i) The indicated mean effective pressure of the engine;

(ii) The air consumption rate of the engine;

(iii) The air-flow into compressor in kg per min.

Q.No.6 a) State the necessity of engine cooling and disadvantages of overcooling **(05)**

b) The following readings were recorded during a trial on a single cylinder, 2-stroke Diesel Engine. **(15)**

Power supplied by electric motor for motoring at rated speed = 1.5 kW; Rated speed = 500 rpm; Net load on brake = 225 N; Diameter of brake wheel = 100 cm; Rate of cooling water through engine jacket = 13.65 kg/min; Rise in temperature of cooling water = 10°C; Fuel consumption = 2 kg/h; C.V. of fuel used = 43000 kJ/kg; A:F ratio = 32:1; C_{pg} (gases) = 1.006 kJ/kg°C; Exhaust gas temperature = 345°C; Ambient temperature = 25°C and Ambient pressure = 1bar; Take L = D = 30 mm Determine:

(i) Mechanical Efficiency (ii) Thermal efficiency

(iii) Brake specific fuel consumption (iv) Brake mean effective pressure

Draw the heat balance sheet on percentage basis.

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TE-sem-V- Choice Base - Mech 19/11/19

(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) Consider the characteristic equation $s^4 + 2s^3 + (4+k)s^2 + 9s + 25 = 0$, using the Hurwitz stability criterion, determine the range of "k" for stability. 08

b) Differentiate between open loop and closed loop system with examples. 06

c) Explain the following terms with respect to the measuring system:
i) Span and Range ii) Drift and Threshold 06

Q2) a) Explain the construction and working of a Nozzle Flapper with a neat sketch 08

b) Illustrate the working principle of Optical Encoder with a neat sketch 08

c) Illustrate the terms state variables and state space with reference to state space modelling of a control system. 04

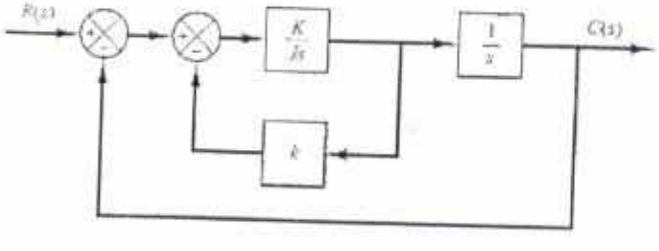
Q3) a) Explain the constructional features and working of a "Ionization Gauge" for pressure measurement. 08

b) A McLeod Gauge has volume of bulb and measuring capillary $V = 100 \times 10^{-6}$ m^3 and measuring capillary diameter of 1 mm. Calculate the pressure indicated when the reading of the measuring capillary is 30 mm in case approximate formula is used. What is the error if the exact formula is used for measurement of pressure? 06

c) Illustrate the working of Ultrasonic flow meters. 06

Q.4 a) Illustrate the constructional features and working of LVDT with a neat sketch 07

b) Determine the values of "K" and "k" of the closed-loop system shown in figure so that the maximum overshoot in unit-step response is 25% and the peak time is 2 sec. Assume that $J = 1$ kg-m^2. 08



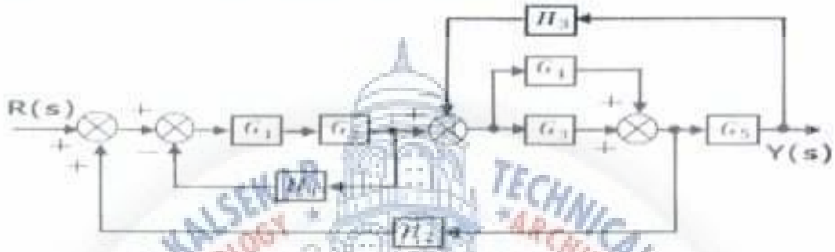
c) A system is described by $\frac{d^2y}{dt^2} + 10\frac{dy}{dt} + 30\,y(t) = 60\,x(t)$, find the natural frequency and damping ratio. 05

Q.5 a) For a system with unity feedback having , $G(s) = \frac{800\,(s+2)}{s^2\,(s+10)(s+40)}$ 10

Sketch Bode plot and determine G.M., P.M and comment on stability.

b) A unity feedback system is represented by the equation $G(S) = \frac{20\,(S+3)}{S(S+1)(S+4)}$, find (i) type of the system (ii) static error co-efficients and steady state error for ramp input of magnitude "5". 10

