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

School: SoET-CBSGS **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		✓	
2	Mechanical Measurement & Controls	MEC502		✓	
3	Production Process – III	MEC503		✓	
4	Theory Of Machine – II	MEC504		✓	
5	Heat Transfer	MEC505		✓	
6					

Note: SC – Softcopy, HC - Hardcopy

(Shaheen Ansari)
Librarian, AIKTC

(52) TE. Sem V – CBSGS – Mech – I.C Engines 25/5/1

Q. P. Code: 39559

Time: 3 Hours **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) Compute the bmep in bar, mean piston speed in m/s and torque in Nm for a two stroke, four cylinder C. I. engine having following specifications bore dia. 150 mm, brake power 265 kW at 2400 rpm, L/d ratio of 0.90. Also identify whether this engine is a square, over square or under square engine.

b) Why C.I engines exhibit more favorable fuel consumption at part load and idling, compared to the carbureted S.I engines?

c) What is mean by opposed type and radial type engine?

d) The diameter and stroke length of a single two stroke engine working on the constant volume cycle are 100 mm and 200 mm respectively with clearance volume 2.75 liters. When the engine is running at 120 rpm the indicated mean effective pressure was 5bar and gas consumption 2.5 kg/hr. If the calorific value of the gas used is 16350 kJ/kg.
Find: (i) Air standard efficiency
(ii) Indicated power developed by the engine and
(iii) Indicated thermal efficiency of the engine.

e) State the difference between ignition timing and firing order.

Q.No.2 a) The following observations were recorded in a test of one hour duration on a single cylinder oil engine working on four-stroke cycle and engine is fitted with rope brake: **(14)**
Bore = 150 mm; Stroke = 300 mm; Fuel used = 2.4 kg; Calorific value of fuel = 42000 kJ per kg; Average speed = 300 rpm; Indicated mean effective pressure = 7 bar; The dead load on the engine = 360 N; Spring balance reading = 30 N; Quantity of cooling water = 300 kg; Temperature rise of cooling water = 35 °C; Diameter of the brake wheel = 1.2 m, Air used = 52.8 kg; Temperature of air in test room = 20 °C; Temperature of exhaust gases = 410 °C; Cp (gases) = 1 kJ/kg K; Atmospheric Pressure = 1.013 bar, Calculate:
(i) Indicated Power
(ii) Brake thermal efficiency.
Draw the heat on minute and percentage basis.

b) Justify the requirement of air motion and swirl in a C. I. Engine combustion chamber is much more stringent than in an S. I. Engine. **(6)**

Q.No.3 a) Describe with suitable sketches the combustion phenomenon in SI engine. Explain the three phases of combustion. Discuss the effect of engine variables on ignition Lag. **(10)**

b) 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)**

Q.No.4	a)	Explain how supercharging helps to improve the power output. What are its limitations	(5)
	b)	The following data relate to a four-stroke cycle petrol engine of Hindustan Ambassador: Capacity of the petrol engine = 1489 C.C., Speed at which maximum power is developed = 4200 RPM, The volumetric and efficiency (at the above speed) = 75%, The air-fuel ratio = 13 : 1, Theoretical air speed at choke (at peak power) = 85 meter per sec., The Coefficient of discharge for venturi C_{da} = 0.82, The Coefficient of discharge for the main petrol jet C_{da} = 0.65, The specific gravity of petrol = 0.74, Level of petrol surface below the throat = 6 mm, Atmospheric pressure and temperature = 1.013 bar and 20°C respectively. An allowance should be made for the emulsion tube, the diameter of which can be taken as 40% of the choke diameter. Calculate the, sizes of a suitable choke and main jet.	(10)
	c)	Describe with neat sketches the working of Wankel Engine.	(5)
Q.No.5	a)	Differentiate **(Any Two)** i) Scavenging and Supercharging. ii) Wet sump and Dry sump lubrication. iii) Water cooling and Air cooling	(5*2)
	b)	Determine the Air-Fuel Ratio (A/F) and percentage richness supplied at 4 km altitude by a carburetor, which is initially adjusted to give 10% lean mixture at sea level. The ambient conditions at sea level are 27 °C and 1 bar. Assume that the temperature of air decreases with altitude given by $t = t_S - 0.00675\ h$, where, h is height in meters and t is sea level temperature in °C. The air pressure decreases with altitude as per the relation $\mathbf{h = 19{,}000 \log_{10}(1/P)}$ where P is in bar. State any assumptions made.	(10)
Q.No.6	a)	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 1210 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:— (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.	(15)
	b)	What is vapors lock? How is it related with ASTM distillation curve of the fuel?	(5)

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TE Sem-V – CBSGS – Mechanical – MMC