Q6) a) Reduce the given block diagram to its canonical form and hence obtain its equivalent transfer function, for the block diagram shown below. 10



b) Obtain the state-space equation and output equation for the system defined by the equation 10

$$\frac{Y(s)}{U(s)} = \frac{s^3 + 3s^2 + 5s + 2}{s^4 + 4s^3 + 5s^2 + 2}$$

(3 Hours) [Total Marks : 80]

N.B.: 1) **Question No. 1** is **compulsory**.
2) Attempt any **THREE** from **question no. 2 to 6**.
3) **Use** illustrative **diagrams** wherever **possible**.

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

a) What do you mean by Fouling in heat exchanger?

b) Differentiate between drop wise and film wise condensation.

c) Define thermal resistance, thermal conductance, thermal conductivity and thermal contact resistance.

d) Define shape factor and state its physical significance.

e) Explain hydrodynamic and thermal boundary layer.

Q2) a) Derive 3 dimensional conduction equation in Cartesian co-ordinates for a homogeneous material, steady state conditions and without heat generation. **10**

b) A 100 mm diameter steam pipe is covered by two layers of lagging. The inside layer is 40 mm thick and has a thermal conductivity of 0.07 W/m K. The outside layer is 25 mm thick and has a thermal conductivity of 0.1 W/m K. The pipe carries steam at a pressure of 1.2 MN/m^2 with 250 ^0C temperature. The outside temperature of lagging is 24 ^0C. If the steam pipe is 20 m long, determine (a) The heat lost per hour, (b) The interface temperature of lagging. Neglect the resistance of the steam pipe. **06**

c) Write a short note on 'Importance of numerical methods.' **04**

Q3) a) Derive expression for temperature distribution and heat dissipation in a straight fin of rectangular profile for infinitely long fin. **08**

b) 3000 kg of water is heated per hour from 30 to 70 ^0C by pumping it through a certain heated section of a 25 mm diameter tube. If the surface of the heated section is maintained at 110 ^0C, estimate length of the heated section and the rate of heat transfer from the tube to water. **08**

The thermo-physical properties of water are: $\rho = 971.6$ kg/m^3; $\mu = 0.355 \times 10^{-3}$ kg/m-s; $k = 0.667$ W/m-deg; $Cp = 4195$ J/kg-deg.

Use $Nu = 0.023 (Re)^{0.8} (pr)^{0.4}$.

c) What is meant by critical thickness of insulation? Explain its significance. **04**

Q4) a) With the help of Buckingham π theorem show that for a forced convection $Nu = C (Re)^m (Pr)^n$ **08**

b) A steel rod (k = 32 W/m K), 12 mm in diameter and 60 mm long with an insulated end is to be used as a spine. It is exposed to surrounding with a temperature of 60°C and heat transfer coefficient of 55 W/m² K. The temperature at the base of fin is 95°C. Determine (i) The fin efficiency, (ii) The temperature at the end of the spine, (iii) The heat dissipation. **08**

c) What are the assumptions for lumped capacity analysis? **04**

Q5) a) Derive the relationship between the effectiveness and the number of transfer units for a parallel flow heat exchanger. **10**

b) A sphere of 20 cm diameter made of cast iron initially at uniform temperature of 400°C is quenched into oil. The oil bath temperature is 40°C. If the temperature of the sphere is 100°C after 5 min, find heat transfer coefficient on the surface of the sphere. Take Cp (C. I.) = 320 J/kg K, ρ (C. I.) = 7000 kg/m³. Use lumped parameter analysis. **06**

c) For a hemispherical furnace, the flat floor is at 700 K and has an emissivity of 0.5. The hemispherical roof is at 1000 K and has emissivity of 0.25. Find net radiative heat transfer from floor to roof. **04**

Q6) a) State and explain Stefan Boltzman law and Kirchhoff's law. **04**

b) The radiative shape factor of the circular surface of thin hollow cylinder of 10 cm diameter and 10 cm length is 0.1716. What is the shape factor of the curved surface of the cylinder with respect to itself? **04**

c) Draw the boiling curve of water and identify the different boiling regimes. **04**

d) Water (C_p = 4200 J/kg °C) enters a counter flow heat exchanger at 38°C flowing at 0.076 kg/s. It is heated by oil (C_p = 1800 J/kg °C) flowing at the rate of 0.152 kg/s from an inlet temperature of 116°C. For an area of 1 m² and U = 340 W/m²°C, determine the total heat transfer rate. **08**