21/5/18

Q. P. Code: 21814

Time: 3 Hrs **[Total Marks 80]**

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q.1 (A) Differentiate between Deflection type and null type of measuring instruments. 8

(B) Define the following terms with reference to the state space modelling of the system. 06
(a) State space (b) State variables

(C) Explain the following terms with reference to static characteristics of the measuring instruments. 06
(a) Resolution (b) Precision

Q.2 (A) Describe the construction and working of diaphragms. Write down the expression for deflection of diaphragms and natural frequency. 06

(B) Describe the construction and working of a d.c. tachometer generator. Explain its advantages and dis-advantages. 06

(C) Obtain the state-space equation and output equation for the system defined by the equation, 08

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

Q.3(A) With a neat sketch explain the constructional feature and working of (i) infrared pyrometers. (ii) Electro-magnetic flow meter. 10

(B) For a unity feedback system, the output response is observed as 10

$c(t) = 1 + 0.504\, e^{-3.07t} - 1.504\, e^{-2.18t}$. Determine damping ratio.

Q.4 (A) Explain the function of Rosettes. Explain the working of 10
(i) Rectangular strain gauge rosettes.
(ii) Delta type strain gauge rosettes.

(B) For a system having G(s) H(s) $=\frac{K(1+s)^2}{s^3}$, find range of values of "K"for system to be stable, using Routh's array. 10

Q.5(A) For a certain feedback system having, 10
G(s) H(s) $=\frac{100\,(s+4)}{s\,(s+0.5)(s+10)}$, Sketch Bode plot and comment on G.M., P.M and stability.

(B) A diaphragm gauge is constructed of spring steel to measure differential pressure of 7 MN/m^2. The diameter of diaphragm is 12.5 mm. Calculate the thickness of diaphragm, if the maximum deflection is 0.33 of thickness. Also calculate the natural frequency of diaphragm. Given, Young's modulus = 200 GN/m^2 , poisson's ratio = 0.28 and density of steel = 7800 Kg/m^3. 10

Q.6 (A) For a unity feedback system having G(s)$=\frac{100(s+1)}{s^2\,(s+2)(s+10)}$, determine 10
(i) Type of system (ii) Error coefficients (iii) Steady state error for input as $1+4t+\frac{t^2}{2}$.

(B) With neat sketches discuss significance of followings aspects of signal conditionings for any one of the sensor: amplification, conversion filtering, modulation/demodulation, and grounding. 10

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(7) TE-Sem-V- CBSGS-May- P.P-III 31/5/18

Q. P. Code: 37939

Time : 3 hours **Marks: 80**

Note 1. All questions carry equal marks.
2. Question number one is compulsory.
3. Solve any three questions from remaining questions.
4. Assume suitable data if necessary.

Q.1 Answer **any four** of the following. 20

i) What is high speed machining? What are the requirements of high speed machining?
ii) Write short note on flexible manufacturing system.
iii) Explain general arrangement of two plate injection mould.
iv)Write the difference between jigs and fixtures.
v) Why pilots are used on progressive die? Explain types of pilot.
vi) Explain principle, advantages and limitations of laser beam machining.

Q.2 a) Explain following design principles used to jigs and fixtures. 10

i) Fool proofing
ii) Burr grooves
iii) Ejectors

b) What is indexing? Explain any one type of indexing jig with neat sketch. 10

Q.3 a) Why jig should have four feet not three? 05
b) Write the design principles used for the turning fixtures. 05
c) What is clearance on cutting dies. What are factors affecting clearance? 05
d) What do you mean by bending allowance? Write the factors affecting it. 05

Q. 4 Write short note on the following.

i) Strip layout 05
ii) Double action redraw die. 05
iii) Explain various methods of reducing cutting force in cutting die. 05
iv) With the neat sketch, explain the principle and working of abrasive jet machining. 05

Q.5 a) With neat sketch explain feed system. What is the balanced feed system? Also write factors affecting runner size. 10

b) What is ejection system? List ejection techniques and explain any one of them with neat sketch. 10

Q.6 a) What is agile manufacturing? Also write enablers of agile manufacturing. 10
b) Explain with neat sketch, principle, working, advantages, limitations & applications of EDM. 10

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TE - sem - V - Mechanical - CBSGS - TOM - II

15/5/18

Q.P. Code: 22663

(3 Hours) **Total Marks: 80**

N.B. 1) Question No.1 is compulsory.
2) Attempt any three questions out of the remaining five questions.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever required but justify the same.

Q1. Attempt any four **(20)**

A. Derive an expression for frictional torque for a cone clutch, considering uniform pressure theory.

B. With the help of neat sketch derive the equation for the ratio of the maximum and minimum tensions in a band and block brake.