TE-sem-V-choice Based - Mech

Paper / Subject Code: 32604 / Dynamics of Machinery

25/11/19

Duration: 3Hrs **Marks:80**

Instructions:

i) **Question No.1 is compulsory**
ii) **Solve any three questions from the remaining**
iii) **Assume suitable data wherever necessary**
iv) **Figure to the right indicates marks.**

Q.1 Solve **any four** questions from following

a) Explain controlling force diagram of governor? **(05)**

b) Derive an expression for effect of gyroscopic couple on a naval ship during pitching. **(05)**

c) Explain why mechanical vibration is an important area of study for engineers. Briefly describe five practical examples of good vibration. **(05)**

d) Draw and explain a plot of magnification factor versus frequency ratio curves for various damping factor values. **(05)**

e) Explain static and dynamic balancing. **(05)**

Q.2 a) The inertia of the connecting rod can be replaced by two masses concentrated at two points and connected rigidly together. How to determine the two masses so that it is dynamically equivalent to the connecting rod? **(10)**

b) Find the natural frequency of the pulley system shown in figure1 by neglecting friction and inertia of pulleys. **(10)**

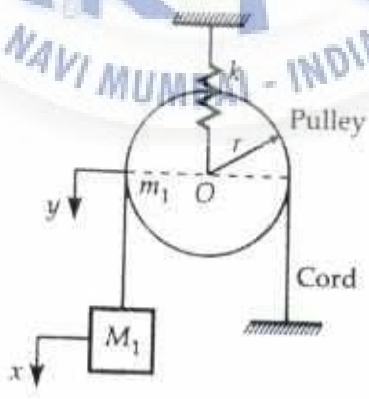


Figure1

Q.3 a) Explain the various types of instrumentation system for condition monitoring. **(10)**

b) The disc of torsional pendulum has moment of inertia 600 kg-cm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 10cm diameter and 40cm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are 90, 60 and 40. Determine a) logarithmic decrement b) damping torque at unit velocity c) time period. Assuming for brass G=4.4×10^{10} N/m2. **(10)**

Q.4 a) A vertical petrol engine 100 mm diameter and 120 mm stroke has a connecting rod 250 mm long. The mass of the piston is 1.1 Kg. The speed is 2000 r.p.m. On the expansion stroke with a crank 20^0 from top dead centre, the gas pressure is 700 KN/m^2. Determine net force on the piston, resultant load on the gudgeon pin, thrust on the cylinder wall, speed above which other things remain same, the gudgeon pin load would be reverse in direction. **(10)**

b) A machine of mass 50 kg operates at 1200 r.p.m. Find the maximum stiffness of an isolator that provides 75 percent isolation. Assume that damping ration of the isolator 7 percent. **(10)**

Q.5 a) Derive the equation for critical speed of a light shaft with a single disk without damping. **(10)**

b) A vehicle moves over a road surface having approximately the sinusoidal profile with a wavelength of 10 m and amplitude of 80 mm. The vehicle is moving with a velocity of 55 km/hr. Calculate the critical speed of the vehicle. If the amplitude of vibration is 25 mm and mass of vehicle is 500 kg. **(10)**

Q.6 a) A shaft supported between bearings 2 m apart and extended 0.5 m beyond bearing at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The masses of end pulleys are 50 kg and 25 kg and there centre of gravity are 20 mm and 15 mm respectively from the shaft axis. The centre pulley has a mass of 100 kg and it's cetre of gravity is 20 mm from the shaft axis. If the pulleys are arranged so as to give the static balance, determine the angular position of the pulleys and the dynamic force produced on the bearing when the shaft rotates at 340 r.p.m. **(10)**

b) A Hartnell governor having a central sleeve spring and two right angled bell crank levers moves between 290 r.p.m. and 310 r.p.m. for a sleeve lift of 15 mm. The sleeve arms and the bell arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and the mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine loads on the spring at the lowest and the highest equilibrium speed and stiffness of the spring. **(10)**

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TE-sem-V-choice Based-Mech 27/11/19

153

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

Duration -3 hours **Marks -80**

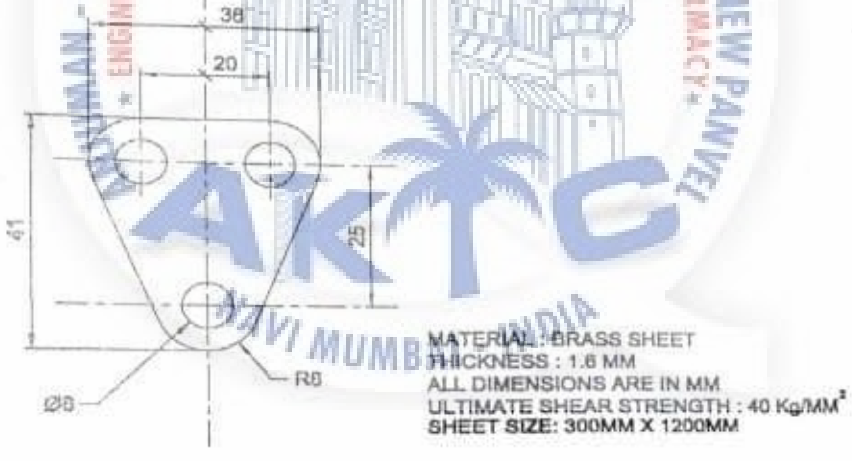
N.B.

(1) Question **No.1** is **compulsory** and **Answer 3** Questions out of **remaining 5** Questions.
(2) Assume suitable **data** wherever **necessary**
(3) **Figurers** to the **right** indicate full **marks**.

Q.1 a) Give reasons for **any five** of the following statements. **15**
i) Grain direction of the strip is a consideration in locating the blank when bending operation is required.
ii) Guide bushes and pillars are always hardened
iii) Segmental die construction is preferred over solid one piece construction.
iv) Compound dies are used for close tolerance work parts.
v) Ejectors is essential for U bending die.
vi) Dowels are located diagonally across each other and as a part as possible.
vii) Pilots are always hardened.

b) Explain construction and working of inverted blanking die. **05**

Q.2 a) Part shown in figure is to be produced on progressive die.
i) Draw an economical strip layout. Consider sheet size 300x 1200mm. **06**
ii) Calculate tonnage required for the layout. **04**
iii) Draw the following views of progressive die. **10**
Plan view of bottom assembly and sectional front elevation.



Q.3 A) 0.8 mm thick circular cup as shown in figure no. 2 is manufactured by using deep drawing operation. 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
(Yield strength of material : 350 N/mm^2)

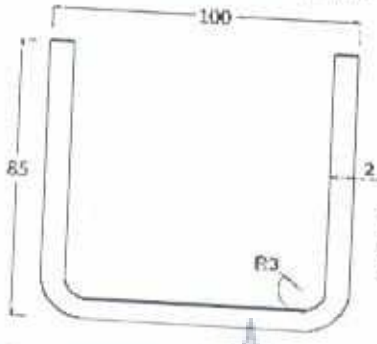


Fig No.2
Deep Drawn Component
(All Dimensions are in mm)

Q.4 A) A press is designed to offer 90 ton of force at 20^0 crank angle with a stroke of 15cm.Stroke is variable from 1cm to 15cm.Calculate tonnage available when ram is 3cm above its BDC. Take stroke length equal to 10cm. **06**

B) Explain various methods of reducing maximum cutting force requirement in a cutting operation. **07**

A 5 mm thick M.S. plate is cut on a shearing machine and length of cut is 550 mm. The shear strength of material is 400N/ sq. mm. Find the cutting force requirement with the cutting blade inclined at 2 degrees, if the percent penetration is 40%.

C) Explain with the help of neat sketch working of Combination Die. **06**

Q.5 A) Differentiate between the following (Any two) **10**

I) Coining and embossing

II) Shaving and trimming

III) Hydraulic press and mechanical press

B) A press has minimum DLH of 400 mm and adjustment of ram is 60 mm. Stroke can be varied from 120 mm to 10 mm. If the bolster plate provided has thickness of 70 mm, determine minimum and maximum shut for a die. **05**

C) What is direct pilot? What are advantages of direct pilot? Why should indirect pilot be spring loaded when used on material over 1.6mm thick? **05**

Q.6 Write short note on the following. **20**

a) Methods of reducing spring back in bending.

b) Explain methods of Feeding stock in press.

c) Write safety precautions taken in the press shop.

d) Compound Die