C. What is stability of a governor? Sketch the controlling force versus radius diagrams for a stable, unstable and isochronous spring controlled governor.

D. What will be the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft?

E. What are the conditions to be satisfied for a system to be dynamically equivalent?

Q2. A. A friction clutch is used to rotate a machine from a shaft rotating at a uniform speed of 250 rpm. The disc type clutch has both of its sides effective, the coefficient of friction being 0.3. The outer and inner diameters of friction plate are 200 mm and 120 mm respectively. Assuming uniform wear of clutch, the intensity of pressure is not to be more than 100 kN/m^2. If the moment of inertia of the rotating parts of the machine is 6.5 kg/m^2, determine the time to attain the full speed by the machine and the energy lost in slipping of the clutch. **(10)**

B. A Proell governor has rotating masses 3 kg each and mass of the sleeve is 20 kg. Each arm is 200 mm long and pivoted at a distance of 20 mm from the axis of rotation. When the governor sleeve is at mid position, the extension link of the lower arm is vertical and the radius of rotation of the balls is 180 mm. At the mid position if the governor speed is 200 rpm, find i) length of the extended link and ii) tension in the upper arm. **(10)**

Q3. A. Derive the equation for the total vertical reaction at each of the outer and inner wheels of a 4 – wheeler considering centrifugal and gyroscopic couple. **(10)**

B. The crank pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has travelled 60^0 from I.D.C., the difference between the driving and the back pressures is 0.35 N/mm^2. The connecting rod length between centers is 1.2 m and the cylinder bore is 0.5 m. If the engine runs at 250 rpm and if the effect of piston rod diameter is neglected, calculate; i) pressure on slide bars, ii) thrust in the connecting rod, iii) tangential force on the crank pin and iv) turning moment on the crank shaft. **(10)**

{Turn Over}

Q4. A A simple band brake as shown in **Figure 1** operates on a drum of 600 mm in diameter that is running at 200 rpm. The coefficient of friction is 0.25. The brake band has a contact of 270^0, one end is fastened to a fixed pin and the other end to the brake arm 125 mm from the fixed pin. The straight brake arm is 750 mm long and placed perpendicular to the diameter that bisects the angle contact. **(10)**

1) What is the pull necessary on the end of the brake arm to stop the wheel if 35 kW is being absorbed? What is the direction for this minimum pull?
2) What width of steel band of 2.5 mm thick is required for this brake if the maximum tensile stress is not to exceed 50 N/mm²?

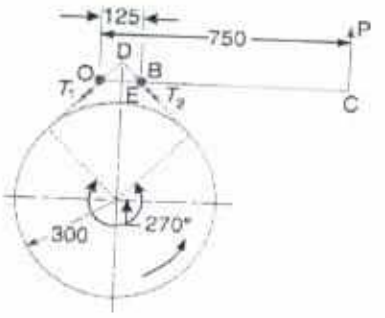

Figure 1

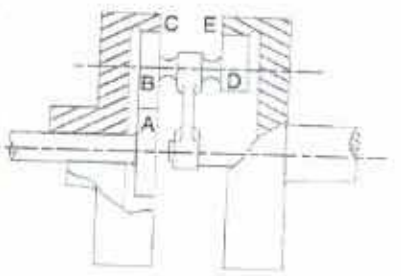

Figure 2

B. In the epicyclic gear train as shown in **Figure 2**, the driving gear A rotating in clockwise direction has 14 teeth and the fixed annular gear C has 100 teeth. The ratio of teeth in gears E and D is 98:41. If 1.85 kW is supplied to the gear A rotating at 1200 rpm, find: 1) the speed and direction of rotation of gear E and 2) the fixing torque required at C, assuming 100% efficiency throughout and that all teeth have the same pitch. **(10)**

Q5. A. A punching machine makes 25 working strokes per minute and is capable of punching 25 mm diameter holes in 18 mm thick steel plates having ultimate shear strength 300 MPa. The punching operation takes place during $1/10^{th}$ of a revolution of the crankshaft. Estimate the power needed for the driving motor, assuming a mechanical efficiency of 95%. Determine suitable dimensions for the rim cross section of the flywheel, having width equal to twice thickness. The flywheel is to revolve at 9 times the speed of the crankshaft. The permissible coefficient of fluctuation of speed is 0.1. The flywheel is to be made of cast iron having a working tensile stress of 6 MPa and density of 7250 kg/m³. The diameter of the flywheel must not exceed 1.4 m owing to space restrictions. The hub and the spokes may be assumed to provide 5% of the rotational inertia of the wheel. **(10)**

B. A ship is propelled by a turbine having a mass of 6000 kg and a speed of 2400 rpm. The direction of rotation of the rotor is anticlockwise when viewed from the bow end. The radius of gyration of rotor is 450 mm. Determine gyroscopic effect when, **(10)**

i) Ship is steering to the left in a curve of 60 m radius at a speed of 1860 m/hr.
ii) Ship is pitching in SHM with bow descending with maximum velocity. The time period of pitching is 18 seconds and the ship pitches 7.5^0 above and 7.5^0 below the normal position.
iii) Ship is rolling and at the instant, its angular velocity is 0.035 rad/sec counterclockwise when viewed from stern.
iv) Also find the maximum angular acceleration during pitching.

Q6. Write short notes on:- **(20)**

A. Constant Mesh Gear Box.
B. Hartung governor.
C. Belt transmission dynamometer.
D. Requirement of clutches.

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Q. P. Code: 39556

Time: 3 Hours **Marks: 80**

Note: - (1) Question No. 1 is compulsory
(2) Answer any Three out of remaining Five
(3) Make suitable assumption, if necessary

Q1. Solve any Five **(5*4)**

a) A steam pipe is insulated to reduce the heat loss. However, the measurement reveal that the rate of heat lost has increased instead of decreasing .Can you comment why?

b) Two pin fins are identical except that the diameter of one is twice that of other. For which fin will (i) Fin Effectiveness (ii) Fin Efficiency be higher?

c) What is lump system analysis? What are the assumptions made in the lumped system analysis and when is it applicable?

d) When heat transfer through a fluid layers is by conduction and when it is by convection? For what case, the rate of heat transfer is higher?

e) What are the limitations of LMTD method? How is Effective – NTU method superior to LMTD method?

f) Explain Thermal Contact Resistance.

Q.2 a) Derive Fourier's differential equation in the Cartesian Co-ordinate. **(10)**

b) A vertical plate 2.2m high and 1.4m wide has been designed on free convention heating of liquid. The temperature of plate surface is maintained at 960 °C while the temperature of liquid is 340 °C.Calculate the heat dissipation from both side of plate. **(10)**

For convection coefficient, Use correlation $Nu = 0.13(Gr.Pr)^{0.33}$.

Properties of liquid at 650°C are $\rho = 10^4 kg/m^3$; $C_p = 150.7\, kJ/kg.K$; $k = 13.02\, W/mK$; $\mu = 3.12 kg/mh$

Q.3 a) Starting from basic derive an expression for effectiveness of parallel flow heat exchanger in terms of NTU and Capacity ratio. **(10)**

b) A longitudinal copper fin (k=380 W/m°C) 600 mm long and 5 mm diameter is exposed to air stream at 20°C. The convective heat transfer coefficient h is 20 W/m^2°C. If the fin base temperature is 150°C, determine (i) the heat transferred in kJ/h and (ii) the efficiency of the fin. Assume that fin is insulated at the tip. **(10)**

Q.4 a) An exterior wall of a house may be approximated by 10 cm layer of common brick (k = 0.75 W/m-deg) followed by 4 cm layer of gypsum plaster (k = 0.5 W/m-deg). What thickness of loosely packed rock wool insulation (k = 0.065 W/m-deg) should be added to reduce the heat loss or gain through the wall by 75%? **(10)**

b) A ceramic block is of 0.3 m × 0.2 m section and is 0.3 m in height. Surface temperature of the block is 380 ^{0}C.if it is exposed to air at 20 ^{0}C, **(10)**

Determine the rate of convective heat loss.

Properties of air $\nu = 34.57 \times 10^{-6}$ m²/s, **k** = 37.81 x 10^{-3} W/mK, **Pr.** =0.699.

The following empirical relation can be used

$$\mathbf{Nu_L = 0.55(Gr \times Pr)^{0.25}}$$

Q.5 a) Define Shape factor and discuss its properties. Derive an expression for shape factor for (i) Hemispherical shape of radius R (ii) Two concentric cylinders. **(10)**

b) In a shell and tube heat exchanger, tubes are 4 m long, 3.1 cm OD, 2.7 cm ID. Water is heated from 22 °C to 45 °C by considering steam at 100 °C on the outside of tubes. Water flow rate through the tubes is 10 kg/s. Heat transfer coefficient on steam side is 5500 W/m²K and waterside, 850 W/m²K. Neglecting all other resistances, find the number of tubes. **(10)**

Q.6 a) For transit conduction, with negligible internal resistance, with usual notations, show that: $\frac{\theta}{\theta_i'} = \exp\left(-B_i . F_o\right)$ Also state the significations of 'B_i' and 'F_o'. **(10)**

b) Write short note on any **two** of the following **(10)**

i) Heisler Charts.

ii) Boiling curves and various regimes of boiling.

iii) Heat Pipe.

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